BIOVALENTIA: Biological Research Journal
Vol. 10 No. 1 (2024)
DOI: https://doi.org10.24233/biov.10.1.2024.436
ISSN Online: 2477-1392
Pages: 68-74

Effectiveness Formulation of Tobacco and Tannin Fermentation Extract against Aphids (*Aphis gossypii* Glover) on Curly Red Chilli

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Abstract: Aphids is one of the main pests that attack curly red chili plants. Bioinsecticides can be an alternative to synthetic insecticides in controlling aphids. Tobacco leaf extract and tannin can act as insecticides against various types of insect pests. The aim of this study was to determine the effectiveness of formulations containing fermented mixtures of tobacco leaves and tannin as bioinsecticides against aphids on curly red chili plants. The efficacy experiment was conducted in a greenhouse arranged in a completely randomized design (CRD) with 5 formulation concentration treatments, namely 10%, 5%, 2.5%, 1.25%, and 0% (water), with 5 replications. The treatment was carried out by directly spraying the formulation liquid onto the underside of leaves infested with aphids. The results showed that the tobacco and tannin formulation treatments significantly reduced aphid populations, particularly at the 5% and 10% concentration treatments. The efficacy of population suppression reached 92% after 3 days for the 10% concentration and suppressed the population by 93% after 5 days of application for the 5% concentration. After 7 days of application, the efficacy of aphid population suppression was 99% and 100%, respectively, for the 10% and 5% concentrations. The LT50 values for population suppression occurred after 1.18 and 2.67 days for the 10% and 5% concentrations, respectively. The fermented mixture of tobacco and tannin formulations has the potential to be used as a bioinsecticide for controlling aphids.

Keywords: *Aphids; Bioinsecticide; Tobacco; Tannin*

Received: 25 June 2024, Accepted: 5 July 2024, Publish: 12 July 2024

1. INTRODUCTION

The curly red chili plant (*Capsicum annuum* L.) is one of the important plants in the horticultural commodities in Indonesia. Red chili is beneficial as a cooking ingredient due to its high nutritional content, and it is useful as an antioxidant and antibacterial agent because it contains bioactive compounds such as phenols, flavonoids, and capsaicinoids. [1]. The potential and opportunities for this plant are quite significant to be developed into a leading product that can increase farmers' income. [2].

The production of chili plants is not yet optimal due to many issues encountered, such as water utilization, the use of quality seeds, and pest and disease attacks[3]. One of the challenges in cultivating chili plants is the attack of aphid *Aphis gossypii* Glover (Hemiptera: Aphididae).

Aphids are one of the important groups of insects in the world.[4]. These pests are often found on the leaves, stems, twigs, branches, and fruit stalks of their host plants[5]. Aphids are polyphagous, meaning they attack various families such as Solanaceae, Cucurbitaceae, Malvaceae, and Rutaceae [6]. In addition to damaging plants, aphids also serve as vectors for viruses such as the Cucumber Mosaic Virus (CMV) [7].

The control of aphids is often done using synthetic pesticides. This method of control can have a negative impact on the environment if used continuously. The residues left behind can contaminate soil and water. Additionally, this type of pesticide can harm non-target organisms and also affect human health [8].

An environmentally friendly and safe alternative for pest control is the use of biopesticides. This type of pesticide is relatively safe because it is derived from plants and contains organic materials that can help control pest attacks. There are about 2,400 species, including 235 plant families, that can be used as biopesticides, each with specific bioactive components that function to control pests. These bioactive compounds are readily available and can be found in tobacco and tannin extracts [9].

Tobacco (*Nicotianae tabacum* L) is one of the plants often used as a biopesticide [10]. This plant contains secondary metabolites such as nicotine, d-limonene, and pyridine [11] Additionally, it contains alkaloids, flavonoids, and saponins. [12]. Nicotine, the main component in tobacco, acts as a neurotoxin for insects with a rapid reaction. Tobacco extract is often used as a biopesticide because it is cheaper, not harmful to health, leaves no residue, and is very effective in controlling various types of pests. [13]. It is known that bioinsecticides containing tobacco can cause more than 50% mortality within 24 hours of application [14]. Other research has shown that tobacco extract consistently increases aphid mortality rates between 74-90% under different conditions [15]. Tobacco extract obtained through boiling or soaking the leaves can also reduce aphid populations [16].

