JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 7 NO. 2 May 2025

DOI :https://doi.org/10.36378/juatika.v7i2.4296
eissn 2656-1727
pissn 2684-785X
pages : 588 – 592

RESEARCH ARTICLE Open Access

Utilizing Cigarette Filter Waste Extract as a Natural Pesticide to Eradicate Whitefly Pests in Chili Plants (*Capsicum frutescens* L.)

Fiqri Algamar[1,*], Khairul Rizal[1], Novilda Elizabeth Mustamu[1], Siti Hartati Yusida Saragih[1]

Abstract

Chili pepper (*Capsicum frutescens* L.) is a plant commonly cultivated in Indonesia. This research employed an empirical, quantitative experimental approach using a Randomized Block Design (RBD). The study included three treatment groups with varying concentrations of cigarette butt biopesticides: a control group, and treatment groups at 10 ml/L, 20 ml/L, and 30 ml/L. The results indicated that biopesticides derived from cigarette butt waste extracts significantly affected the control of whitefly pests on chili peppers. The ANOVA test yielded an F value of 150.044 with a significance level of 0.000, demonstrating a highly significant difference among the treatments. The control group exhibited the highest average mortality rate of 62.22% for pests, followed by the 10 ml/L treatment at 50.67%, the 20 ml/L treatment at 42.67%, and the 30 ml/L treatment, which was the least effective, with an average mortality rate of 32.00%. These findings suggest that higher concentrations of the extract are more effective in reducing the number of living pests, positioning this biopesticide as an environmentally friendly alternative for pest control.

Keywords: Chili Pepper Plants, Cigarette Filter Waste, Natural Pesticides, Waste Extract, Whitefly Pests

1. Introduction

Chili pepper plants (Capsicum frutescens L.) are widely cultivated in Indonesia. These peppers are rich in nutrients, including vitamin A, vitamin C, and essential minerals such as iron, potassium, calcium, phosphorus, and niacin. Specifically, chili peppers contain 15 grams of protein, 11 grams of fat, 35 grams of carbohydrates, 150 milligrams of calcium, and 9 milligrams of iron (Sukasana et al., 2024). Agriculture plays a crucial role in supporting food security in various countries, including Indonesia. Among agricultural commodities, chili peppers hold significant economic value. However, chili pepper plants often suffer losses due to pest infestations, which can significantly reduce production. Common pests that attack chili pepper plants include aphids, thrips, and caterpillars, all of which can cause substantial damage if not effectively managed (Siregar, 2023). Additionally, improperly disposed cigarette filter waste can pollute the environment due to the presence of hazardous chemicals that are difficult to break down. Pest control for cayenne pepper plants is typically conducted using synthetic chemical pesticides. While these pesticides have demonstrated effectiveness in managing pests, their excessive use can have adverse effects on the environment, human health, and the sustainability of agricultural ecosystems (Intarti et al., 2020).

Pesticides are chemicals employed to manage the growth of pests, diseases, and weeds. They are generally classified based on the types of organisms whose populations they target, including insecticides, herbicides, fungicides, and nematocides. Additionally, other types of pesticides are utilized to control pests such as rats and snails. It is essential to maintain the productivity of each plant to ensure a consistent supply of products. Appropriate control techniques are necessary to prevent losses caused by pests and diseases that affect plants (Aditiawati & Mia Rosmiati, 2014). Integrated Pest Management (IPM) is a strategy used to address pest outbreaks that lead to reduced crop productivity. Integrated pest management strategies can be implemented through (1) promoting healthy plant growth, (2) engaging in biological control activities, and (3) utilizing plant varieties that are resistant to pests and

*Correspondence: fiqrialgamar1808@gmail.com
1) Universitas Labuhanbatu - Jl. SM. Raja Aek Tapa No.126 A KM 3.5, Bakaran Batu, Kec. Rantau Sel., Kab. Labuhanbatu, Sumatera Utara 21418, Indonesia

diseases.(Prihatiningrum et al., 2021) .

