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Toxicity Test of Shallot Skin Extract (Allium ascalonicum) on Mortality of Leaf Roller Caterpillar (Spoladea recurvalis)

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Abstract: Pests are creatures that destroy crops and, in general, hurt farmers financially. The leaf roller caterpillar is one of the pests that can result in crop loss in horticultural crops, particularly spinach. Vegetable pesticides, including shallot skin extract, can effectively and sustainably control the pest leaf roller caterpillars. This study sought to ascertain the impact of shallot skin extract on leaf roller caterpillar mortality after 48 hours of treatment. The experimental study design with a completely randomized design (CRD), 7 treatments, 4 replications, and a total of 28 treatments was employed. P0 (negative control), P1 (10,000 ppm), P2 (20,000 ppm), P3 (30,000 ppm), P4 (40,000 ppm), P5 (50,000 ppm), and P6 (500 ppm decis/positive control) were the treatments employed. 280 leaf roller caterpillars served as the test subjects. The study's findings after 48 hours of observation under the P5 treatment indicated that shallot skin extract had a fatality rate of 100%, killing 40 test animals. The study's finding is that shallot skin extract significantly affects how many leaf roller caterpillars die.

Keywords: Leaf roller caterpillars; Mortality; Toxicity

Introduction

More than 20,000 species have been identified in Indonesia, a tropical nation that makes up around 25% of all flowering plant species in the globe. In Indonesia, a wide variety of plants are grown; however, it is impossible to separate plant pests from the planting process (Adnan et al., 2022). However, Indonesia uses a lot of pesticides because it is an agricultural nation. In Indonesia, both the number of registered pesticides and their commerce are rising. Furthermore, Indonesia uses pesticides not only during planting but also during storage after harvest (Pitoi et al., 2022).

The majority of Indonesia's population derives a significant portion of their income from the agricultural sector, but efforts to achieve optimal agricultural production are still hindered by a number of limiting factors, such as water scarcity, climate change, and plant pests and diseases (Dewi et al., 2022). When growing vegetables, diseases and pests are significant considerations since they not only impact the crops' development and look but also their production and quality (Wang et al., 2022) Farmers are increasingly dependent on fertilizers and chemical drugs so that production costs increase from year to year (Ngawit et al., 2021).

Vegetable production and consumption have the potential to provide cash and jobs in poor nations. According to Ngungi et al. (2022), vegetables are primarily used as a source of nutrients, antioxidants, minerals, and dietary fiber. According to Ugwu et al. (2022), amaranth often has a high number of minerals, including calcium, magnesium, iron, vitamin C, and other critical elements like gluten-free carbohydrates, that are needed for optimum health. The most widely consumed leafy vegetable, amaranth, was found to contain pesticide residues in market samples. It is attacked by a variety of insect and non-insect pests, although important insect pests including Spoladea recurvalis (F.) (Beet webworm), Spodoptera littoralis (Boisduval) (cotton leafworm), and Hypolixus sp. (F.) (amaranth stem weevils) have been observed to reduce its productivity (Maloth, 2023).

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Spoladea recurvalis (Lepidoptera: Crambidae) larvae can completely obliterate an amaranth plant's leaves during extreme outbreaks. The majority of farmers heavily rely on chemical pesticides to combat amaranth bugs (Opisa et al., 2020). An eco-friendly technique for eradicating plant pests and illnesses is essential due to the various drawbacks of using synthetic pesticides, such as ecosystem imbalances and environmental deterioration that might lead to human poisoning (Salamiah & Orbani, 2022).

