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The Effectiveness Of Using Liquid Smoke For Pest Control On Mustard Greens

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ABSTRACT
Pest control in mustard greens cultivation is a crucial aspect of increasing agricultural productivity. This study aims to determine the effectiveness of liquid smoke as a natural pest control agent against pests such as the armyworm (Spodoptera litura), loopers (Plusia spp.), aphids (Aphidoidea), and grasshoppers (Caelifera). The research method used was observation of the presence of pests that appeared during the growth of mustard greens with various concentrations of liquid smoke applied to the plants. Observations were made on pest populations, plant damage, and plant growth throughout the study. The research data were analyzed qualitatively. The results showed that liquid smoke effectively reduced pest populations and the level of damage to mustard greens significantly. Higher concentrations of liquid smoke provided better results in pest control without negative effects on plant growth. The results of the 24-day study identified a total of 22 pest organisms on the control mustard green plants. The conclusion of this study is that liquid smoke is an effective and sustainable alternative for pest control in mustard greens. The use of liquid smoke can support safer and more sustainable agricultural practices.

***Keywords**: Liquid Smoke, Pest Control, Effectiveness, Mustard Greens*

INTRODUCTION
Mustard greens (Brassica juncea L.) are a high-value vegetable commodity rich in fiber and nutrients, including protein, fat, carbohydrates, calcium, phosphorus, iron, and vitamins A, B, and C. However, the production of mustard greens in Indonesia decreased from 727,467 tons in 2021 to 706,305 tons in 2022, a decline of 2.9%. This reduction is attributed to pest infestations, including the diamondback moth (Plutella xylostella L.), the cabbage head caterpillar (Crocidolomia binotalis), the armyworm (Spodoptera litura), the inchworm (Plusia spp.), and the leaf miner (Liriomyza sp.), which can damage plant leaves, reduce the quality and quantity of the harvest, and negatively impact farmers' incomes (Raharjo, 2017).

Pest control efforts on mustard greens generally still rely on conventional methods that predominantly use chemical insecticides as the primary solution, often with high spraying frequencies. While effective in reducing pest populations in the short term, the continued use of chemical insecticides has significant negative impacts on the environment and human health. Insecticide residues that are difficult to decompose can accumulate in mustard greens and potentially pose health risks to consumers. Furthermore, constant exposure to chemical insecticides can lead to resistance in pest populations and increase the risk of new, more resilient pest species emerging in the long term (Arif, 2015).

The negative impacts of chemical insecticide use not only affect pests but also the overall agricultural ecosystem, as they can kill natural parasitoids and predators that are crucial for ecosystem balance. This can exacerbate pest control problems in the long run. Therefore, environmentally friendly and sustainable alternatives, such as the use of liquid smoke, are needed. Liquid smoke, a product of the condensation of the combustion of lignin- and cellulose-containing materials, can reduce negative environmental and health impacts while enhancing agricultural sustainability by improving soil quality, controlling pests, and supporting plant growth (Basri, 2010).

The use of liquid smoke biopesticides has the potential to effectively control armyworms and pod borers, particularly in mustard greens. Liquid smoke can inhibit pest feeding activity. Effectiveness can be understood in terms of how well an organization succeeds in acquiring and utilizing resources in its

pursuit of objectives. Effectiveness is reflected in the preparation that can lead to a more meaningful process in achieving goals. It describes the meaningfulness of resource management in achieving the planned objectives. Based on the above explanation, research is needed to determine the effectiveness of liquid smoke in controlling pests on mustard greens.

METHOD

The research was conducted on an independent agricultural plot at home, from May to June 2024. In May 2024, mustard green seeds were sown in seed trays. The materials used in this study included mustard green seeds, soil, manure, urea fertilizer, water, and polybags. The tools used were cutting tools, agricultural tools, and sprayers.

Experimental Design

This study employed a Two-Group Factorial Design. The first factor was the control group with liquid smoke treatment, while the second factor was the control group without liquid smoke treatment. Observations were made twice a week, resulting in a total of 7 observations analyzed in this study. The liquid smoke treatment was applied once a week, with three sprayings conducted on the 7th, 14th, and 21st days. Each group consisted of 20 polybags, with each polybag containing 4 mustard green plants. Thus, the total number of mustard green plants used in this study was 160.

