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Effectiveness of Resam Fern Leaves Extract (*Gleichenia linearis*) as Bioinsecticide on Mortality of Black Ant (*Dolichoderus thoracicus*)

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Abstract

Insecticides are type of pesticide used to eradicate or control pests. Generally, there are two types of insecticides, namely natural and synthetic insecticides. Natural insecticides are scarce due to their inability to eradicate pests such as black ants. Meanwhile, the use of synthetic insecticides is very practical and fast but can cause pollution that is harmful to humans, animals and other living things. Thus, natural insecticides are needed that can eradicate black ants effectively and efficiently and do not pollute the environment or poison other organisms. The research method used is combination of experimental methods, observation, and literature studies. In determining the best insecticide variation for mortality, a black ant mortality rate was measured using timer for 50 black ants. After the data was obtained, it was analyzed descriptively to determine the value of the mortality rate for each experimental sample. Based on the data obtained, the best variation of natural insecticides was the control variation of fern leaf extract with 3.646 seconds per ant. This is because fern leaf extract in insecticides contains tannin compounds which have several benefits as active pesticide ingredients. Thus, fern insecticides are effective in exterminating black ants.

Keywords: *black ants, fern leaves, insecticides*
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Abstrak

Insektisida adalah pestisida yang mengandung senyawa kimia yang digunakan untuk membasmi atau mengendalikan hama. Secara garis besar, terdapat dua jenis insektisida yaitu insektisida alami dan sintetis. Insektisida alami cukup sulit ditemukan dikarenakan ketidakmampuan insektisida dalam membasmi hama seperti semut hitam. Sedangkan, penggunaan insektisida sintetis memang sangat praktis dan cepat tetapi dapat menimbulkan polusi yang membahayakan manusia, hewan dan makhluk hidup lainnya. Dengan demikian, dibutuhkan insektisida alami yang dapat membasmi semut hitam secara efektif dan efisien serta tidak mencemari lingkungan maupun meracuni organisme lainnya. Metode penelitian yang digunakan adalah kombinasi metode eksperimen, observasi, dan studi literatur. Dalam menentukan variasi insektisida terbaik terhadap mortalitas tersebut, dilakukan pengukuran kecepatan mortalitas semut hitam dengan menggunakan timer kepada 50 semut hitam. Kemudian data dianalisis menggunakan statistik deskriptif untuk mengetahui efektifitas mortalitas untuk setiap sampel percobaan. Berdasarkan data yang diperoleh, variasi terbaik insektisida variasi kontrol ekstrak daun fern leaves dengan kecepatan 3,646 detik per semut. Hal ini dikarenakan ekstrak daun fern leaves dalam insektisida mengandung senyawa tanin yang mempunyai beberapa manfaat sebagai bahan aktif pestisida. Dengan demikian, insektisida fern leaves efektif dalam membasmi semut hitam secara efektif.

Kata kunci: *insektisida, fern leaves, semut hitam*
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INTRODUCTION

Ants are eusocial insects which are also known as the third largest household pest after mosquitoes and cockroaches. Ants have various types of species, ranging from beneficial to detrimental. Beneficial ants such as the type of skeleton ant which is used as a predator of fruit plant pests, can automatically reduce the use of chemical pesticides in eradicating plant pests. Whereas harmful ants are those that interfere with the lives of other living things because they are classified as omnivore animals or eat everything, both plants and animals[1]. One of the harmful ants is black ants on food with stinging bites and odors. However, to eradicate pests in the form of insects themselves, people tend to use chemical or synthetic insecticides that contain harmful substances, to control pests such as cockroaches, mosquitoes, flies, termites, ants, rats because they are considered more practical, effective and efficient. Ideally, these synthetic insecticides are used to kill only the target organisms. But in fact, insecticides that contain a lot of chemicals are not selective enough and instead poison other organisms that play a role in the environment[2].

Insecticides are usually packaged in various formulations including liquid, mosquito coil, aerosol, mat, vaporizer, insect repellent lime and burning paper with various active ingredients and concentrations used. The use of synthetic insecticides is indeed very practical and fast but can cause pollution that is harmful to humans, animals and other living things. This pollution can spread to the environment so that it is inhaled by the upper respiratory organs and has an impact on the lower respiratory organs[3]. Meanwhile, the insecticide that is often used to control ants is magic lime which contains the chemical substance deltamethrin of 0.6%. Deltamethrin is a broad-spectrum insecticide that acts as a contact poison and stomach poison[4].