A horticultural product from the family of spicy vegetables, shallots. When it comes to cooking, red onions are a staple ingredient with a high economic wort (Warman et al., 2022). With a wide range of plant species that contain chemical compounds (phytochemicals) like alkaloids, tannins, flavonoids, phenolics, saponins, and steroids that can affect the development process and are toxic to insect pests, Indonesia has a tremendous amount of potential for the development of natural pesticides (Syarifuddin et al., 2022). After the tomato, onions are the second-most significant vegetable crop in the world. As a result, a lot of onion waste, including onion peel, is created, which has an adverse effect on the environment. Red onion skin may be used in the right ways to create value-added goods since it contains bioactive chemicals, including phenolics and flavonoids (Chadorshabi et al., 2022).

Red onion skin extract has been widely utilized for adsorption and extraction investigations as an agricultural waste (Chukwu unce john cu). Quercetin and its glycosylated derivatives, which make up the majority of the flavonoids in onions, are concentrated in the outer layer of the bulb. As a result, anthocyanins, particularly cyanidin derivatives, are widely distributed throughout the red onion's exterior layer, with about 60% of them concentrated in the skin (Stoica et al., 2022). Particularly when used as a cooking spice, shallots generate a lot of skin waste (Banu, 2020). In Indonesia, shallot consumption is currently rising along with the country's population growth (Basri, 2022).

In addition to saponins, tannins, glycosides, and anthraquinones, larvicidal flavonoid compounds identified in shallot skin (Allium cepa L.) include polyphenols, sesquiterpenoids, monoterpenoids, steroids, triterpenoids, acetogenins, and quinones. This chemical, which is also present in the leaves, can reportedly act naturally as a larvicide (Dewiyani et al., 2022).

Method

The study was carried out between January and July of 2022. The village of Prov. Aceh served as the site of this study. At the Pharmaceutical Laboratory of the Faculty of Mathematics and Natural Sciences (MIPA) of Syiah Kuala University, a rotary evaporator was used to remove the skin of a shallot.

A total of 280 leaf of roller caterpillars in the third instar served as the study's subject. The spinach plantation in Niron Village provided the Spoladea recurvalis eggs that were used to reproduce the leaf roller caterpillar. Also, the eggs are kept in a jar until they develop into larvae, which are distinguished by a green to gray tint. After that, it is raised until it develops into a larva and then a moth. The moths are raised until they develop into eggs, after which they develop into larvae until they reach the third instar. The spinach leaves that are given to the larvae are changed daily.

The leaf roller caterpillars were acclimated, extracts were created, and extract treatments were administered to the test animals.

Result and Discussion

Leafroller Caterpillar Mortality Rate

The effects of each treatment on the mortality of leaf roller caterpillars that had been monitored for 48 hours varied as a consequence of the toxicity test of shallot skin extract. There were no dead leaf of roller caterpillar larvae at a concentration of 0 ppm, which was the concentration at which the number of dead leaf roller caterpillars was calculated. At doses of 10,000 ppm, 20,000 ppm, 30,000 ppm, 40,000 ppm, 50,000 ppm, and 500 ppm (positive control/applied pesticides), the leaf roller caterpillar larvae started to die. The injection of shallot skin extract resulted in the death of 16 test animals with a mortality rate of 40% at a dose of 10,000 ppm (P1). At a concentration of 20,000 ppm (P2), 20 test animals died with a mortality rate of 50%.

The outcomes of the shallot skin extract toxicity test on the mortality of leaf roller caterpillars after 48 hours of observation had various impacts on each treatment. The quantity of dead leaf roller caterpillars was determined by the amount of shallot skin extract present; at a concentration of 0 ppm, none were present. Leaf roller caterpillar larvae started to die at doses of 10,000 ppm, 20,000 ppm, 30,000 ppm, 40,000 ppm, 50,000 ppm, and 500 ppm (applied pesticides/positive control). When shallot skin extract was administered to test animals, 16 of them died, representing a 40% mortality rate, at a dose of 10,000 ppm (P1). This can be seen in Figure 1.