Another natural pest control method is to utilize cigarette filter waste extract as a pesticide. One agricultural commodity with excellent market potential is cayenne pepper (Capsicum frutescens L.). There are various obstacles to cultivating cayenne pepper, including pest attacks and plant diseases. Among the many types of chili plant diseases, leaf damage disease caused by whitefly pest attacks (Paracoccus marginatus) is a serious threat to farmers, as it is easily transmitted, resulting in decreased production and even crop failure (Sutriadi et al., 2020). According to the World Health Organization (WHO), the habit of throwing cigarette butts carelessly is carried out by millions of people. At least two-thirds of cigarette butts are found scattered on sidewalks or gutters, and eventually end up in the ocean. Cigarette butt waste is classified as hazardous and toxic waste, equivalent to factory waste, can pollute the environment and endanger human survival. The high production of cigarette butts is unfortunately not accompanied by efforts to manage it. Apart from being visual waste, cigarette waste can be categorized as a poison that is very dangerous for mammals (Akhmad et al., 2021).

On the other hand, cigarette butts and cigarette filters are one type of waste that is difficult to decompose and is often found in various places, adding to the burden of environmental pollution. Cigarette filters, which are made of acrylic or cellulose acetate, contain various hazardous chemical compounds contained in cigarette smoke, such as nicotine, tar, and heavy metals. In recent years, research has shown that the ingredients contained in cigarette filter waste can have the potential to act as active biological compounds with pesticide properties (Afifah F., Yuni Sri Rahayu, 2015). This point opens up the possibility of utilizing cigarette filter waste as a raw material for making more environmentally friendly natural pesticides. Water from soaking tobacco stems (Nicotiana tabacum L.) can be used as a bioinsecticide to control pests in chili plants (Budiyani & Sukasana, 2020). The effects caused by tobacco soaking water are very real; the higher the concentration used, the higher the mortality of chili plant pests (Sukasana et al., 2024).

Treatment at a concentration of 10% is considered more efficient because it is more economical compared to 0.5%, and it is quite effective in affecting pest mortality in chili plants. Therefore, based on this, it is necessary to overcome the problem of chemical pesticides by replacing them with natural tobacco pesticides that have no side effects, using tobacco materials that are planted and unused (Pests, 2024). According to (Rika et al, 2024) it shows that plants that are applied with cigarette butt insecticides have a very significant effect on the intensity value of edamame attacks, while the best concentration in controlling edamame plant pests is cigarette butt waste insecticide with a concentration of 20%, while this study also utilizes cigarette filter waste, thus providing added value in waste management. In addition, the focus of this study is on cayenne pepper plants and aims to provide a dual solution, particularly in pest control and the reduction of hazardous waste. Cigarette butts mostly contain tobacco which has the potential to be used as a biopesticide for agricultural activities. Nicotine levels in cigarette butts can be utilized as ingredients in the production of insecticides (Akhmad et al., 2021). The use of cigarette butt waste as a natural pesticide aligns with the principles of a circular economy, where waste is converted into valuable resources. This finding can provide added value to waste that was previously considered useless. Additionally, this approach has the potential to support the sustainability of the agricultural sector by reducing its dependence on synthetic chemicals.

Based on this background, this study aims to investigate the potential of cigarette filter waste extract as a natural pesticide for controlling pests in chili plants. Thus, this study is expected to provide an innovative, environmentally friendly solution for the agricultural sector, while also helping to overcome the problem of cigarette butt waste in society.

2. Material and Methods

2.1. Time and Place Study

This study will be implemented in the Village of Mampang Subdistrict, Pinang Regency, South Labuhanbatu, which is located at coordinates 1°49′44.4″ N and 100°1′19.2″ E, with an elevation of about 105 meters above sea level. This study, which is in progress, started in January 2025 and is expected to be finished.

