The Insecticidal Activity of Acacia Bark Extract on the Mortality Rate of Rice Earhead Bug (Leptocorisa Oratorius)

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ABSTRACT

Synthetic pesticides have been widely used in agriculture, despite their harmful effects on the environment and human health. In response to this, there is a growing need to explore alternative methods of pest control. This study aimed to investigate the effectiveness of acacia bark extract as an organic insecticide against rice earhead bug *(Leptocorisa oratorius*) with the goal of reducing reliance on synthetic pesticides. The treatment were as follows: Treatment 1 (Acacia bark extract obtained through boiling for 1 hour), and Treatment 2 (Acacia bark extract obtained through soaking for 5 days). Results analyzed statistically through the use of the scale that the researchers made, and it was found that Treatment 1 was more effective in managing rice earhead bugs compared to Treatment 2. Treatment 1 exhibited rapid action and immediate reduction of pest populations, making it ideal for quick mitigation during critical growth stages. Additionally, both treatments were effective in achieving 100% mortality of rice earhead bugs, but Treatment 1 consistently reached this outcome faster. However it is recommended to make a formulation to reduce the unpleasant aroma of the organic insecticide. Adding a few drops of essential oils, such as lavender or citrus, can mitigate the extract's unpleasant odor while enhancing its insecticidal properties. Moreover, if the extract is in a sealed container in a cool, dark place it can prevent the odor development over time.

Keywords: *Acacia bark extract, Rice Earhead Bug, Agricultural Pesticide, Mortality Rate*

INTRODUCTION

Rationale

During the past few decades, application of synthetic pesticides to control agricultural pests has been a standard practice (Rozman, et al.2007). Pesticides are extensively used in modern agriculture and are an effective and economical way to enhance the yield quality and quantity, thus ensuring food security for the ever-growing population around the globe. Approximately, 2 million tons of pesticides are utilized annually worldwide (Sharma, et al. 2019). According to Lengai, et al. (2020), the main advantages of botanicals are that they are easily to produced by farmers and are potentially less expensive. Botanical insecticides keep attracting more attention from environmental and small farmers worldwide as they are considered as a suitable alternative to synthetic insecticides (Pavela 2016). Agricultural crops are susceptible to attack by several insect pests Sustainable Agricultural Research and Education (SARE). Acacia bark extract's two major components that kill termites are saponin and tannin. It is rich in phenolic compounds and has been reported to possess antimicrobial and phytotoxic activities (Mohana et al. 2011).

The Rice Earhead Bug (*Leptocorisa oratorius*) is a serious pest of many crop plants especially rice according to Van Den Berg & Soehardi (2000) . According to Serrano, et al. (2014), it is a small insect that attacks the ripening rice grains and makes them wither. It sucks the milk from developing grains and stems in the early stage of grain formation which causes a foul smell in the field. Heavy infestation of this pest can result in total loss of the crop. Research conducted all over the world shows that bioactive compounds from medicinal plants are a potent molecule for the management of Leptocorisa according to Ismayati, et al. (2018).

According to Manila Standard (2022), farmers nowadays are simply unable to take their production further due to the high expense of many critical inputs. These items such as fertilizers, pesticides, seeds, weaned animals, feed and any other production input. Compounding this is the low palay prices that could be expected after harvesting, which keeps many farmers in a perpetual state of struggle and often in serious debt. According to International Rice Research Institute (IRRI), this scenario is alarming due to the fact farmers will have a low rice production.

Utilizing botanical ingredients as insecticides can effectively target and kill insects while being cheaper than synthetic alternatives (Ahmed, et al. 2021). A good alternative to these chemical-rich insecticides are acacia barks since acacia barks are rich in alkaloids (Colas, et al. 2014)

Alkaloids, a type of secondary metabolite found in plants, have significant effects on insects. They can serve as eco-friendly alternatives to synthetic insecticides, which pose environmental and human health risks. Alkaloids can disrupt insect cellular and physiological processes, leading to redox imbalances and hormonal regulation. (Fowsiya & Madhumitha. 2020)

Synthetic pesticides have been shown to harm a broad spectrum of non- target species, which in turn contributes to a global decline in biodiversity. This unintended impact can disrupt ecosystems and have long-lasting consequences for the environment. Having acacia bark as an alternative is a safer method for pest control. Unlike synthetic pesticides, Acacia bark offers a more targeted and environmentally friendly approach. (Wan. 2023)

Numerous articles have been written about the growth of acacia bark extract as insect repellent. The majority of this literature used Acacia bark (Calapati. 2019;Perumal. 2023) According to Yingprasert & Cherdchim (2021), the bark extract appeared to be toxic to termites (*Coptotermes gostroi*) that consumed impregment wood.