The data obtained from the research results cannot be directly used for analysis of variance data, this is because they do not contribute normally. One of the causes is the existence of data containing zeros (0) in the negative control (P0), so that the data in Table 1 must be transformed into a square root. To see the effect of giving

shallot skin extract on the mortality of leaf roller caterpillars in each treatment, an analysis of variance (ANOVA) was carried out which can be seen in Table 1.

According to the findings of statistical analysis using analysis of variance (ANOVA), the mortality of leaf roller caterpillars was considerably affected differently by shallot skin extract (Allium ascalonicum) (Spoladea recurvalis). 2.57. Utilizing = 0.05. Afterwards, further tests are conducted to ensure if there is a true difference. In order to conduct more tests, it is determined that the coefficient of variation has been calculated to be 35% (big CC). The Duncan's Multiple Range Test (DMRT) is the next test employed, and it is shown in Table 2. P2, P3, P4, P5, P6, and P7 were the Duncan's Multiple Range Test (DMRT) findings that were achieved at a significant level. This is seen in Table 2. DMRT the mortality impact of administering shallot skin extract.

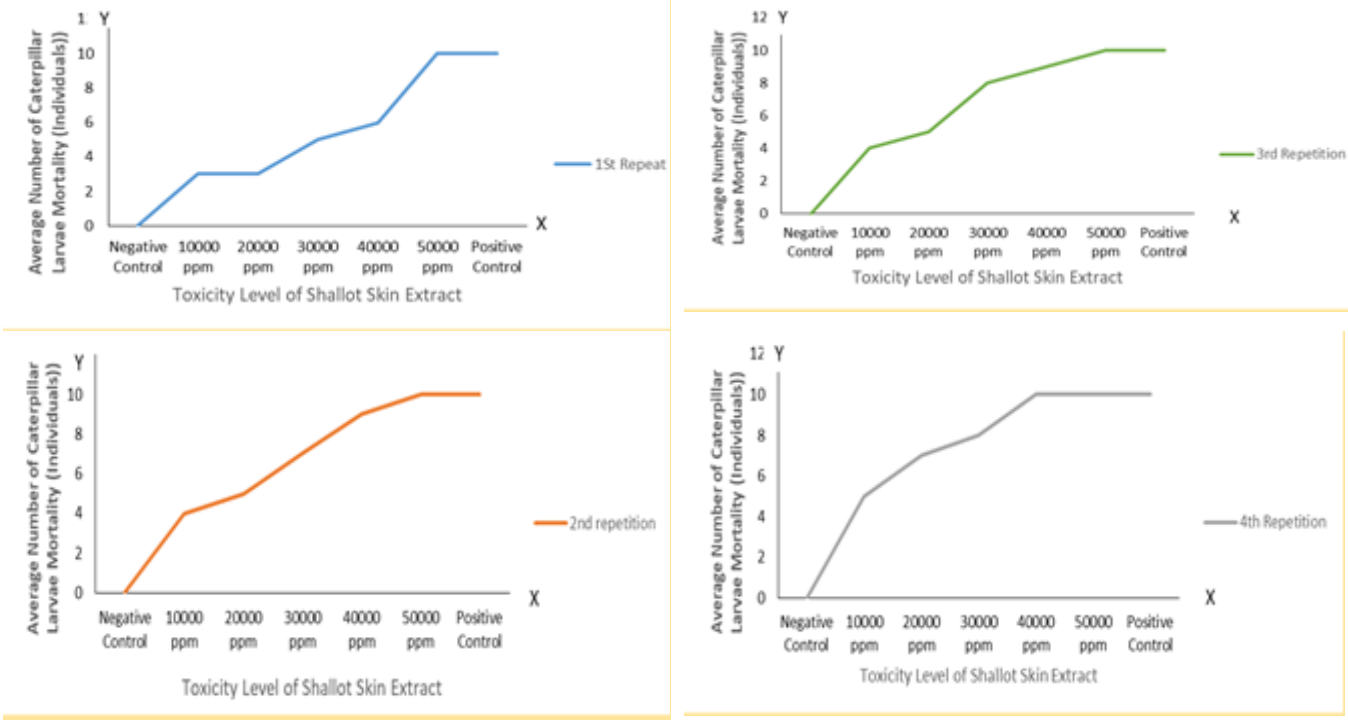

Figure 1. Average total mortality of leaf roller caterpillar (*Spoladea recurvalis*) based on the concentration of shallot skin extract (allium ascalonicum)

