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Optimization of onion peels in the control of hydroponic brassica rapa L pests

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ABSTRACT

Pest attacks on plants are the most common problem faced by farmers. One type of pest that most often attacks plants with hydroponic methods is the Aphis gossypii pest. Seeing this, an innovation must be developed in controlling pests that are more environmentally friendly. This study aimed to determine how influential the use of shallot and garlic skin baths as pest control in hydroponic Brassica rapa L. plants with concentrations of 25%, 50%, and 75%. This research is an experimental study in which the data obtained is processed using the ANOVA method. The results of the study based on the data processing results showed that there was less visible difference between the three treatments given for four weeks of treatment. So, it can be in the application of natural pesticides, which can be given in the first week with a concentration of 25%, in the second week 50%, and in the third week and fourth week 75%.

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INTRODUCTION

Pests that are often found in vegetable crops are aphid-type pest attacks. Aphis gossypii is an organism that can damage plants with a large enough number and with such rapid development (O'Hara et al., 2022). Plants attacked by aphids can cause the plant to experience inhibition in the growth process (Arianti & Marselina, 2020). This pest attack if it occurs in large numbers will cause shrinkage of the leaf blade, this is because the pest absorbs the liquid in the plant (Hawiyah et al., 2022).

Aphis gossypii pests are very difficult to control this is because of its very strong insecticide resistance (Wei et al., 2023). So difficult to control and even this Aphis gossypii pest is an aphid pest problem faced by farmers globally that attacks cotton, melons, and other landscape crops (Quan et al., 2019). This type of aphid pest is also the most common in plants cultivated with hydroponic systems.

Hydroponics is a plant cultivation system without the help of soil, where the role of soil is replaced by water flowing on the axis (Samiha, 2023). Hydroponic systems have many variations in the use of media, one of which is by using installations, which in the use of this installation is using a long pipe that is given a hole where the plant is placed. The installation pipe is supplied with nutrient water with the help of a pump. The use of hydroponic systems is very suitable for use in places with minimal plantation land, one of which is urban (Singgih et al., 2019). In addition to urban areas, the use of hydroponic systems is also very suitable to be developed in areas that have vast peatlands. Thus, planting using a hydroponic system is a suitable innovation to be developed. One of the plants that is most often cultivated using a hydroponic system is the Brassica rapa L plant (Laksono, 2020).

Brassica rapa L. is a type of vegetable that has high economic value (Rosyida et al., 2022). Brassica rapa L. plants are close relatives of the mustard family, where this type of vegetable is very susceptible to viruses and pests (Widya & Inti, 2022). Brassica rapa L. plants contain minerals, vitamins, carbohydrates, protein, and fat. Every 100 grams of Brassica rapa L. contains vitamin A 3600 SI, minerals, vitamin C 74 mg, calories 21 cal and protein 1.8 grams (Harun et al., 2022). Brassica rapa L. plants have important benefits for health, this is because Brassica rapa L. plants have dietary fiber that can facilitate digestion, besides that the fiber can also bind the cause of cholesterol, and the content of betakarotein in Brassica rapa L. can prevent cataracts disease (Mutryarny & Lidar, 2018).

One of the organic materials that can be utilized as a pest control or natural pesticide is onion skin waste (*Allium cepa* L.). Onion skin is an organic waste that can be reused and has economic value, in which there are bioactive compounds with antioxidant and antimicrobial potential (Cruz et al., 2023). Based on research conducted by Sri Mulyanti in 2020 who conducted research on shallot skin (*Allium cepa* L.) as a natural pesticide for tritip caterpillars in green mustard plants. The results showed that shallot skin is effective in controlling tritip caterpillar pests in green mustard plants (Mulyati, 2020). Onion skin contains flavonoid compounds (Kimoto-Nira et al., 2020) and acetogenins which function as anti-pests (Hafsan et al., 2022). In addition, shallot skin also contains flavonoids, phenolic acids, fructo oligosaccharides, oganosulflur compounds, and phenolic glycosides (Stoica et al., 2023). In the research conducted (Dhowlaghar et al., 2023) mentioned the results of high working liquid chromatography analysis on REPO to identify flavonoids and anthocyanins in shallot skin resulted in 459.15 mg/g ± 16.45 (DW) and 33.14 mg/g ± 0.99 (DW), respectively.