However, there are no published literature showing the effectiveness of Acacia bark extract in killing the Rice Earhead bug in rice field farms without affecting the rice plantation. Therefore, this study seek to confirm its effectiveness.

This study aims to determine the effectiveness of the Acacia bark extract to produce an organic insecticide on the mortality rate of the Rice Earhead bug that is affecting agricultural crops and farmers.

This study investigates the effectiveness of acacia bark extract as an insecticide against the rice earhead bugs. It aims to understand how this natural extract can potentially reduce the mortality rate of rice earhead bugs population, that is crucial for the filipino farmers as these pest can destroy and harm the rice crops. This knowledge is efficient, safe, and low-cost pest control strategies that are needed to reduce the reliance of farmers on pesticides and to improve agricultural production and food security for smallholder farmers in the Philippines. If successful, this research could provide an eco-friendly alternative to chemical insecticide, potentially can lead to increase the rice production and economic benefits to the Filipino farmers.

A. Questions or problems being addressed

This study aims to assess the efficacy of acacia bark extract in increasing the mortality rate of rice earhead bugs and enhancing rice production among Filipino farmers. Specifically, it will seek answers the following questions:

1. Which treatment of acacia bark extract is more effective in managing rice earhead bugs and affecting the physical properties of rice crops?

1. T1 (extract obtained through decoction)

2. T2 (extract obtained through maceration)

2. What is the effect of T1 and T2 acacia bark extract in physical properties of rice crops.

3. rice flowering development
4. rice grains
5. rice stem

3. What is the level of effectiveness of T1 and T2 acacia bark extract on rice earhead bugs in terms of:

1. Mortality rate
2. Number of hours it takes effect

B. Engineering goals, expected outcomes and hypothesis

Engineering goals:

This study aims to produce an organic insecticide that will benefit organic agricultural farming in support to R.A. 10068 known as Organic Agricultural Act of 2010. This legislation, enacted in the Philippines, promotes the adoption of organic farming methods and sets standards for organic production. By creating an organic insecticide, the study seeks to address the challenges faced by organic farmers in effectively managing pest infestations without resorting to synthetic chemicals. Organic farmers prioritize environmentally friendly and sustainable practices, and the development of an organic insecticide aligns with their commitment to using natural substances for pest control.

The production of an organic insecticide has significant implications for organic agricultural farming. Pest management is a critical aspect of crop production, as insects can cause substantial damage and reduce yields. However, conventional pesticides often contain synthetic chemicals that may have harmful effects on human health and the environment. By developing an organic insecticide, the study aims to provide organic farmers with an effective and sustainable alternative. This organic insecticide would be derived from natural sources, minimizing the potential negative impacts on ecosystems and human health while still offering effective pest control measures for organic crops. Ultimately, the study seeks to support the principles of organic farming outlined in R.A. 10068 and contribute to the growth and development of sustainable agriculture practices.

Expected outcome:

Develop organic insecticide (*Acacia bark extract*) for rice earhead bug that will benefit Filipino farmers.

Null:

H_O: There is no significant difference among the two treatments (T1 and T2) and their respective replications (R1, R2, R3) regarding the mortality rate of rice earhead bugs and their impact on rice production among Filipino farmers.

Alternative:

H_A: There is a significant difference among the two treatments (T1 and T2) and their respective replications (R1, R2, R3) regarding the mortality rate of rice earhead bugs and their impact on rice production among Filipino farmers.