Meanwhile, on the other hand, there are many plants that can be used as natural or vegetable insecticides without harmful chemicals, one of which is ferns. The resam fern plant (*Gleichenia linearis*) is a type of fern plant that is easy to find in Indonesia because it attaches a lot to oil palm trees and roadside cliffs, so it is called a weed[5]. Weeds are plants that often grow where they are not wanted because they cause disturbance to the plant. Within a plant commodity there is always competition in food absorption, especially competition between cultivated plants and weeds fighting over nutrients[6]. So, instead of being allowed to become weeds on other plants, fern is better extracted

Nusantara Scientific Medical Research Journal (NSMRJ)
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https://nusantarascientificjournal.com/index.php/nsmrj/article/view/22

to be used as a vegetable insecticide. *Gleichenia linearis* itself contains compounds that affect insect metabolism, such as antifeedants, which are compounds that inhibit eating. Ferns also contain many allelochemical compounds in the form of flavonoids, triterpenoids, saponins, tannins, alkaloids and steroids which are theoretically harmless to humans, but sufficient to fulfill the role as a vegetable insecticide. So far, ferns have been widely used as traditional medicines, vegetables, ornamental plants, building poles, etc., but no one has optimized ferns as natural insecticides to control black ant pests that are effective and environmentally friendly[7].

The use of fern fern extract has previously been the object of research but not for controlling black ant pests. In his research conducted a toxicity test of a vegetable insecticide from fern fern leaves on the larvae of *Plutella xyostella L*, which is the main pest of cabbage plants[8]. The sample used in this study was 250 larvae of *Plutella xyostella L* instar 3 with 4 treatments, namely the concentration of *G. Linearis (Burm.f.)* S.W Clarke leaf extract. 5%, 10%, 15%, 20% and control (0%) with 5 repetitions. Data were analyzed using the Kruscal Walis and the Probit test. It was concluded that *Gleichenia linearis* leaf extract could be used as a pest controller for *Plutella xyostella L larvae* because it was proven to be toxic and the lowest LC50 value was the best, namely 0.127% -1.546% at 48 hours.

The study conducted to determine the concentration of *G.linearis* leaf extract on the germination and growth of *Cynodon dactylon* weed seedlings[9]. This study used a completely randomized design with 5 replications consisting of control, 0.1; 0.2 and 0.3 gr/ml (germination) compared to control, 0.1 and 0.2 gr/ml (grow). The results showed that the effective concentration that could inhibit the germination of *C. dactylonis* at a concentration of 0.3 g/ml and inhibit the growth of other plants was a concentration of 0.2 g/ml.

In the same year, a study was also conducted to determine the concentration of *G.linearis* leaf extract on the germination and growth of *Mimosa pudica L*. This study also used a Completely Randomized Design (CRD) with 5 replications consisting of control, 0 ,1; 0.3; 0.5 and 0.7 g / ml[10]. Germination and growth treatments were started from control, 0.1; 0.3; 0.5 and 0.7 g / ml. The results showed that the concentration that inhibited the germination of *M. pudica* weeds was 0.5 g/ml and the growth concentration was 0.5 g/ml. As explained above, it can be concluded that no research has been found that

Nusantara Scientific Medical Research Journal (NSMRJ)
Volume 01, No. 01 (2022), Page 60 – 68
https://nusantarascientificjournal.com/index.php/nsmrj/article/view/22

optimizes Fern leaves leaf extract as an insecticide to control black ant pests. So that this research can be called a new idea regarding the optimization of Fern leaves leaf extract as an insecticide tested based on the mortality of black ants.

Therefore, an experiment will be carried out entitled " Effectiveness of Resam Fern Leaves Extract (*Gleichenia Linearis*) as Bioinsecticide on Mortality of Black Ant (*Dolichoderus thoracicus*). This study will put forward a new idea related to optimizing ferns as bioinsecticide to control black ants. This fern insecticide is environmentally friendly because it is made from natural ingredients without a mixture of chemicals that are harmful and pollutes the environment. As an alternative solution to reduce the use of synthetic insecticides, the number of negative impacts produced by synthetic insecticides is calculated. In this fern extract insecticide, the composition will be combined with alcohol, to obtain the best variation that is most effective in controlling black ant pests.

METHODOLOGY

Research Type

This type of research is a type of quantitative experimental research using a combination of experimental methods, direct observation and literature study. The research began with a literature study on ferns and black ant and the manufacture of vegetable insecticides using the internet and continued with field observations to obtain ferns and black ants. To determine the success of this study, an experimental method was used to obtain information regarding the effect and effectiveness of the Fern leaves Plant Insecticide on the mortality of black ants. With this combination of methods, maximum results will be obtained both quantitatively and qualitatively.