Tannins are secondary metabolite compounds that are quite abundant, making up about 25% of the dry weight of leaves, roots, and bark in plants[17]. Tannins can act as antinutrients and enzyme inhibitors [18]. Various studies have shown that tannins, as polyphenolic compounds, can have antimicrobial and insecticidal properties[19]. As biopesticides, tannins function as a defense against pest attacks by inhibiting the performance of digestive enzymes[20]. Tannins mixed with shrimp shell compost extract, which contains amino acids, can reduce the population of *A. gossypii* on curly red chili plants [21].

The aim of this research is to determine the effectiveness of a formulation containing a fermentation mixture of tobacco leaves and tannins as a biopesticide against aphid pests on curly red chili plants.

2. MATERIALS AND METHODS

2.1. Time and Place of Experiment

The experiment was conducted from March to May 2024 in Greenhouse of Department Plant Protection, Faculty of Agriculture, Sriwijaya University.

2.2. Tools and Materials

The tools used in this research are a macro lens, writing instruments, and a 100ml spray bottle. The materials used are 250g of dried tobacco and shrimp shell compost extract containing 2% tannin.

2.3. Preparation of Formulation

The tobacco and tannin formulation is made by soaking 250g of dried tobacco leaves in one liter of shrimp shell compost extract solution containing 2% tannin and fermenting it for 3 days at room temperature. The soaking liquid is then filtered with a 100-mesh nylon filter. The soaking liquid

or fermentation liquid is stored at room temperature until used.

2.4. Biological Specimens

A. gossypii adults were obtained from chili cultivation areas in the experimental garden of the Faculty of Agriculture, Sriwijaya University. The adults from the field plants were transferred using a brush to the test chili plants, which were 30 days after planting (DAP), and were left for 5 days to allow A. gossypii to acclimate and reproduce on the experimental plants.

2.5. Green House Experiment

This experimental method was carried out using a completely randomized design (CRD) with 5 treatments and 5 replications. The treatments were applied by directly spraying the formulation liquid onto the underside of leaves where A. gossypii was present. A total of 25 chili plants were used in this experiment. The treatments consisted of 5 types: 4 treatments with different concentrations of biopesticide (10%, 5%, 2.5%, 1.25%) and one control treatment (water only). Each treatment used 5 curly red chili plants as replications..

Before observations were made, the number of A. gossypii on the plants was counted (pre-treatment). Observations were conducted 24 hours after the application of the biopesticide and continued for 7 days by counting the remaining number of A. gossypii. The population growth of A. gossypii (%) was calculated according to the following formula Sana et al. (2022) [22] using the equation :

$$\text{Percent Reduction} = \frac{\text{Pre Treatment Population} - \text{Post Treatment Population}}{\text{Pre Treatment Population}} x100$$

2.6. Data Analysis

The data obtained were analyzed using ANOVA and followed by a honest significant difference test at 5% using R studio version 2024.04.1.

3. RESULTS AND DISCUSSION

The greenhouse experiment results showed that the population of A. gossypii treated with tannin and tobacco formulation decreased significantly, especially in the 5% and 10% concentration treatments. In contrast, the aphid population on the control plants increased significantly by up to 434% on the seventh day after treatment.

The reduction in aphid numbers began to decrease significantly after 24 hours of treatment at the 10% concentration and after 3 days at the 5% concentration. Population suppression approached 100% (efficacy 92%) on the third day of observation for the 10% concentration, while population suppression efficacy of 93% was achieved after 5 days of treatment at the 5% concentration. After 7 days of application, the efficacy of aphid population suppression was 99% and 100% for the 10% and 5% concentrations, respectively. At the 2.5% concentration, population reduction occurred after 4 days of application, but efficacy only reached 52% after 5 days, with efficacy then declining (Figure 1). Based on statistical analysis using the drc package in R, the LT50 for mortality caused by the 10% dose treatment was 1.18 days, indicating that at the 10% concentration of tannin and tobacco biopesticide can kill 50% of A. gossypii after 1.18 days of treatment. At the 5% concentration, the LT50 value was reached in 2.67 days. At the 2.5% and 1.5% concentrations, the LT50 value could not be determined due to fluctuating population suppression of A. gossypii, and no suppression occurred at the 1.5% concentration.

