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RESEARCH ARTICLE

Investigation of *coccinia grandis* leaf extract and its efficacy against stored grain pests

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Abstract

Significant postharvest losses from stored grain pests emphasize the need for sustainable control methods, with Telakucha (*Coccinia grandis*) leaf extract showing promise as a natural, eco-friendly pesticide due to its allelopathic effects. The aims of this study are to assess the mortality response of rice weevils (*Sitophilus oryzae*), Red Flour Beetles (*Tribolium castaneum*), and pulse beetles (*Callosobruchus chinensis*) influenced by the 100, 70, and 50% methalonic leaf extract of Telakucha (*Coccina grandis*). Telakucha leaf extracts mixed with three concentrations of grain weight, viz., dose-1 (10% of grain weight, 2 ml), dose-2 (7.5% of grain weight, 1.5 ml), and dose-3 (5% of grain weight, 1 ml). The result showed that the mortality percentage is higher in a 100% extract treatment than 70% and lower in a 50% extract. Rice weevil mortality at the dose-3 of 100% extract was lower than the other two pests. At 70% extract, the mortality rate of pulse beetles in dose-1 and dose-2 was lower than the other two insects, and the mortality rate of red flower beetles in dose-3 was found to be lower than the rest. In 50% extract, the mortality rate of rice weevil at doses 1, 2, and 3 was higher than that of red flower beetles and pulse beetles. This treatment had the best results on rice weevils and the least on red flower beetles. Here three dosages demonstrated no activity on the red flower beetle and pulse beetle. In the case of 10% dose exhibited the highest allelopathic effect of each pest, whereas 5% dose demonstrated the lowest allelopathic effect. The effectiveness of the leaf extract was found to increase proportionally with the increase in dosages. The Telakucha leaf extract result also showed that it was significantly higher than that of the control. Therefore, Telakucha leaf extract might be used for the effective and eco-friendly management of these three pests.

Keywords: *Coccina grandis*, Stored Grain Pests, Management Technology, Leaf Extract, Telakucha

1.Inroduction

Ivy gourd (*Coccinia grandis*), a perennial vine from the Cucurbitaceae family, offers a variety of agricultural and medicinal positive aspects. It is mostly grown for its tender fruits, which are commonly used in salads and culinary dishes. Though it originated in India, it thrives in tropical and subtropical regions, and the plant is valuable for nutritional purposes since it contains its rich supply of crucial minerals and vitamins, especially vitamin C, vitamin A, calcium, iron, potassium, and the B-complex vitamins (Deshwal *et al*., 2020; Laboni, *et al*., 2024). Ayurvedic and Unani practices, in particular, have widely used the roots, stems, and leaves of Coccinia grandis for medicinal purposes. The roots are recognized for their

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skin-healing, anti-inflammatory, and antidiabetic properties, while the leaves provide significant antibacterial properties (Said *et al*., 2015; Sawrab *et al*. 2025).

The vine's therapeutic value has been shown by its efficacy in alleviating a variety of health conditions, including diabetes, urinary tract infections, and joint pain, as well as research has found that aqueous extracts of *Coccinia grandis* contain more potent antibacterial characteristics than ethanol-based extracts, which further supports its potential in alternative medicine. In addition, the Cucurbitaceae family's extensive significance is underscored by the utilisation of other cucurbit species, including *Lagenaria siceraria*, *Trichosanthes cucumerina*, and *Benincasa hispida*, which are also plentiful in proteins and vitamin C (Khisa *et al*., 2025).

Postharvest losses due to insect infestations significantly impact global food security, particularly in developing countries, with losses reaching 15–20% of annual agricultural output (Parul *et al*., 2021). Insects cause both quantitative and qualitative damage to grains, reducing nutritional content by up to 25% and promoting harmful microbial growth, leading to health risks from mycotoxins like aflatoxins and ochratoxins (Maruf *et al*., 2024; Karim *et al*., 2024). Innovative solutions, such as hermetic storage systems, which reduce infestations by 95%, and integrated pest management (IPM), combining biopesticides and temperature control, have been shown to improve grain quality and reduce losses by up to 40% (Howlader *et al*., 2024; Hasan *et al*., 2025). Addressing these challenges is essential for enhancing global food security, especially in regions with inadequate infrastructure and storage technologies.

Chemical pesticides have been used since the 1950s to manage these pests, but excessive use has led to major problems, including pesticide resistance in insects, toxic residues in food, and environmental pollution, additionally, the widespread usage of synthetic pesticides causes concern regarding their long-term effects on the environment, human health, and food safety. Further, the prices associated with pesticide application have risen significantly, aggravated by their widespread use, particularly in developing countries where storage issues are rampant. Considering the detrimental impacts of synthetic chemicals, the need for alternative pest control strategies has grown increasingly critical. Researchers are investigating eco-friendly, cost-effective solutions like plant-based insecticidal extracts, baits, and attractants to control pests in stored grains. *Coccinia grandis* leaf extracts have demonstrated progress as a safe, natural alternative to synthetic pesticides. By adopting plant-based extracts, the grain storage industry might reduce environmental damage and mitigate health risks associated with chemical residues (Covele *et al*., 2020; Yesmin *et al*., 2024)).

Thus, ongoing investigations into eco-friendly pest control methods, notably those employing natural plant extracts like Coccinia grandis, might play an influential part in reducing post-harvest losses. These techniques offer a safer, more sustainable solution to the long-standing problem associated with pest infestations in stored agricultural products, helping preserve food quality and prevent significant losses in crop cultivation.