In addition to shallot skin, the skin of garlic (*Allium sativum* L.) can also be utilized as a natural pest control on plants. The content possessed by garlic skin is similar to the content possessed by garlic bulbs. The content is a lot of active metabolites, including sulfur compounds such as allicin, alliin, diallyl trisulfide. These compounds have antimicrobial, antibacterial, antioxidant, anti-inflammatory, and anti-cancer properties (Zhu et al., 2021). The content possessed in garlic skin (*Allium sativum* L.) as pest control is allicin, which has the ability to control pests in plants that work to protect the food source of pests in these plants (Yenie et al., 2013).

This study aimed to determine how influential the use of shallot and garlic skin baths as pest control in hydroponic Brassica rapa L. plants with concentrations of 25%, 50%, and 75%. The three concentrations see which concentration has more influence than other concentrations. To answer that direct observations were made on hydroponic Brassica rapa L. plants for 26 days. The contribution of this research is expected to help in developing organic materials which can be used as pest control which in content can also help in providing liquid fertilizer to plants. So, the application of liquid fertilizer can control pests and also provide nutrients to plants organically. In addition, this research was also carried out in a way that can be done by the community in general.

In contrast to previous research conducted with laboratory standards. In addition, this research is also expected to provide insight into optimizing organic materials as an alternative material in controlling environmentally friendly pests.

RESEARCH METHODS

Research Design

The method used in this study was a complete randomized design experiment. This research was conducted from June to August 2024. This study uses three concentrations in each treatment, namely 25%, 50%, and 75%. This study has 20 replicates in each concentration (Table 1).

Table 1. The design used in the research

Repeat	Number of Aphis gossypii colonies		
	T1 (25%)	T2 (50)	T3 (75%)
First week			
R1			
R2			
R3			

Population and Samples

The number of Brassica rapa L. plants in this study used a total of 60 plants. Brassica rapa L. which is ready to be used for treatment, namely the age of the garden is 14 days old, with the specification of the number of leaves being 4 strands, thus the Brassica rapa L. plant is ready to move and do the experiment. In each concentration, there are 20 plants as replicates which have the same planting age in each replicate.

Instruments

The instrument used in this study was to count the number of pest colonies each week. The tools used in this research are measuring cups, large jars, filters, spray bottles, used bottles, installations, and small pump machines. The materials used in this study were shallot skin, garlic skin, Brassica rapa L. seeds, AB mix nutrients, and water.

Procedures

The stages in this research are first to sow Brassica rapa L seeds, while also collecting onion skin waste and separating it from other organic waste. The second stage, weighing shallot skin and garlic skin as much as 100gr each, which is then put into a large jar. In the third stage, onion skins and garlic skins are weighed, and one liter of water is, the jar is then closed tightly and stored in a place that is not exposed to direct sunlight, stored for 24 hours. The fourth stage, after soaking for 24 hours then filtering, so that a natural pesticide solution from shallot skin and garlic skin is obtained. The fifth stage, dissolving the solution with the following concentrations

P1: 25% (25ml pesticide solution: 75ml water)
P2: 50% (50ml pesticide solution: 50ml water)
P3: 75% (75ml pesticide solution: 25ml water)

The sixth stage, application to hydroponic Brassica rapa L. plants carried out from 14 days after planting to 40 days after planting. The last stage is to make observations and research (Figure 1).