OBJECTIVES

More specifically, this study aims to:

1. Determine which treatment of Acacia bark extract is more effective in managing rice earhead bugs and affecting the physical properties of rice crops:

a. T1 (extract obtained through decoction)

b. T2 (extract obtained through maceration)

2. Determine the effect of Acacia bark extract in physical properties of rice in terms of:

    a. rice flowering

    b. rice grains

    c. rice stem

3. Determine the level of effectiveness of Acacia bark extract on rice earhead bug in terms of the following:

    a. mortality rate

    b. number of hours it takes effect

METHODOLOGY

Research Design

This study used the experimental method of research in determining the mortality rate, number of hours that will take effect the organic insecticide (*Acacia bark extract*) in rice earhead bug and the impact on rice production to Filipino farmers.

It was laid out in Randomized Complete Block Design wherein the two (2) treatments with three (3) replications was compared with same length of time.

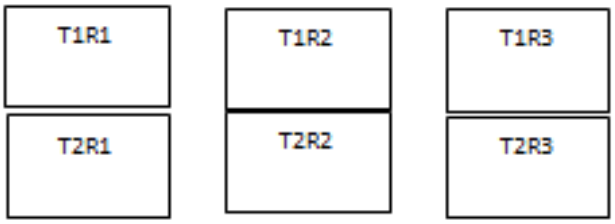

Figure 1: Experimental Lay-out

Wherein:

(T1) – Treated with Acacia bark extract (*thru acacia bark boiled in potable water for an hour*)

(T2) – Treated with Acacia bark extract (*thru acacia bark soaked in potable water for a 5*)

(R) – Replication of the Treatment(s)

Materials

The study utilized the following materials: 6 kilograms of acacia bark, 12 liters of potable water, 2 large pails, 2 large pots, 2 blocks of flowering rice, 90 rice earhead bugs, a stopwatch, 2 hand sprayers, 3 bundle of firewood, 1 weighing scale, 2 beakers, and 1 record book and pen.

Methods and Procedure

The following steps were followed by the researcher in conducting the experimentation procedure.

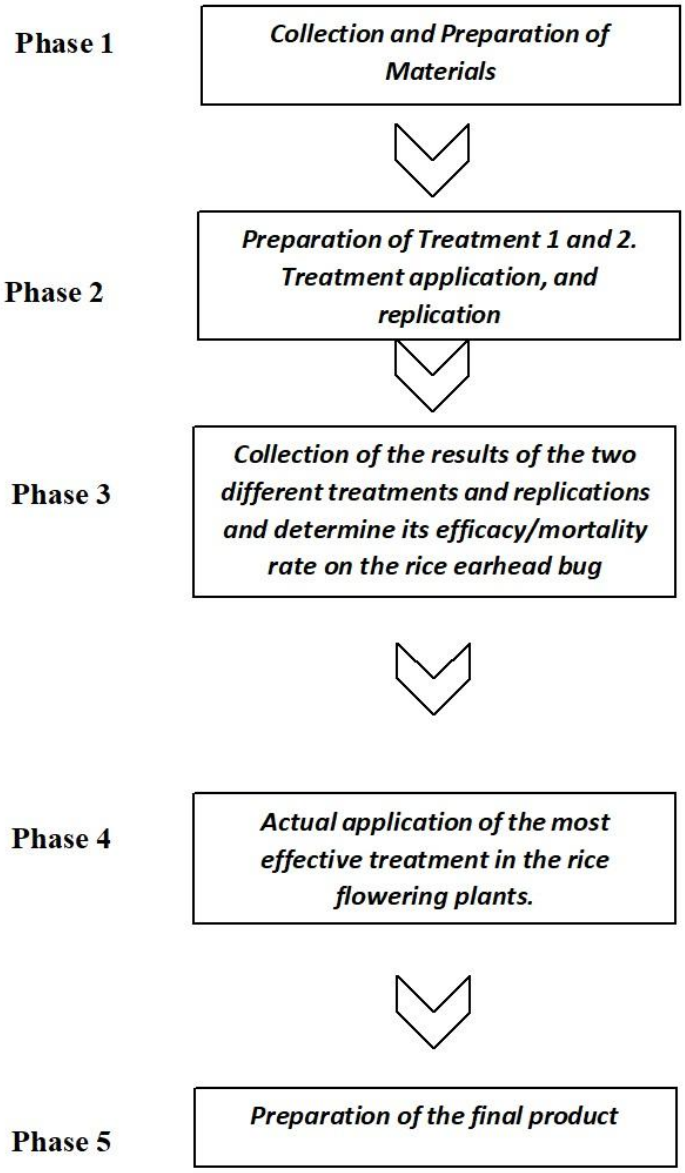

Figure 2*: Flowchart of Acacia bark extraction through the use of decoction and maceration as well as the application of the invented solution and the collection of data.*