2.2. Materials and tools

In this study, various tools and materials will be utilized for the extraction of cigarette filter waste, the application of natural pesticides on cayenne pepper plants, and the observation of the effectiveness of pest control and plant growth. The materials used in the study include cigarette filter waste/Cigarette Butts, Cayenne Pepper Seeds, Planting Media, Polybags, Labels, and Stationery. The tools used in the study include knives, Hoes, Drums, Filters, Bottles, Hand Sprayers, and Cameras.

2.3. Method Study

The type of research conducted is empirical research with an experimental research approach, utilizing a quantitative testing method in the form of a Randomized Block Design (RAK) with three repetitions. This point includes cigarette butt biopesticides of various concentrations, resulting in 12 experimental units, as well as qualitative tests on nicotine content. The treatment factors for biopesticides given are control, (10) ml/L, (20) ml/L, (30) ml/L.

2.4. Research Implementation

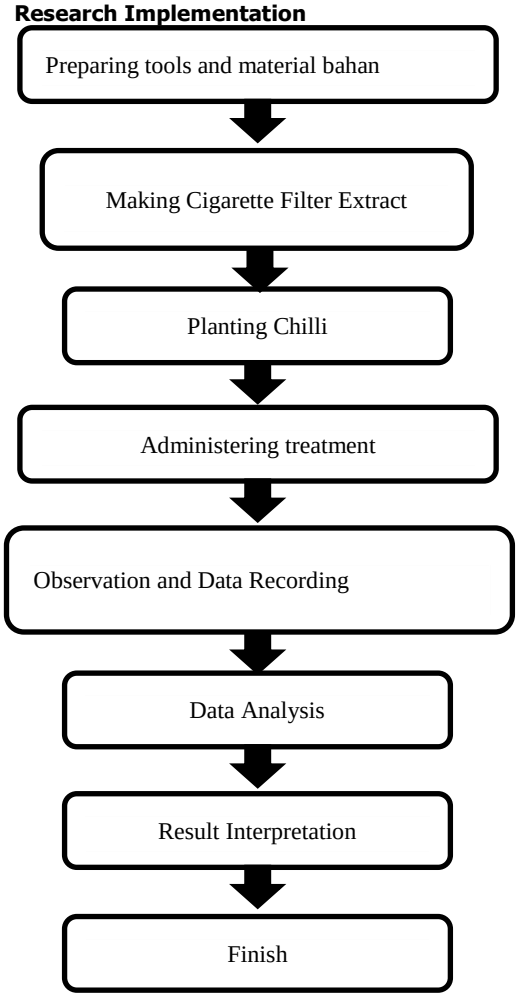

Figure 1. Researc flow diagram

2.5. Data analysis

Primary data regarding the utilization of cigarette filter waste/butts as a pesticide by exterminators to control pests on chilli cayenne pepper plants. The method of data collection in this study involves collecting primary data directly from the experiment and observations made by the researcher. Data analysis for this study was conducted using SPSS software version 24.

Observations on the intensity of whitefly pest attacks on cayenne pepper plants were carried out every 72 hours after spraying (Ratna et al., 2016). Data collection techniques were carried out offline, with the effectiveness test of biopesticides conducted by measuring the intensity of pest attacks. Attack Intensity (IS) is calculated using the formula proposed by Marhani (2018), namely:

$$\boldsymbol{I = \frac{\sum(ni \times vi) \times 100\%}{N \times Z}}$$

Information:

I = intensity of pest attack (%)
ni = number of plant leaves attacked by pests
vi = Large-scale attack
Z = Highest scale value of the category attack set
N = number of plant leaves observed

2.6. Observed Parameters

This research design is an experimental type, involving the testing of cigarette butt biopesticides with different concentrations and various application techniques. The parameters observed were the intensity of whitefly pest attacks on cayenne pepper plants.

