



Control of pests in the green mustard plant through papaya leaf extract

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Abstract

A green mustard plant (*Brassica juncea* L) is often attacked by plant pests' organisms, which often disturb farmers. This research aims to determine the types of pests and the effect of papaya leaf extract as a vegetable pesticide on pests in the green mustard plant. The research method used was an experiment with a completely randomized design consisting of 5 treatments and 5 replications with each concentration of papaya leaf extract as well as 0%, 25%, 50% 75% and 100%. The parameters observed were the types of pests and the impact of papaya leaf extract as vegetable pesticides on pests in the green mustard plant. The data collection was using observation sheets and documentation. The data analysis used descriptive and inferential analysis. The inferential analysis used the ANOVA test and continued with the Least Significance Different (LSD) test at a significant level of 0.05. The results show that there were several types of pests such as small snails, green grasshoppers (*Atractomorpha crenulata*), armyworms (*Spodoptera litura*), green caterpillars or leaf destroyers (*Plutella xylostella*). The results of statistical analysis showed that the administration of papaya leaf extract had a significant effect on pests that attack the green mustard plant. The results of the variance analysis showed a significant value of treatment (sig: 0.000) smaller than the alpha value (α : 0.05). Furthermore, the LSD test showed that the fifth treatment with 100% concentration was significantly different from other treatments in controlling pests in the green mustard plant.

Keywords: plant pests, green mustard plant, papaya leaf extract

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INTRODUCTION

The papaya plant is one of the many crops cultivated in agriculture in Indonesia. The papaya plant is very easy to grow and almost spread throughout the territory of Indonesia. However, the general public is still lacking in utilizing the papaya plant (Rhamadi 2015). The community only uses fruits and leaves from the papaya plant for consumption. In fact, the papaya plant has been a very important role in everyday life.

The papaya plant is belonging plant that to family *Caricaceae* (Amran et al. 2018, Patil et al. 2014), that rich source of three powerful antioxidant vitamins (C, A and E); the minerals (magnesium and potassium), the B vitamin, pantothenic acid, foliate and fibers (Girish and Prabhavathi 2019, Milind and Gurditta 2011). Furthermore, it's can also be used to control plant pest organisms. This is because the chemical content found in fruits, leaves, roots and papaya seeds are effective for controlling pests. The papaya leaves, there is a lot of sap containing groups of cysteine protease enzymes such as *papain* and *kimopapain* as well as compounds of *alkaloids*, *terpenoids*, *flavonoids*, and *amino acid* groups that are effective in pests control (Mawuntu 2016). Papaya plant can be use as vegetable pesticides to pests' control.

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

Providing environmentally friendly vegetable pesticides to vegetable crops is a very good step in fulfilling daily basic needs. One of the most popular vegetables by people is green mustard (*Brassica juncea* L.). Green mustard is a type of vegetable that is widely consumed by the people of Indonesia (Asmara et al. 2018), starting from the lower class to the upper class. Green mustard vegetables contain a variety of food

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Table 1. Completely Randomized Design

	Replication 1	Replication 2	Replication 3	Replication 4	Replication 5
Treatment 0	T ₀ R ₁	T ₁ R ₁	T ₂ R ₁	T ₃ R ₁	T ₄ R ₁
Treatment 1	T ₀ R ₂	T ₁ R ₂	T ₂ R ₂	T ₃ R ₂	T ₄ R ₂
Treatment 2	T ₀ R ₃	T ₁ R ₃	T ₂ R ₃	T ₃ R ₃	T ₄ R ₃
Treatment 3	T ₀ R ₄	T ₁ R ₄	T ₂ R ₄	T ₃ R ₄	T ₄ R ₄
Treatment 4	T ₀ R ₅	T ₁ R ₅	T ₂ R ₅	T ₃ R ₅	T ₄ R ₅

Note:

T₀ (Treatment 0) = papaya leaf extract 0% = 0 ml.

T₁ (Treatment 1) = papaya leaf extract 25% = 250 ml.

T₂ (Treatment 2) = papaya leaf extract 50% = 500 ml.