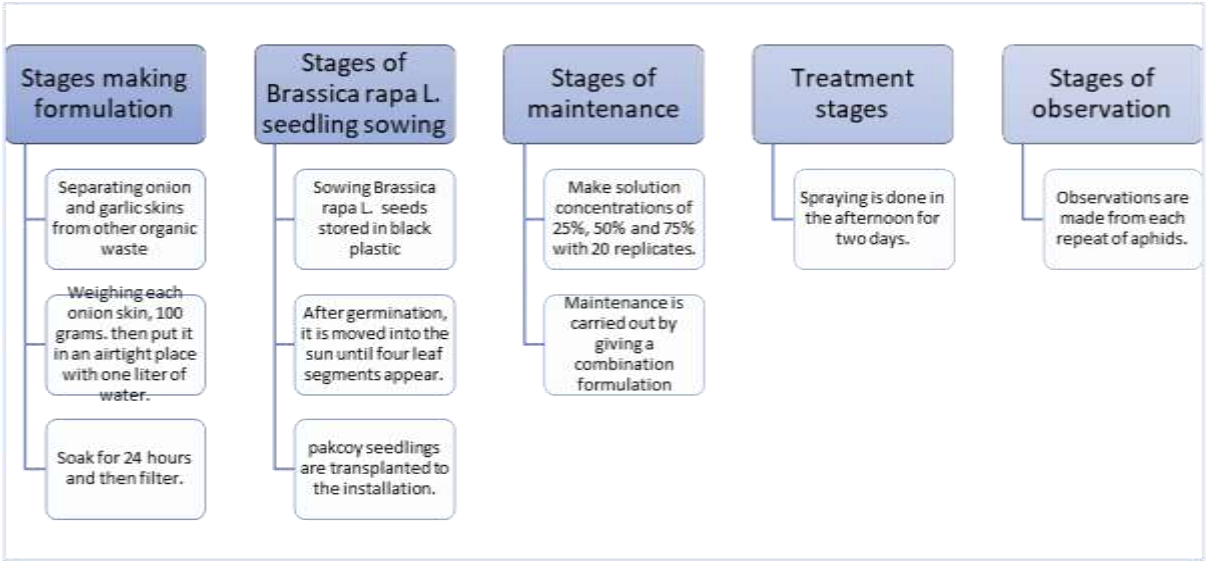

Figure 1. Diagram of the research procedure

Data Analysis

Data were obtained by counting the number of pest colonies found on hydroponic Brassica rapa L. plants for four weeks after planting. Furthermore, the data were analyzed using ANOVA analysis using SPSS statistics 25. ANOVA is a statistical method used to obtain more accurate data (Hassan et al., 2024).

RESULTS

Research data was obtained from the calculation of the number of Aphis gossypii pests attacking hydroponic Brassica rapa L. plants. Observation time starts from the first week after planting (WAP). The number of pests was obtained from the calculation of the average every week. The following is the average data from the calculation of pests every 1 WAP, 2 WAP, 3 WAP, and 4 WAP.

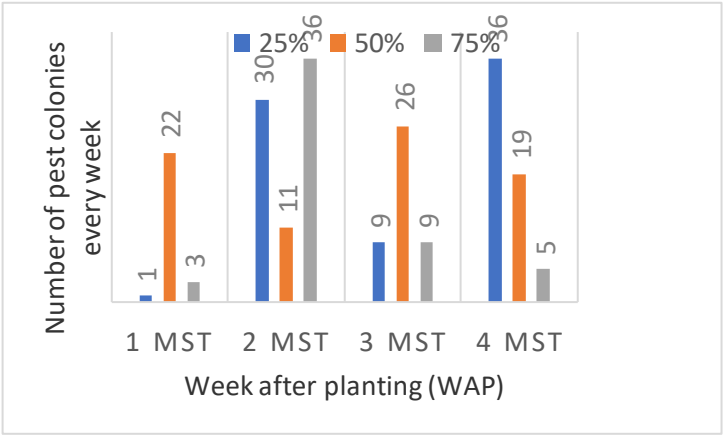

Figure 2. Diagram comparison of pest infestation values each week

Figure 2 Three data explain each concentration, namely the blue color shows the application of 25% concentration to the plant. The orange color shows the provision of 50% concentration on plants. The gray color shows the provision of concentration on plants as much as 75% on plants. At 1 WAP in each treatment, there was also no significant difference based on the data in Table 1.

Table 1. ANOVA test results on one WAP

Treatment	Average	FH	FT(5%)	Sig.
25%	71,45±319,54	0,205	3,16	.815
50%	157,2±702,80			
75%	214,3±958,39			

The data in Table 1 shows that the value of FH <FT is 0.205 <3.16. The F value is quite clear in the difference, this indicates that less effect of the three treatments given to hydroponic Brassica rapa L. plants at 1 WAP.

Table 2. ANOVA test results on two WAP

Treatment	Average	FH	FT(5%)	Sig.
25%	600,1±1105,3	0,085	3,16	.918
50%	785,7±2045,4			
75%	592,9±1729,5			

From Table 2. it appears that the value of FH <FT, namely 0.085 is smaller than 3.16, this means that it does not have a significant effect and is supported by the sig value. 0.918>0.05, this shows that 25%, 50%, and 75% have less effect in controlling pests on hydroponic Brassica rapa L. plants.