PHASE I

Collection and preparation of materials

In Phase 1 of the research project, various materials were collected and prepared. The researcher gathered 6 kilograms of Acacia bark from Zone 4, Brgy. Ayugan, Ocampo, Camarines Sur (1 kilogram per treatment, with 2 treatments and 3 replications). Additionally, 12 liters of potable water were collected from Zone 3, Brgy. Pinit, Ocampo, Camarines Sur (2 kilograms were used per treatment, with 2 treatments and 3 replications). To contain the treatments, the researcher purchased 2 large pails from the Ocampo Public Market. A bundle of firewood was also acquired from the market to be used for boiling the Acacia bark. In order to boil and soak the bark, the researcher borrowed 2 large pots from Aguinillo's residence in Zone 3, Brgy. Pinit. 2 hand sprayers were purchased from the 101 Shopping Mall in Pili, Camarines Sur. The researcher provided a stopwatch or timer for measuring the length of time accurately. Furthermore, 90 specimens of rice earhead bugs were collected from Zone 1, Brgy. Pinit (15 specimens per treatment with 2 treatments and 3 replications). Finally, a block of flowering rice was borrowed from a local farmer in Brgy. Pinit for the application of the most effective treatment. These materials were essential for the subsequent phases of the research project.

PHASE II

Preparation of Treatment 1 and 2. Treatment application and replication

In Phase II, Treatment 1 and 2 were prepared and applied as follows. The researcher chopped 2 kilograms of Acacia bark into medium-sized pieces, using a knife. Then, a large pot was prepared with 2 liters of potable water for boiling the Acacia bark. 1 kilogram of chopped bark was added to the pot along with 2 kilograms of water and boiled for a duration of 1 hour for Treatment 1. After the boiling process, the mixture was allowed to cool, and the treatment was transferred into a hand sprayer. For Treatment 2, another 1 kilogram of chopped bark was soaked in 2 kilograms of water in a large pail for 5 days before being transferred to a hand sprayer. 15 rice earhead bugs were placed in large net containers. The researcher then proceeded to spray the rice earhead bugs with Treatments 1 and 2 using the hand sprayer, while simultaneously starting the timer. The behavior and effects of the treatment on the bugs were observed, and the length of time it took for any noticeable effects to occur was recorded in the researcher's record book. For treatment replications, 2 more replications of T1 and T2 were conducted. Replication 2 included the preparation and application of T1 and T2. Replication 3 also included the preparation and application of T1 and T2. The behavior and effects of the treatment on the bugs were observed, and the length of time it took for any noticeable effects to occur in each treatment of each replication was recorded in the researcher's record book.

PHASE III

Collection of the results of the three different treatments and replications and determine its efficacy/mortality rate on the rice earhead bug

1. Compile the results of the two different treatments and its three respective
2. Create a table that will show the results of the two different treatments and its three respective replications.
3. Analyze the results of the two different treatments and its three respective replications and generate a conclusion.

PHASE IV

Actual application of the most effective treatment in the rice flowering plants

The researchers visited Aguinillo's rice field located in Zone 1, Brgy. Pinit, Ocampo, Camarines Sur. They requested permission from the rice field owner to conduct an experiment on at least one small block of their rice flowering plants. During an interview with the farm owner, it was revealed that the most effective application of insecticides was in the early morning and late afternoon when the rice earhead bug, locally known as Tayangaw, was present in the field. The necessary materials for the treatment application were prepared, including a hand sprayer and the treatment solution. One of the researchers recorded the current status of the rice flowering plants in a record book before the treatment was applied. This included observations of the leaves' color, the presence of flowers, the condition of the grains, and the stems. Additionally, the presence and count of pests were recorded. After noting the data, the other researcher proceeded to spray the treatment. Over the course of a week, the researchers revisited the rice plants five times to reapply the treatment and observe the mortality rate of the rice earhead bugs or Tayangaw.