T₃ (Treatment 3) = papaya leaf extract 75% = 750 ml.

T₄ (Treatment 4) = papaya leaf extract 100% = 1000 ml.

Table 2. Procedures planting green mustard

No	Procedures
1	Prepared 70 green mustard seeds to be seeded.
2	Insert 70 green mustard seeds into the water. Choose 50 green mustard seeds that sink, while floating seeds can be removed. Mustard seeds that are submerged in water indicate the quality of good mustard seeds.
3	Prepared the soil to be used as a planting medium in seeding.
4	The soil to be used as a planting medium is loosened by hand so that dirt or garbage in the soil can be removed.
5	After the soil becomes loose, put the soil in plastic (medium size) then plant mustard seeds on each planting medium that has been made.
6	After planting the seeds, finish giving a splash of water so that the soil becomes moist, can also be given a cover in the form of leaves.
7	After the plant has a height of approximately 7 cm, green mustard seedlings are ready to be moved to the beds.
8	Before being placed on a bed, first, remove the plastic so that it does not interfere during the growth process.
9	Make a hole in the bed to put green mustard plants. Give a distance between the holes.
10	After the planting process is complete, flush the green mustard plant so that it does not wither.

Table 3. Making papaya leaf extract as a vegetable pesticide

No	Procedures
1	Prepared 1 kg of papaya leaves then cut to get a smaller size.
2	Papaya leaves that have been cut then pounded to facilitate the extract.
3	The crushed papaya leaves are put into the drum, 10 L of clean water is added and 30 g of detergent is added.
4	After all the ingredients are put in the drum then stir until all ingredients are evenly distributed.
5	After 24 hours of soaking, strain the soaking water using a coconut milk filter to get papaya leaf extract.
6	Dilute papaya leaf extract with clean water according to the specified concentration (0%, 25%, 50%, 75%, and 100%).

substances that are essential for health. Green mustard vegetables also contain vitamins and nutrients that are important for health (Nurshanti 2010). Green mustard plants are often attacked by pests, which of course harm the farmers.

Saputra (2011) revealed that several types of pests that often attack green mustard plants include cabbage crop caterpillars (*Crociodolomia binotalis zell*), tritip caterpillars (*Plutella maculipennis*), armyworm caterpillars (*Spodoptera sp*), soil caterpillars (*Agrotis ipsilon*), caterpillar (*Tepha javanica*) and snails (*Agrolimax sp*). These types of pests are one of the main obstacles to increasing the production of green mustard both in quality and quantity. In order for green mustard production to continue to increase, it is necessary to do research using papaya leaf extract as a vegetable pesticide in pests controlling that attack green mustard plants.

Based on the problems, it is necessary to conduct research related to control of pest in green mustard plants through papaya leaf extract. This research aims to determine the types of pests and the effect of papaya leaf extract as a vegetable pesticide on pests in green mustard plants.

MATERIALS AND METHODS

The research method used was in the form of an experiment with a completely randomized design

consisting of 5 treatments and 5 replications. Treatments in the form of papaya leaf extract as a vegetable pesticide with various concentrations. The research design used can be seen in **Table 1**.

The tools used in this research were hoes, polybags, ballpoint pens, observation sheets, scales, sprayer, measuring cups, coconut milk filters, drums, mortar and pestle, and cameras. The material used in this research is papaya leaves, clean water, soap, and green mustard seeds. The green mustard seeds used come from the superior Kumala mustard seed produced by PT Agri Makmur Mandiri.

The research procedure consisted of 3 stages, namely planting green mustard, making papaya leaf extract as a vegetable pesticide and applying papaya leaf extract to green mustard plants. Explanations regarding the stages of the research can be seen in **Tables 2-4**.