Table 3. ANOVA test results on three WAP

Treatment	Average	FH	FT(5%)	Sig.
25%	142,9±142,8	0,960	3,16	.389
50%	314,3±217,3			
75%	1637,0±366,0			

From Table 3. It is not too different from the data obtained from 1 WAP, where the value of FH <FT is 0.960 <3.16. In addition, the sig. the value obtained is lower than 2 WAP but not smaller than 0.05. So, it can be concluded that the three treatments given at 3 WAP do not have a significant effect.

Table 4. ANOVA test results on four WAP

Treatment	Average	FH	FT(5%)	Sig.
25%	824,9±2179,9	1,211	3,16	.305
50%	1528,9±2730,1			
75%	416,7±1863,3			

The data in Table 4. shows the same thing as the previous data. However, at 4 WAP, the calculated F is higher than before, but not much greater than the F table. At the sig value. Experienced a decrease from the previous week, namely to 0.305>0.05. Of the four weeks of treatment, the lowest sig. value is at 4 WAP which is 0.305 and the highest calculated F value is at

4 WAP which is 1.211. So, from the calculation results it can be concluded that the treatment given to Brassica rapa L. plants does not have a significant difference and has less real influence.

DISCUSSION

This study examines the use of natural materials as the main ingredient in making pest control in Brassica rapa L. plants that are hydroponically cultivated. In this study, natural pesticides were given in the form of various formulations with the number of Brassica rapa L. plants in each treatment of 20 plants. Onion skin and garlic skin are natural ingredients that are most often encountered in everyday life and contain active compounds known to have the potential for pest control.

Onion skin and garlic from the three treatments given to Brassica rapa L. plants cannot be ascertained which concentration influences pest attacks from 1 WAP to 4 WAP. This is because each week has a different average calculation value for each concentration. So that it can be applied, at 1 WAP to 4 WAP using different concentrations with the provisions, namely 1 WAP using a concentration of 25%, at 2 WAP using 50%, at 3 WAP and 4 WAP using a concentration of 75%. besides that, the results of the ANOVA analysis showed that there were no significant differences so no further tests were carried out.

The ingredients needed in controlling pests in hydroponic Brassica rapa L plants are acetogenin and allisin, which are two active compounds that can inhibit the growth of organisms (Mardiah et al., 2017 and Kurnia et al., 2022). Acetogenin compounds are compounds associated with neurodegeneration, with a mechanism of action similar to rotenone, a specific inhibitor of mitochondrial complex I (i.e., decreased OXPHOS, and ATP depletion) (Gaetano et al., 2021). The content of allisin, resulting from the mixture of aliin and alliinase compounds, allisin compounds are compounds that can be used as protective compounds that have a mode of action by activating transient receptor potential ankyrin 1 (TRPA1) and transient receptor potential cation channel subfamily V member 1 (TRPV1) which are excitatory ion channels in the main sensory neurons of the pain pathway, thus causing pain and inflammation in predatory animals (Salehi et al., 2019).

Acetogenin and allisin compounds both can protect plants with different ways of working. So, it can be ascertained that shallot skin and garlic skin have benefits in controlling pests. Apart from these two contents, shallot skin also has flavonoid compounds 48 times greater than the concentration in edible parts (Nile et al., 2021). The compound has an insecticidal effect on the type of pest on the plant.

Based on the data that has been obtained, it can be seen that the application of pesticides made from shallot skin and garlic skin has an effect, but of the three treatments given, the difference is not so visible. Several factors influence this, one of which is the environment and also the composition of the two ingredients. In addition, the provision of shallot skin and garlic skin soaks can have an impact on the growth process of Brassica rapa L. plants which grow larger and maximize than hydroponic Brassica rapa L. plants in general. This happens because the compound content of shallot skin and garlic skin has bioactive compounds that can stimulate growth (Zhang et al., 2024).

CONCLUSION

The conclusion of this study is the provision of shallot skin and garlic skin soaks on hydroponic Brassica rapa L plants with concentrations of 25%, 50%, and 75% can be given with different concentrations each week. In the first week with a concentration of 25%, the second week 50%, and in the third week and fourth week using a concentration of 75%. So, it is necessary to conduct further research related to the combination and concentration given to hydroponic Brassica rapa L plants. This research contributes to the utilization of environmentally friendly

alternative materials in controlling pests on plants by utilizing materials in the surrounding environment.

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