3. Results and Discussion

Based on the field observations, the results of the intensity of pest attacks are presented in Table 1. Based on the results of the data in the field, the attack intensity calculation is continued with the formula below:

$$\boldsymbol{I = \frac{\sum(ni \times vi) \times 100\%}{N \times Z}}$$

I = (75/45) × 100% = 0.6 × 100% = 60.00%

Based on the results of the calculation of the intensity of whitefly pest attacks in the P0 treatment, repetition 1, a value of 60.00% was obtained. The results above were then followed by the ANOVA test, which was used to assess the differences between each treatment presented in Table 2 below.

Based on the results of the ANOVA test on the number of dead pests, the calculated F-value was 150.044 with a significance value (p-value) of 0.000. A significance value smaller than 0.05 indicates a very significant difference between biopesticide treatments from cigarette butt waste on pest mortality. Thus, it can be concluded that different biopesticide concentrations have a significant effect on the number of dead pests. Then, continued with a DMRT test at a 5% level (Table 3).

The results showed that treatment with a concentration of 30 ml/L resulted in an average pest mortality of 32.00%, which was significantly different compared to other treatments. Treatments with concentrations of 20 ml/L and 10 ml/L showed an average mortality of 42.67% and 50.67%, respectively, while the control without treatment had the highest average mortality of 62.22%. This difference suggests that cigarette butt extract is effective in controlling pests, with higher concentrations yielding a more pronounced effect. This study is in line with (Pratiwi, FA, Utami, TS, & Arbianti, 2020) that cigarette butt extract using 96% ethanol solvent resulted in the highest mortality rate in armyworm pests (Spodoptera frugiperda) of 27.2%, with the compound 16-Hentriacontanone as the main component that has the potential as a natural insecticide. Different research by Gudeta et al. (2021) found that the nicotine content in cigarette butt extract can be used as an effective insecticide against cabbage aphids, with varying efficiency depending on the extraction method used.

Table 1. Results of field observations on the intensity of pest attacks

Treatment	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5	Number of Plants On Scale × Scale Value	Attack Intensity (%)
Control	2	3	4	4	2	45	60.00
Control	3	3	3	4	2	47	62.67
Control	4	3	3	3	2	48	64.00
10 ml/L	3	5	4	2	1	39	52.00
10 ml/L	4	6	3	2	0	36	48.00
10 ml/L	3	5	5	1	1	39	52.00
20 ml/L	5	6	3	1	0	31	41.33
20 ml/L	6	5	3	1	0	32	42.67
20 ml/L	6	4	3	2	0	33	44.00
30 ml/L	8	5	2	0	0	25	33.33
30 ml/L	9	4	2	0	0	24	32.00
30 ml/L	10	3	2	0	0	23	30.67

Table 2. Results of the ANOVA test on pest attack intensity

ANOVA					
Dead Pests					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1466.769	3	488,923	150,044	.000
Within Groups	26,068	8	3.259		
Total	1492.837	11			

Table 3. Results of the DMRT test of pest attack intensity

Treatment	Average
30 ml/L	32.00 ± 0.76a
20 ml/L	42.67 ± 0.77b
10 ml/L	50.67 ± 1.33c
Control	62.22 ± 1.17d

Figure 2. Documentations of the research

4. Conclusion

The results indicated that biopesticides derived from cigarette butt waste extracts significantly affected the control of whitefly pests on cayenne peppers, yielding an F-value of 150.044 with a significance level of 0.000. This result demonstrates a highly significant difference among

the treatments. The control treatment exhibited the highest average mortality rate of 62.22% for the pests, followed by P1 (10 ml/L) at 50.67%, P2 (20 ml/L) at 42.67%, and the least effective treatment, P3 (30 ml/L), with an average mortality of 32.00%. The findings suggest that higher concentrations of the extract correlate with increased effectiveness in reducing the population of living pests, positioning this biopesticide as an environmentally friendly alternative for pest control.

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