The parameters observed included the types of pests and the effects of giving papaya leaf extract to green mustard plants. The data collection techniques used documentation and measurement techniques. The data from the measurement results are analyzed using descriptive and inferential analysis. The descriptive analysis used seem mean values and inferential analysis used seem ANOVA test and followed by Least Significance Different (LSD) at a significant level of 0.05 to seem the real difference of each treatment. All data

Table 4. Applying papaya leaf extract to green mustard plants

No	Procedures
1	Prepared tools and materials used during the research process.
2	The treatment with different concentrations of papaya leaf extract is carried out every 4 days during the research process.
3	Papaya leaf extract is given by spraying using a sprayer on the part of the green mustard plant.
4	Conduct observations when green mustard plants arrive on the 35th day or until the harvest of the green mustard plant.

Table 5. The types of pests in green mustard plants

Treatments	The types of pests
T0 / 0%	Small snail, Green grasshopper (<i>Atractomorpha crenulata</i>), Armyworm (<i>Spodoptera litura</i>), Green caterpillar or Leaf Destructive caterpillar (<i>Plutella xylostella</i>)
T1 /25%	Small snail, Green grasshopper (<i>Atractomorpha crenulata</i>), Armyworm (<i>Spodoptera litura</i>), Green caterpillar (<i>Plutella xylostella</i>)
T2 /50%	Small snail, Green grasshopper (<i>Atractomorpha crenulata</i>), Armyworm (<i>Spodoptera litura</i>)
T3 /75%	Green grasshopper (<i>Atractomorpha crenulata</i>)
T4 /100%	Green grasshopper (<i>Atractomorpha crenulata</i>)

Table 6. The mean value of the effect of papaya leaf extract on pests

No	Treatments	Means
1	T0	15.00
2	T1	14.20
3	T2	13.00
4	T3	10.80
5	T4	0.40
	Total	10.68

analysis were calculated using the SPSS version 18 program.

RESULTS

The research results are all data collected in the field during the research process. The results of the study are as follows:

The Types of Pests

Based on the results of observation, there are several types of pests that attack green mustard plants. Observation of the type of pests was carried out from the beginning of the transfer of green mustard seedlings to the difference until the harvest period. The observations regarding the types of pests in green mustard plants can be presented in **Table 5**.

The results of the research in **Table 5** show that the number of pests identified at each concentration had different amounts. The first treatment with a concentration of 0% has a higher number of pests compared to other treatments and the fifth treatment with a concentration of 100% has the least amount of pests.

Effect of Giving Papaya Leaf Extract on Green Mustard Plants

The administration of papaya leaf extract was carried out for 35 days until the harvest of green mustard plants. The results of the research related to descriptive analysis in **Table 6** show that the fifth treatment with a concentration of 100% has the lowest average value of 0.40, while the first treatment with a concentration of 0% shows the highest average of 15.00. These results indicate that the administration of papaya leaf extracts as a vegetable pesticide that can control pests in green mustard plants.

Table 7. Results of ANOVA test related to the effect of papaya leaf extract on pests

	Sum of square	df	Mean square	F	Sig
Between Groups	710.640	4	177.660	51.645	.000
Within Groups	68.800	20	3.440		
Total	779.440	24			

Table 8. Test LSD for the effect of papaya leaf extract as a vegetable pesticide on pests

Treatments	Concentration	Means value	Standard deviation	Corrected value	LSD Notation
T1	0%	15.00	2.00	13.270	a
T2	25%	14.20	1.92	12.470	a
T3	50%	13.00	2.12	11.270	a
T4	75%	10.80	2.16	9.070	b
T5	100%	0.40	0.54	-1.330	c

After knowing the mean value of the number of pests that attack green mustard plants, ANOVA tests were then carried out. The results of the ANOVA test of the effect of papaya leaf extract as vegetable pesticides on pests can be seen in **Table 7**.

The ANOVA test results in **Table 7** show that the significant value of the treatment is 0.000 and smaller than alpha 0.05 so that there is an effect of treatment on the number of pests in green mustard plants. Furthermore, LSD test with a level of 0.05. The LSD test results of the influence of papaya leaf extract as vegetable pesticides on pests can be seen in **Table 8**.

Based on the results of the LSD test in **Table 8** show that treatments one to 3 were not significantly different but significantly different from the fourth treatment. Furthermore, the fifth treatment with 100% concentration was the most significantly different from the other treatments.