Table 1. Analysis of Death Variants of Gold Leaf Roller Caterpillars for 48 Hours

SD	DF	SS	MS	F Count	F Table (0.05)
Treatment	6	19.05	3.17	79.25*	2.57
Galat	21	0.98	0.04		
Total	27	20.03			

*Real Different

Table 2. DMRT test results on mortality

Treatment	Average	Real difference in treatment distance						C
		2	3	4	5	6	7	
PO	0.71							a
P1	2.11	1.4*						b
P2	2.32	0.21	1.61*					c
P3	2.72	0.4	0.61	2.01*				d
P4	2.98	0.26	0.66	0.87	2.27*			e
P5	3.24	0.26	0.52	0.92	1.13	2.53*		f
P6	3.24	0ns	0.26	0.52	0.92	1.13	2.53*	g

Note: Numbers followed by letters and in the same column are not significantly different at the 0.05 test level. C : Code

Table 2 demonstrates that the P6 positive control (pesticide/synthetic medication) level, which was the same as P5, had the maximum mortality of leaf roller caterpillars (extract concentration 50,000 ppm). P4 (40,000 ppm), P3 (30,000 ppm), P2 (20,000 ppm), and P1 are the next levels (10,000 ppm). There was no mortality of leaf roller caterpillars at P0 (negative control/ without extracts). According to the findings of the probit study, the calculated level of shallot skin extract that would result in 50% mortality (LC_{50}) was 26,831.50 ppm. The P3 therapy specifically allows for the use of a concentration of 30,000 ppm shallot skin extract.

Discussion

Based on the study's findings and an examination of the data collected, it was determined that the leaf roller caterpillars died completely at a concentration of 50,000 parts per million (ppm) (P5) and at a concentration of 500 ppm decisively in treatment P6

(Positive Control). Death was not reported for treatment P0 (the negative control). The complete mortality of the leaf roller caterpillars occurred at a concentration of 50,000 ppm.

Figure 2. Preparation of shallot skin extract

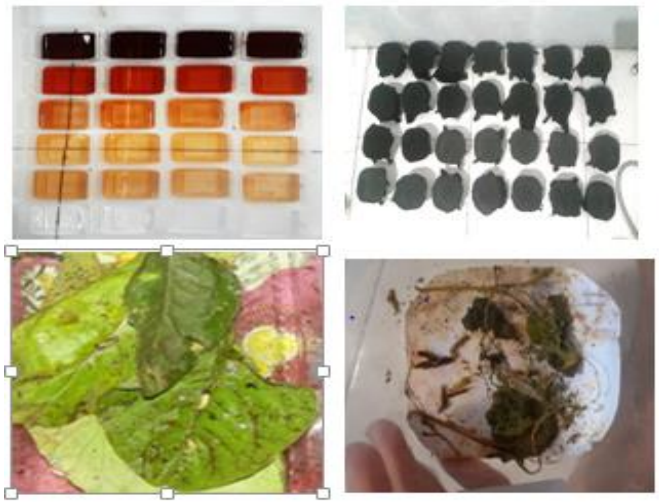

Figure 3. Application of shallot skin extract on Spoladea recurvalis

This is because the shallot skin extract contains secondary metabolite components in the form of flavonoids, alkaloids, and safonins, which can kill insect pests. Insects cannot consume so-called flavonoids. Flavonoids have the ability to limit both growth and respiration. The skin mucosa will suffer damage if the actions of the flavonoids in the caterpillar's body come into contact with the skin. The toxic properties of bandotan leaf extract are due to the flavonoids, which have the ability to kill larvae (Krisna et al., 2022).