Preparation of Plants and Growing Media

Mustard green seeds were sown in trays filled with cocopeat, then watered. The germination process involved regularly watering the plants twice a day, in the morning and afternoon. The seedlings were grown until they sprouted and developed into seedlings, as indicated by the emergence of 3-4 initial leaves. The growing media used was a mixture of soil and manure in a 1:1 ratio. This mixture was evenly mixed and then placed into polybags to serve as the growing medium for 30 experimental units. Subsequently, the mustard green plants were maintained by regular watering and weed control.

Application of Liquid Smoke

This study referred to the research by Yulia (2018), where the application of liquid smoke was carried out on mustard green plants that were one week old, using a sprayer in accordance with the predetermined concentration and application frequency. Spraying was conducted between 15:00 and 17:00 WIB to ensure optimal absorption of the liquid smoke by the plants. This process aimed to test the effectiveness of liquid smoke in controlling pests on mustard green plants, with a focus on the critical timing of application relative to plant response.

Observations

- Pest Count Observations
  Pest count observations were conducted twice a week during the research period. Each mustard green plant in the treatment group (with liquid smoke) and the control group (without liquid smoke) was carefully observed. The observations included identifying the types of pests attacking the plants and recording the number of pests found on each plant. The pests observed included the armyworm (Spodoptera litura), the inchworm (Plusia spp.), the leaf miner (Liriomyza sp.), aphids (Aphidoidea), and grasshoppers (Caelifera).
- Leaf Damage Observations
  Leaf damage was assessed based on the percentage of leaves damaged by pest attacks. Observations involved identifying and recording the damaged parts of the leaves on each plant. Leaf damage was categorized into several levels of severity: mild (0-25% damage), moderate (26-50% damage), severe (51-75% damage), and very severe (>75% damage) (Putri et al, 2021).

Data Analysis

The data obtained were analyzed using descriptive analysis, which describes the average number of pests on mustard greens treated with liquid smoke and on control mustard greens. This was done by calculating the number of pests on mustard greens treated with liquid smoke and on control mustard greens during the observation period, calculating the amount of leaf damage on mustard greens treated with liquid smoke and on control mustard greens during the observation period, and identifying the pests present in the group of mustard greens treated with liquid smoke and in the control group.

Through these steps, descriptive analysis will provide a clear overview of the effectiveness of liquid smoke in controlling pests and reducing leaf damage on mustard green plants during the observation period. Additionally, identifying the types of pests that appeared on the control mustard greens will further aid in understanding pest dynamics on mustard green plants..

RESULT AND DISCUSSION

Pest Count

The analysis of variance results showed that the effect of the treatment was significantly different compared to the control (without treatment). This study observed the number of pests on mustard green plants over 25 days, with observations conducted twice a week. The liquid smoke treatment was applied on the 7th, 14th, and 21st days. The data on the number of pests in the group treated with liquid smoke and the control group (without liquid smoke) are presented in Table 1.

Table 1. Number of Pests on Mustard Green Plants

Day	Date	Number of Pests	
		Mustard Greens with Liquid Smoke	Control Mustard Greens
0	June 2, 2024	0	0
4	June 5, 2024	0	0
6	June 8, 2024	0	0
10	June 12, 2024	0	0
13	June 15, 2024	0	1
17	June 19, 2024	0	5
20	June 22, 2024	0	13
24	June 26, 2024	0	22
Total Pests		0	22

From the data, it can be observed that during the observation period, the number of pests on mustard greens treated with liquid smoke remained zero from day 0 to day 24. In contrast, the number of pests on control mustard greens began to increase on day 13 and continued to rise until day 24. The observation data indicate that the use of liquid smoke on mustard greens is highly effective in controlling pests. During the observation period, no pests were found on the mustard greens treated with liquid smoke, while the number of pests on the control mustard greens significantly increased after day 13. By day 24, the control mustard greens had 22 pests, showing a rapid and significant increase compared to the mustard greens treated with liquid smoke.

These results demonstrate that liquid smoke can effectively control pest populations on mustard green plants, protecting them from pest attacks that could damage and reduce yields. The 100% effectiveness indicates that liquid smoke not only prevents pest development but also has a strong repellent effect, ensuring the plants remain pest-free throughout the observation period.