DISCUSSION

The Types of Pests

The higher the concentration of papaya leaf extract given to green mustard plants, the fewer the number of pests and vice versa the smaller the concentration of papaya leaf extract given will be the greater the number of pests. This proves that the higher the concentration of papaya leaf extract can reduce the number of pests in green mustard plants.



Fig. 1. Armyworm (*Spodoptera litura*)

The types of pests that have been identified are armyworms, green grasshoppers, small snails, and green caterpillars. Various types of pests, the type of grasshopper is most commonly found in green mustard plants. This is because when the study was conducted during the dry season so that other types of pests such as armyworms, green caterpillars and little snails were found. According to Ningrum et al. (2010) the used of pesticides in vegetable crops in the highlands is classified as very intensive, this is mainly due to the cool climate conditions with high humidity and high rainfall creating good conditions for the breeding of plant pests and diseases. Armyworms, green caterpillars and small snails will be easily found when cold or humid environmental conditions such as during the night or rainy season.

Armyworm (*Spodoptera litura*)

Armyworm (*Spodoptera litura*) is one type of pest in green mustard plants found at the time of the study. The results of observation show that armyworms are difficult to find during the day because armyworms prefer to hide in dark places or in the ground and will come out at night. This is similar to that expressed by Handayani (2017) that this armyworm attack needs to be watched out because during the day it is not visible and usually hides in a dark place, inside the ground, and behind the leaves, but at night the army caterpillars carry out



Fig. 2. Green grasshopper (*Atractomorpha crenulata*)

intense attack activities and it can even cause a decrease in crop yields. Armyworm from the research results can be seen in **Fig. 1**.

Green grasshopper (*Atractomorpha crenulata*)

Green grasshopper (*Atractomorpha crenulata*) is one of the active pests, so it needs to be controlled properly so as not to reduce plant productivity, especially green mustard plants. The results of observation show that green grasshoppers attack plants by eating leaves from plants so that the leaves will suffer damage resulting in crop failure. Damage caused by green grasshoppers can deplete the entire leaf and leaves only the petiole. Example of damage caused by green grasshoppers can be seen in **Fig. 2**.

Small snails

A small snail is generally the same as other snails. The results of observation show that small snails do not like heat so finding or seeing small snails cannot be done during the day. The attack of small snails is usually done at night because at night the temperature is cold. Small snails will be very much and easily found in plants during the rainy season where moist natural conditions are the right time to do activities. Small snails are one type of pest that attacks plants on the leaves so that they can often reduce crop yields. Example of small snails from research results can be seen in **Fig. 3**.



Fig. 3. Examples of small snails

Leaf Destructive Caterpillar (*Plutella xylostella*)

Leaf Destructive Caterpillar (*Plutella xylostella*) is one type of pest that often interferes with green mustard plant. The part that is attacked by green caterpillars is the part of the leaves which results in damaged green mustard leaves. Damage caused by green caterpillars by eating parts of the leaves so that green mustard leaves become hollow. Example of Leaf Destructive Caterpillar (*Plutella xylostella*) which damage green mustard plants can be seen in Fig. 4.

Effect of Giving Papaya Leaf Extract on Green Mustard Plants

Based on the results of the descriptive analysis show that the average number of pests in green mustard plants was different for each treatment. The administration of papaya leaf extract as a vegetable pesticide with a concentration of 100% showed the smallest average number of pests at 0.40 and the highest was found at a concentration of 0%, 15.00. The results of the descriptive analysis mean that the higher the concentration of papaya leaf extract given to green mustard plants, the smaller the number of pests will be, while the smaller the concentration of papaya leaf extract given to green mustard plants will increase the number of pests. This proves that the higher the



Fig. 4. Leaf Destructive Caterpillar (*Plutella xylostella*)

concentration of papaya leaf extract as a vegetable pesticide can reduce the number of pests in green mustard plants.