Tools and Materials

The tools used in this study are described as follows, knife, cutting boards, big bowl, frying pan, spatula, gas stove, tea filter, bottle, analytical balance, spoon. The materials used in this study are described as follows, resam fern leaves, alcohol, water.

Research Variable

Independent Variable

Independent variables or independent variables are variables that influence or cause changes or the emergence of the dependent variable[11]. The independent variables in this study were fern and alcohol with varied compositions. Variations are made as much as:

Nusantara Scientific Medical Research Journal (NSMRJ)
Volume 01, No. 01 (2022), Page 60 – 68
https://nusantarascientificjournal.com/index.php/nsmrj/article/view/22

1. Alcohol control (Without Fern leaves leaf extract)
2. Control of Fern leaves leaf extract (without alcohol)
3. Alcohol: Fern leaves leaf extract (1: 1)
4. Alcohol: Fern leaves leaf extract (1: 2)
5. Alcohol: Fern leaves leaf extract (2: 1)

Dependent Variables

The dependent variable or dependent variable is the variable that is affected or becomes the result, because of the independent variables [11]. The dependent variable in this study is insecticides which are seen based on mortality of black ants (*D. Thoracicus)* and duration of insecticidal effect.

Research Steps

This research was conducted in three stages, with the first stage being the preparatory stage, namely the extraction of Fern leaves leaves. The second stage, is the stage of making insecticides. And finally, the third stage, is the testing stage in the form of interviews related to insecticides. The following is a description of the stages of the assessment.

Preparation phase

The details of the extraction stage are described as follows; the middle part of the fern leaves is cut so that each sorus is separated (into small pieces) then roasted. Next, The leaves of fern leaves have been roasted and soaked for 3 days. Finally, the fern water is strained until there are no leaves left.

Insecticide Manufacturing Stage

The details of the insecticide manufacturing stage are described as follows, fern leaves *(G. linearis*) leaf extract and alcohol are prepared. Next, the mass of fern leaves extract and alcohol was measured using an analytical balance. Then the variation of the composition is adjusted by comparing the composition between fern leaves leaf extract and alcohol. Variations in the composition were made with a ratio of 1:1, 1:2, 2:1, alcohol control (without added Fern leaves leaf extract), and fern leaves leaf extract control (without added alcohol)

Testing Stage

The details of the insecticide testing stages are described as follows; insecticides and research questionnaires are prepared in advance. Research questionnaires and insecticides were presented to the panelists to be assessed in terms of black ant mortality and duration of insecticide effects. Next, assessment is carried out for all

Nusantara Scientific Medical Research Journal (NSMRJ)
Volume 01, No. 01 (2022), Page 60 – 68
https://nusantarascientificjournal.com/index.php/nsmrj/article/view/22

insecticide variations. Finally, Research data for each insecticide variation were obtained by using statistical tests were carried out.

Data Collection Stage

In this study, data was collected through 2 stages. The first stage of data was collected through experimental activities, carried out by applying variations of alcohol and fern leaf extract. The second stage, the data or information that supports this research is analyzed through literature study and studied more deeply to obtain the required information.

Data Analysis Method

Descriptive Statistics

Descriptive statistics are a type of statistics used to describe related activities of collecting, structuring, summarizing, presenting data to make it more meaningful. Descriptive statistics are limited to providing a description or general description of the characteristics of the object under study without the intention of generalizing the sample to the population. The mean (mean) and standard deviation are part of the descriptive statistics used to report the results of research measurements[12].

RESULT AND DISCUSSION

This study aims to determine the effect of the insecticide Fern leaves leaf extract on black ant mortality as well as to determine the most appropriate and effective variation of Fern leaves leaf extract insecticide in black ant mortality. In determining the best insecticide variation for mortality, the speed of ant mortality was measured using a timer for 50 respondents (ants). The data collection process was taken by spraying resam fern insecticide on the respondent with a distance of 3 cm from spraying, then measuring the time needed to kill the ant. After spraying the insecticide liquid, the ants become weak and eventually die. From there the time data was obtained, then we could know the value of the mortality rate produced by each respondent. The recorded mortality rate data is shown in table 4.1 of the measurement results. In this research, we measured the mortality time of black ants (*D, thoracicus*) from the effects of 5 variations of insecticides which were carried out in 10 trials. The mortality time will be the data to obtain the value of the mortality rate of an ant per second which will be used as a test parameter. The measurement result data is shown by the following data table 1.