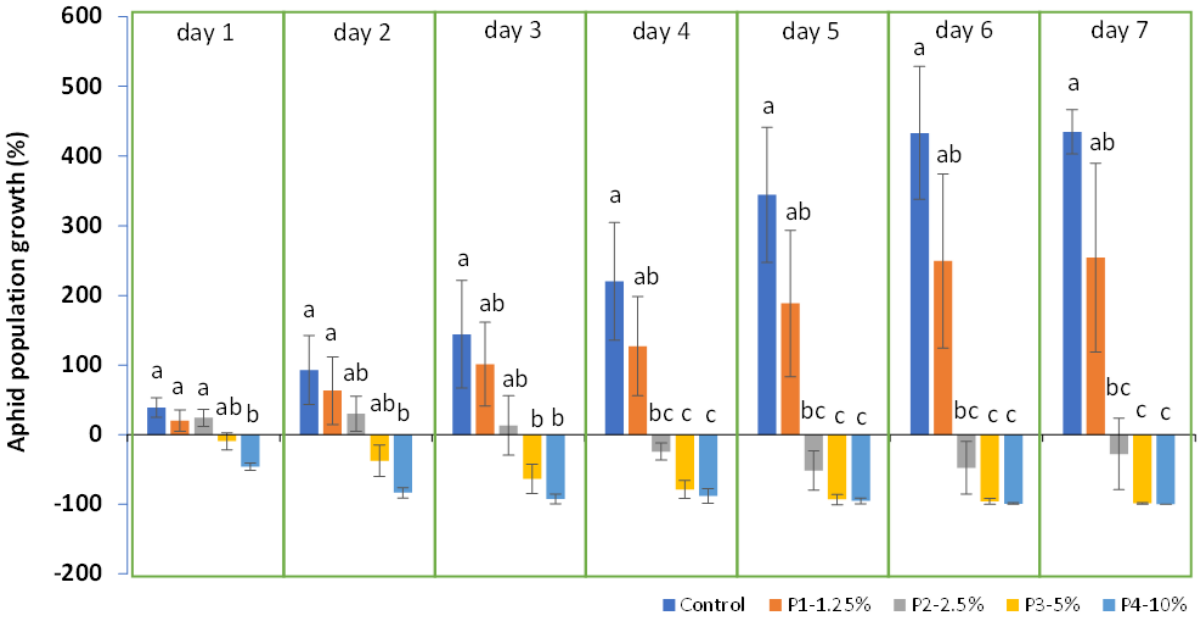

Figure 1: Population growth of aphids treated with tobacco and tannin formulations

The results of this experiment indicate that formulations of tobacco extract and tannin can reduce aphid populations by causing aphid mortality on curly red chili plants. The control efficacy reached 92% and 93% at concentrations of 10% on the third day and 5% on the fifth day after application, respectively. These formulations contain nicotine and tannin compounds, which are plant secondary metabolites with insecticidal properties. Tobacco extract contains nicotine, which can act as a repellent, antifeedant, and insect growth regulator [23]. Nicotine is neurotoxic because it mimics acetylcholine, an important neurotransmitter in the insect nervous system. Nicotine competes with this neurotransmitter, leading to uncontrolled insect nervous system function [24].

The addition of tannin, which also has insecticidal properties, in bioinsecticide formulations is suspected to play a role in increasing the efficacy of aphid population suppression. The tobacco formulation in this study, made through fermentation and mixed with tannin, is more effective compared to the extraction method using boiling and blending as done by Suprapti and Daryanti[25]. In their research, the mortality rate of the aphid Aphis craccivora was less than 75% and did not increase to 40%. Meanwhile, the study conducted by Iqbal et al [26] which created tobacco bioinsecticide by grinding, only resulted in a wheat aphid mortality rate of 60% after 6 days of application. The formulation created in this study is also more effective compared to the fermentation of tobacco leaves in the research by Ghosh et al. [27] which only showed a control efficacy rate of 50%. Furthermore, Keerio et al. [13] reported that hot water extracts from several varieties of tobacco leaves at a concentration of 5%, which is four times more concentrated than in this study, could suppress the cabbage aphid Brevicoryne brassicae with an efficacy of

68-86%. However, when detergent was added, the efficacy increased to 78-97%. The results of this study reveal that the fermented tobacco leaf formulation with added tannin is effective in suppressing aphid populations and has the potential to be developed as a bioinsecticide for aphid control.

4. CONCLUSION

The results of this study indicate that the fermented tobacco and tannin formulation can reduce aphid populations on curly red chili plants with an efficacy of 99%-100% after 7 days of application at concentrations of 5% and 10%, respectively

5. ACKNOWLEDGEMENTS

It is written at the end of the manuscript, at above references (see template in details).

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