Based on the results of ANOVA, it was shown that there was an influence between the treatments given to the number of pests in green mustard plants with a smaller probability of neglect ($0.000 < 0.05$). The results of this study are in line with the research of Surya and Zahara (2016) that the administration of an extract of papaya leaves (*Carica papaya* L.) has a positive effect on mortality of leaf caterpillars (*Plutella xylostella*). The higher the concentration of papaya leaf extract (*Carica papaya* L.) used, the higher the mortality rate of leaf caterpillars (*Plutella xylostella*). Research results of Fajri et al. (2017) the greater the concentration of the solution of papaya leaves given to a certain extent will be more deadly to eat leaf-eating caterpillars in green mustard plant. This shows that the higher the concentration of the solution of papaya leaves given, the better it will be in controlling or killing leaf caterpillars in mustard plants.

Mawuntu (2016) based on his research states that the results of the study show that there is a relationship between the treatment of extract concentration and mortality of *Plutella xylostella* larvae. Where the higher the concentration of treatment, the higher the mortality of *Plutella xylostella* larvae. Papaya leaves contain the enzymes papain, saponins, flavonoids, and tannins which have a role as vegetable pesticides. The content

of papaya leaves is a contact poison that enters the insect's body through natural holes from the insect's body. These compounds also work as stomach poisons that enter through the mouthpiece of insects. Then the liquid enters through the insect's esophagus and then enters the digestive tract which will cause disruption of eating activities (Setiawan and Oka 2015). The use of papaya leaf extract as a vegetable pesticide can be used to control insects. Giving pesticides can be done when the plant has not been attacked by a pest as a preventative step (Setyaningrum and Saparinto 2012).

Green mustard plants given the application of papaya leaf extract provide maximum fresh mustard leaves. The lower the level of damage caused by crop caterpillars the higher the wet weight. In the study conducted, the highest dry wet weight was found at a concentration of 100% and the lowest in control. The size of the wet weight of mustard plants is influenced by a large number of leaves of mustard plants which are attacked by crop caterpillars (Mukarlina et al. 2013).

Based on the LSD test showed that at the 5% level the effect of papaya leaf extract on pests on green mustard plants in the fifth treatment (100% concentration) was significantly different from the other treatments. The results of the LSD test with 100% concentration of papaya leaf extract as vegetable pesticides gave optimal results for the insensitivity of pest attacks on green mustard plants. The papaya leaf extract is in the form of a distinctive smelling liquid, on papaya leaves, there is sap papaya containing a group of cysteine protease enzymes such as *papain* and *kimopapain*. Papaya sap also produces compounds such as *alkaloids*, *terpenoids*, flavonoids and non-protein amino acids that are very toxic to plant-eating insects (Konno et al. 2004, Nisa et al. 2016). The content of chemical compounds in the papaya plant is a contact poison that can control the pest.

The high mortality caused by the dosage treatment of papaya leaves is caused by the content of papaya leaves which works significantly and has a negative impact on aphids. The concept of vegetable pesticides

is the higher the dose of a pesticide given to control pests, the higher the mortality obtained. So that between dose treatments has different effects (Setiawan and Oka 2015).

CONCLUSION

Based on the results of research and discussion, conclusions can be drawn as follows: (1) there are several types of pests such as small snails, green grasshoppers (*Atractomorpha crenulata*), armyworms (*Spodoptera litura*), green caterpillars or leaf destroyers (*Plutella xylostella*); (2) green mustard plants treated with papaya leaf extract as vegetable pesticides (concentration of 100%) showed a smaller average yield compared to other treatments (concentrations of 0%, 25%, 50%, and 75%); (3) there is a significant effect of papaya leaf extract on pests in green mustard plants; (4) the administration of papaya leaf extract in the fourth treatment with 100% concentration was significantly different from other treatments (concentrations of 0%, 25%, 50%, and 75%). Thus, it can be concluded that the fourth treatment with a concentration of 100% gives the best results in overcoming pest attacks on green mustard plants.

Based on the results of the research that has been done, the researcher suggests the following: (1) for future researchers who will conduct similar research it is recommended to look at plant pests organisms on different plant objects; (2) Further research is needed regarding the concentration of papaya leaf extract as a pesticide in the laboratory.

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