The dose of the extract used directly correlates with the effect of shallot skin extract on leaf roller caterpillar mortality (Figure 1). Higher extract concentrations will enable the production of more toxins, which might lead to a high mortality rate for insect pests (Gunawan, 2021). Various doses of shallot skin extract were administered to leaf roller caterpillars for 48 hours; all treatments caused fatalities. Explains that the killing power for killing larvae is higher as the dose increases are exactly proportionate to the increase in the hazardous substance. Claimed that the land had not been used Compared to land that is not applied, the level of attack keeps rising (Wahyu, 2023).

In order to be employed for more ecologically friendly agricultural pest management, the chemical components found in shallot skins actively contribute to pest control. Furthermore, shallot skin is a natural insecticide that is safe to use on plants, reducing the need for synthetic pesticides that can harm the environment. There are other reports of this compound's toxicity. Diallyl disulfide, diallyl trisulfide, diallyl sulfide, and dipropyl disulfide are among the primary chemical constituents of the Allium species (Bastaki et al., 2021). Apart from that, the growth regulator contained in shallot skin has a similar role to Indole Acetic acid (Yusmar et al., 2022)

Mechanism of Toxicity Content in Shallot Skin

Shallot skin (Allium cepa) includes larvicidal flavonoid chemicals, alkaloids, polyphenols, sesquiterpenoids, monoterpenoids, steroids, triterpenoids, acetogenins, and quinones. The chemicals in the shallot skin extract can harm the stomachs of leaf roller caterpillars if they swallow it. Leaf roller caterpillars may perish if shallot skin extract is administered directly. Onion peel contains acetogenin compounds. Low doses of this compound have the potential to be stomach toxic, which will kill insect pests. Insect pests that consume leaves containing small levels of acetogenin compounds experience disrupted digestion, damage to their digestive organs, and ultimately death (Ridhwan et al., 2022).

Because the acetogenin compounds in shallot skin can prevent electron transfer in the respiratory system of insect pest cells, insect pests cannot get the nutrients their bodies need from food. Insect pests are therefore akin to people who do not eat anything since the nutrients in the leaves they ingest cannot be distributed throughout their bodies, despite the fact that they consume leaves that have been contaminated with squamosin. Pest insects will slowly disappear (Mulyati, 2020). Apart from flavonoids and alkaloids, tannins are also capable of causing damage to the structure of cells (Gerrine et al., 2023).

The quantities of secondary metabolite components that are harmful to pests (flavonoids, alkaloids, tannins, triterpenoids, and saponins) will also be greater due to the performance effect of kirinyuh leaf extract, according to other studies. Circulation and air temperature in the application media, which is bad since it uses plastic as a

material cover, are other elements that further speed up larval death (Daun, 2023). Vegetable pesticides are pesticides made from natural plant ingredients that are easy to obtain and easily decompose internally so they do not cause environmental pollution. (Adibah, 2023). The use of this botanical insecticide has a relatively small impact on the environment compared to the use of chemical insecticides. Therefore it is very necessary to control methods that are environmentally friendly, safe for users and consumers (Gusti, 2023).

Conclusion

The outcomes demonstrated that administering shallot skin extract had an impact on leaf roller caterpillar deaths. In order for the research's results to be applied as a different way to manage leaf roller caterpillar pests utilizing vegetable pesticides. Vegetable insecticides provide a number of benefits, including minimal persistence so that residues are rapidly broken down in nature, relative safety and the ability to prevent the emergence of pest resistance, and great selectivity so that they are harmless to species other than their intended targets.

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Author Contributions
The authors in this journal conducted the research, prepared tools and materials, and processed data in the research process.

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Conflicts of Interest
This research was conducted to use shallot skin as a vegetable insecticide to eradicate leafroller caterpillar pests.

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