PHASE V

Preparation of the final product

The researchers analyzed the recorded information, including the changes in leaves' color, flower presence, grain condition, stem health, and pest count. The mortality rate of the rice earhead bugs was calculated based on the observations over the week. A detailed written report was prepared, outlining the methodology, results, and conclusions drawn from the experiment. Recommendations for the application of the most effective treatment in rice flowering plants were highlighted, considering factors such as time of day and frequency.

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RESULTS

Which treatment of acacia bark extract is more effective in managing rice earhead bugs and affecting the physical properties of rice crops?

1.

    1. *T1 (extract obtained through decoction)*
    2. *T2 (extract obtained through maceration)*

In the first replication of Treatment 1, 1 Tayangaw died in the first hour, and this number stayed the same in the second hour. By the third hour, 3 Tayangaws had died, followed by 4 in the fourth hour and 5 in the fifth hour. The number spiked to 10 by the sixth hour and further increased to 15 by the seventh hour, remaining the same until the eighth hour.

In the second replication of Treatment 1, the number of deaths followed a similar pattern to Replicate 1. Only 1 Tayangaw died in the first hour, and 2 in the second hour. By the third hour, 3 Tayangaws had died, followed by 4 in the fourth hour and 5 in the fifth hour. The number increased to 10 by the sixth hour, and by the seventh hour, it reached 14, finally reaching 15 by the eighth hour.

In the third replication of Treatment 1. Similar to the other replicates, 1 Tayangaw died in the first hour, followed by 2 in the second hour and 3 in the third hour. The trend continued with 4 deaths in the fourth hour and 5 in the fifth hour. However, in this replicate, only 9 Tayangaws died by the sixth hour. By the seventh hour, the number increased to 15, remaining constant until the eighth hour.

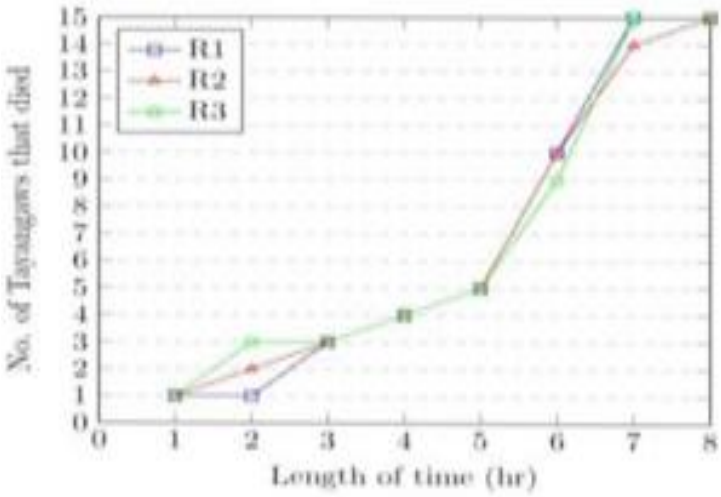

Figure 3*: Data collected during T1 and its replicates R1, R2, R3*

What is the effect of T1 and T2 acacia bark extract in physical properties of rice crops.

1. *Rice flowering development*
2. *Rice grains*
3. *Rice stem*

In the first replication of Treatment 2, the number of deaths increases over time. At 1 hour, there are no deaths. By 2 hours, the number rises to 1. At 3 hours, it reaches 2 and stays the same at 4 hours. The deaths increase to 3 at 5 hours and then to 5 at 6 hours. By 7 hours, the number of deaths is 7. This continues to rise to 10 at 8 hours, 11 at 9 hours, and 12 at 10 hours. At 11 and 12 hours, the number of deaths is 13. The deaths then increase to 14 by 13 hours and stay the same at 14 hours. By 15 hours, the number of deaths reaches 15.