Leaf Damage

The analysis of variance results showed that the effect of the treatment was significantly different compared to the control (without treatment). This study observed the extent of leaf damage on mustard green plants over 25 days, with observations made twice a week. The liquid smoke treatment was applied on the 7th, 14th, and 21st days. The data on the extent of leaf damage in the group treated with liquid smoke and the control group (without liquid smoke) are presented in Table 2.

Table 2. Leaf Damage on Mustard Green Plants

Day	Date	Number of Leaf Damage	
		Mustard Greens with Liquid Smoke	Control Mustard Greens
0	June 2, 2024	0	0
4	June 5, 2024	0	0
6	June 8, 2024	0	0
10	June 12, 2024	0	0
13	June 15, 2024	0	2
17	June 19, 2024	0	4
20	June 22, 2024	0	8
24	June 26, 2024	0	13
Total Leaf Damage		0	13

From the data, it can be observed that during the observation period, the extent of leaf damage on mustard greens treated with liquid smoke remained zero from day 0 to day 24. In contrast, the extent of

leaf damage on control mustard greens began to increase on day 13 and continued to rise until day 24. The observation data suggest that the use of liquid smoke on mustard greens is highly effective in preventing leaf damage. During the observation period, no leaf damage was observed on mustard greens treated with liquid smoke, while the extent of leaf damage on control mustard greens significantly increased after day 13. By day 24, the control mustard greens had 13 damaged leaves, showing a rapid and significant increase.

The effectiveness, in terms of the number of leaves damaged by pests, indicates that liquid smoke can effectively protect mustard green leaves from pest-induced damage. The 100% effectiveness suggests that liquid smoke not only prevents the development of pests that damage leaves but also may have a strong protective effect, ensuring that the plants remain healthy and free from damage throughout the observation period.

Pest Types

Based on the observation data, there is a difference in the types of pests between mustard greens treated with liquid smoke and control mustard greens. Mustard greens treated with liquid smoke had no pests, while control mustard greens had 5 grasshoppers, 1 armyworm, 1 inchworm, and 13 aphids. The data is presented in the table below.

Table 3. Types of Pests on Mustard Green Plants

Day	Date	Pest Types	
		Mustard Greens with Liquid Smoke	Control Mustard Greens
0	June 2, 2024	-	-
4	June 5, 2024	-	-
6	June 8, 2024	-	-
10	June 12, 2024	-	-
13	June 15, 2024	-	1 Armyworm
17	June 19, 2024	-	1 Armyworm, 1 Inchworm, 3 Grasshoppers
20	June 22, 2024	-	1 Armyworm, 1 Inchworm, 5 Grasshoppers, 6 Aphids
24	June 26, 2024	-	1 Armyworm, 3 Inchworms, 5 Grasshoppers, 13 Aphids
Total Number of Pest Types		0	4

This study observed the types of pests attacking mustard green plants with liquid smoke treatment and control mustard green plants. The observations showed a significant difference in pest diversity, with 5 grasshoppers, 1 armyworm, 1 inchworm, and 13 aphids identified among the two treatment groups. Mustard greens treated with liquid smoke successfully avoided pest attacks completely, while control mustard greens faced a variety of pests totaling 22.

In the control mustard greens, a total of 22 pests were found, consisting of 1 armyworm, 3 inchworms, 5 grasshoppers, and 13 aphids. This indicates that without liquid smoke treatment, mustard greens are more susceptible to pest attacks, which can lead to leaf damage and potential reductions in yield. This research aligns with the study by Yulia (2018), which stated that liquid smoke contains 20 chemical compounds, including phenols and acetic acid, which act as active insecticidal agents against pests.

CONCLUSIONS

Based on the conducted research, liquid smoke has been demonstrated to be effective in controlling pests on mustard green plants. The results indicate that liquid smoke treatment resulted in the complete absence of pests on the treated mustard greens, unlike the control mustard greens. Moreover, the mustard greens treated with liquid smoke showed no leaf damage, whereas the control mustard greens did. The

types of pests found, including armyworms, inchworms, grasshoppers, and aphids, were absent from the mustard greens treated with liquid smoke. Therefore, it can be concluded that liquid smoke is highly effective in managing pest populations on mustard green plants.

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