Nusantara Scientific Medical Research Journal (NSMRJ)
Volume 01, No. 01 (2022), Page 60 – 68
https://nusantarascientificjournal.com/index.php/nsmrj/article/view/22

Table 1. Results of Measuring the Time of Death of Black Ants from 5 Variations of Insecticides Carried Out 10 Times

Variation	1	2	3	4	5	6	7	8	9	10
1	4.6	5.1	5.8	4.8	3.5	3.8	3.6	4.9	5.6	7.5
2	5.2	5.4	8.1	5	4.4	4.2	4.4	5.3	6.1	7.5
3	3.2	3.9	4.0	3.9	4.3	3.6	4.6	5.6	3.2	4.2
Control Fern Leaves Extract	4.1	2.8	3.3	3.6	3.5	4.1	3.2	4.2	4.2	3.5
Control Alcohol	3.1	4.8	4.2	3.5	4.8	5.1	3.3	4.9	4.1	4.1

It has been explained previously that the time data that has been obtained from the black ant mortality will be processed into data on the speed of the black ant mortality itself. Mortality rate data is presented in graphical form as follows:

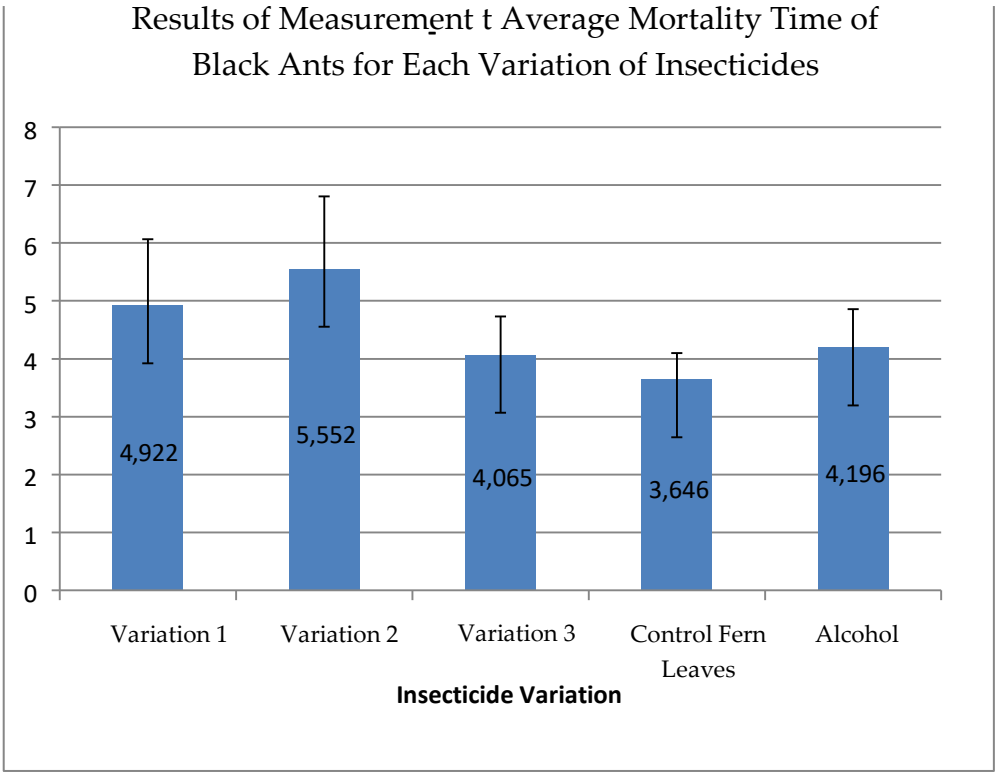

Figure 1. Results of Measurement t Average Mortality Time of Black Ants for Each Variation of Insecticides

The average t value of the time indicates the speed of effect of the insecticide. This speed will affect the effectiveness of each variation of

the insecticide itself in killing black ant pests. In addition to obtaining data on the mortality rate of each respondent for each variation, the most effective variation in killing ants was also obtained. Based on comparison table 1 it can also be concluded that the best variation is the variation that has the fastest mortality rate, namely the control variation of fern extract with an average value of 3.646 seconds per ant. This is because Fern leaves leaf extract in insecticides contains allelochemical compounds, one of which is tannin. Tannins are active compounds of secondary metabolites that have several functions, including astringents, anti-diarrhea, anti-bacterial and antioxidants.

CONCLUSION

Based on the analysis and processing of the data, the best variation of natural insecticides was the control variation of fern leaf extract with 3.646 seconds per ant. This is because fern leaf extract in insecticides contains tannin compounds which have several benefits as active pesticide ingredients. Thus, fern insecticides are effective in exterminating black ants.

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Nusantara Scientific Medical Research Journal (NSMRJ)
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