In the second replication of Treatment 2, the number of deaths starts at 1 at 1 hour and stays the same at 2 hours. By 3 hours, the deaths rise to 2 and remain at 2 at 4 hours. At 5 hours, the deaths increase to 3 and then to 4 at 6 hours. By 7 hours, the number of deaths jumps to 7. At 8 hours, the deaths increase to 10 and stay the same at 9 hours. By 10 hours, the deaths rise to 12 and stay the same at 11 hours. At 12 and 13 hours, the number of deaths is 13. By 14 hours, the deaths rise to 14 and finally reach 15 by 15 hours.

In the third replication of Treatment 2, the number of deaths is 1 at 1 hour and remains the same at 2 hours. By 3 hours, the deaths rise to 2 and stay the same at 4 hours. At 5 hours, the deaths increase to 3 and then to 5 at 6 hours. By 7 hours, the number of deaths rises to 6. At 8 hours, the deaths increase to 9 and then to 11 at 9 hours. By 10 hours, the deaths rise to 12 and stay the same at 11 hours. At 12 and 13 hours, the number of deaths is 13. By 14 hours, the deaths rise to 14 and finally reach 15 by 15 hours.

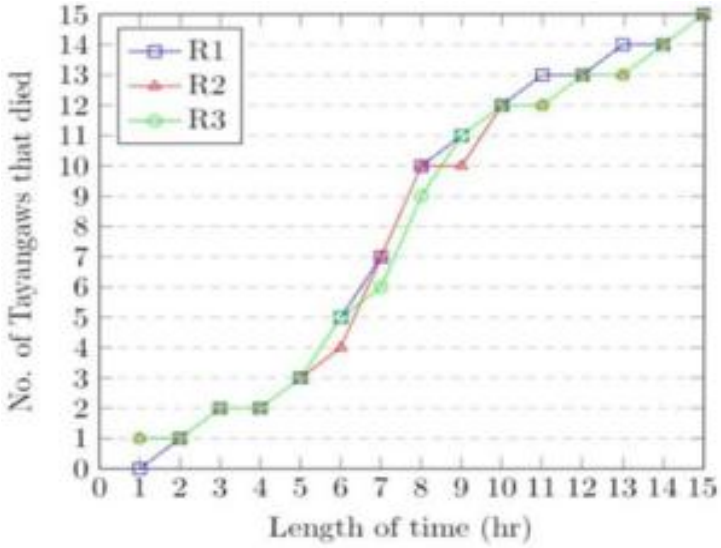

Figure 4: *Data collected during T2 and its replicates R1, R2, R3*

What is the level of effectiveness of T1 and T2 acacia bark extract on rice earhead bugs in terms of:

1. *Mortality rate*
2. *Number of hours it takes effect*

In the application of Treatment 1 on rice crops, it showed low or ineffective results in the physical properties of rice crops regarding its rice flowering development, rice

grain, and rice stem. In the application of Treatment 2 on rice crops, it showed high or very effective in the physical properties of rice crops regarding its rice flowering development, rice grains, and rice stem. In the rice crops with no application of either treatments, it was shown to be very high or extremely effective on the physical properties of rice crops regarding its rice flowering development, rice grains, and rice stem.

PHYSICAL PROPERTIES OF RICE CROPS	**T1**	**T2**	**NO TREATMENT**
a. rice flowering development	4	2	1
b. rice grains	4	2	1
c. rice stem	4	2	1

Figure 5: *Data collected during application of T1 and T2 and their respective replicates on rice crops*

Scale:

5 - Very low or extremely ineffective

4 - Low or ineffective

3 - Medium or moderately ineffective

2 - High or very effective

1 - Very high or extremely effective

DISCUSSION

Which treatment of acacia bark extract is more effective in managing rice earhead bugs and affecting the physical properties of rice crops?

T1 (extract obtained through decoction)

T2 (extract obtained through maceration)

Based on findings, Treatment 1 acacia bark extract obtained through decoction is more effective in terms of rapid action and immediate reduction of pest populations. This treatment is ideal for quick mitigation and protection of rice crops during critical growth stages, thereby potentially preserving the physical properties and yield of the crops.

The findings says that Treatment 2 acacia bark extract obtained through maceration, acts more slowly and is better suited for scenarios requiring prolonged pest control. However, the delayed action may result in more extended periods of pest damage, which could negatively impact crop quality and yield if not managed in conjunction with other pest control strategies.

Overall, the choice between T1 and T2 treatments depends on the specific pest management needs and the critical timing of pest infestations in the rice cultivation cycle. This study is supported by Vingprasent et al. (2021) it says that the bark extract appeared to be toxic in termites. This study is similar to the studies of Permural et al. (2023) and Calapati (2019) which stated that acacia bark extract has high impact on killing termites.

The study reveals that T1 acacia bark extract is more effective in terms of rapid mortality, achieving full effect within 7 to 8 hours. In contrast, T2 acacia bark extract, while ultimately achieving the same level of mortality, does so over a longer period 15 hours. Depending on the specific agricultural requirements, either treatment can be selected for optimal pest control. Further research could explore the long-term effects and potential environmental impact of these treatments to fully assess their suitability for large-scale agricultural use. This study is supported by Colas et.al (2014) it says that results proved that the extract from acacia bark is effective against rice black bug this study is similar to the study of Merro (2019), Cabasan et.al (2019), Mohammed Elhang et.al (2020) and Kabbashi et.al (2016).

What is the effect of Treatment 1 acacia bark extract in physical properties of rice crops?

1. Rice flowering development
2. Rice grains
3. Rice stem

Based on the data in Figure 5, it was found out that the treatment 1 has low or ineffective effect on physical properties of rice crops. According to Oerke (2006), crops grown for human consumption is at risk due to

incidence of pests. Crop losses due to these harmful pests can be substantial and may be prevented, or reduced, by crop protection measures. The researchers made an extract of acacia bark that might protect crops from these pests, specifically insects. Another study formulated by Chowański et al. (2014), states that synthetic insecticides are very efficient in insect control but can be harmful for the environment and health. The extract of acacia bark that researchers created might be efficient to reduce the farmers' usage of synthetic insecticides. This study is also supported by Khatun et al. (2011), outlining the efficacy of acacia bark extract might be useful as pests control agents and can minimize the severe damage caused by insect pests.

What is the level of effectiveness of Treatment 1 and Treatment 2 acacia bark extract on rice earhead bugs in terms of:

1. mortality rate

2. number of hours it takes effect

1. The findings indicates that both treatment 1 and treatment 2 are effective in killing the Tayangaw, but they differ significantly in their rates of mortality and the time required to reach full effect. This shows that treatment1 results in a rapid increase in mortality within the first 7 to 8 hours. By the 7 hour, all replicates reached or were close to maximum mortality 15 deaths. Treatment2 shows a more gradual increase in mortality over 15 hours. The maximum mortality 15 deaths is consistently reached by the 15 hour across all replicates. This study is supported by kabbashi et.al (2016) it says that a acacia bark exhibit 100% mortality, this satudy is similar to the studies of Cabasan al (2019) and Elhang E. et.al (2020).

2. Treatment 1 exhibits rapid action with significant mortality rates observed as early as the 3 All replicates achieve maximum mortality by the 7 or 8 hour. Treatment2 shows a slower, steady increase in mortality. It takes up to 15 hours to reach maximum mortality, indicating a more prolonged period of activity compared to treatment1. Both treatments are effective in achieving 100% mortality, but treatment1 consistently reaches this outcome faster. This study is supported by Colas et.al (2014) it says that results proved that the extract from acacia bark is effective against rice black bug, this study is similar to the study of Merro I. (2019).

CONCLUSION AND RECOMMENDATION

Based on the research findings, it is suggested that acacia bark extract can be utilized as an effective organic pesticide. Incorporating these alternative materials promotes the use of organic substances in pesticide production.

The research findings align with existing literature, supporting the effectiveness of acacia bark extract in enhancing the pesticidal properties. These findings contribute to the growing body of knowledge on sustainable and eco- friendly alternatives, furthering the development of environmentally friendly organic pesticides.

It is recommended to add a few drops of essential oil, such as lavender or citrus, which have natural deodorizing properties, to lessen the unpleasant odor of the acacia bark extract. This not only enhances its insecticidal properties but also offers synergistic effects. Additionally, storing the extract in a sealed container and keeping it in a cool, dark place can help prevent the development of odors over time.

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