2. Materials and Methods

2.1 Experimental design

The IPM Laboratory of Entomology Department, Bangladesh Agricultural University (BAU), Mymensingh, conducted a study from September 2023 to April 2024 to evaluate indigenous plant Extract telakucha (*Coccinia grandis*) against Red Flour Beetle, rice weevil, and pulse beetle. Toxicity, mortality, and grain protectant properties of selected plant extracts were examined, and the investigation was followed by Completely Randomized Design (CRD) design.

Fresh *Telakucha* leaves were collected as a treatment from around the BAU Campus in Mymensingh. Once brought to the lab, the leaves were washed under running water. The plant material was then air-dried in the shade before being ground into a fine powder using a grinder.

Four treatments were applied, including a control, in an experiment where extract of *telakucha* was mixed with wheat flour, rice, and pulse seeds at concentrations of 5.0%, 7.5%, and 10% with three conditions (50%, 70% and 100% solution).

Each treatment, along with the control, was replicated three times. Leaf powder was used to prepare plant extracts by dissolving 10 grams in 100 ml of methanol and distilled water. The mixture was stirred for 15 minutes, left for 24 hours, and then stirred again. It was filtered through cloth and filter paper (Whatman No. 1), then stored in a sealed flask at room temperature. Extracts were prepared in 50% solution (50% water and 50% methanol), 70% solution (30% water and 70% methanol) and 100% solution (100% methanol).

Three concentrations of plant extracts (100%, 75%, 50%) were prepared with solvents, and 1.0 ml (5%), 1.5 ml (7.5%), and 2.0 ml (10%) as a treatment were applied to 20g of wheat flour, pulse seeds, and rice in Petri dishes using a micropipette. Ten insects per replication were treated, with each treatment replicated three times. A control group was treated with solvent only.

This study occurred with a major stored grain insect pest: the red flour betle (*Tribolium castaneum* Herbst), the rice weevil (*Sitophilus oryzae*), and the pulse beetle (*Callosobruchus chinensis*). It belongs to the order Coleoptera. The test insects *T. castaneum*, *Callosobruchus chinensis*, and *Sitophilus oryzae* were collected from Mymensingh and maintained in the Entomology Department lab at BAU. They were reared on wheat flour, pulse, and rice in jars at 27–30 °C and 70–75% RH. Ten pairs of adult insects were placed in each jar, with the jar mouth covered to prevent contamination. After 7 days, the adults were removed, and the jars were left for the life cycle to complete. The first generation emerged within 28 days and was used for the experiment.

2.2. Collecting data

Insect mortalities were recorded at 24, 48, and 72 hours after treatment (HAT). The data were corrected using Abbott's (1987) formula and then transformed into arcsine percentages. To measure Direct Mortality Tests, select a specific insect species, ensuring they are of similar age and health. Prepare various concentrations of the treatment, such as insecticides or plant extracts, along with a control group using a solvent only. Set up the experiment using Petri dishes, placing a predetermined amount of treatment solution in

Table 1.The treatments were applied accordingly.

Treatment	Concentration	Solution (%)	Ingredients
Control	-	-	Wheat flour, rice, pulse seeds
Treatment 1	5.0%	50%	Telakucha extract mixed with wheat flour, rice, pulse seeds
Treatment 2	7.5%	70%	Telakucha extract mixed with wheat flour, rice, pulse seeds
Treatment 3	10%	100%	Telakucha extract mixed with wheat flour, rice, pulse seeds

Figure 1: The investigation area of Bangladesh

Figure 2: Setup of this experiment

Figure 3: Preparing and Filtering on Plant extract

each dish that contains a standard amount of food (e.g., 20g of wheat flour, pulse seeds, or rice). Introduce a fixed number of insects (e.g., 10-20) into each treatment dish and monitor them for mortality at set intervals, such as 24-, 48-, and 72-hours post-treatment. Record the number of dead insects for each treatment and control group, calculating the percentage of mortality. Apply Abbott's formula to correct for control mortality and transform the data into arcsine percentages for analysis. Finally, analyze the data statistically to assess the significance of treatment effects and present the findings clearly, utilizing tables or graphs to illustrate the mortality rates across different concentrations and time intervals. Consistency in test conditions and proper replication will enhance the reliability of the results.

2.3. Statistically analysis

The research investigations were conducted in a highly randomized manner. The data were analyzed using the SPSS 29 statistics software, version 2022. Mean values are separated by the X-stat test at 5% and 1% probability to gauge the significance of individual treatment (Rahman et al., 2024).

3. Results

3.1. Mortality test of Rice weevil at 100% plant leaf extract

In comparison to the control, the number of adults mortality and the mean mortality percent response of the rice weevil at 100% plant leaf extract were significantly higher in all doses of 10% (2.0 ml), 7.5% (1.5 ml), and 5% (1.0 ml) of wheat flour, rice, and pulse seeds. It was observed that maximum numbers of adult mortality of Rice weevil in 100% Telakucha leaf extract were exhibited in dose-1 (2.0 ml) at 24, 48, and 72 hours after treatment (HAT) with a number of 10 (Table 2). 100% Telakucha leaf extract exhibited the highest mean mortality percentage of rice weevils, with a value of 100% in both dose-1 (2.0 ml) and dose-2 (1.5 ml). Conversely, 100% leaf extract exhibited the lowest mortality percentage (40%) in dose-3 (1.0 ml) (Table 2).

3.2. Mortality test of Red Flour Beetle at 100% plant leaf extract

The numbers of adult mortality and the percent of mean mortality percent response of the Red Flour Beetle at 100% plant leaf extract were substantially higher than that of the control in all doses of 10% (2.0 ml), 7.5% (1.5 ml), and 5% (1.0 ml) of wheat flour, rice, and pulse seeds. The maximum numbers of adult mortality (10) of Red Flour Beetle in 100% Telakucha leaf extract were demonstrated in Dose-1 (2.0 ml) at 24, 48, and 72 HAT, and equivalent numbers were also found in dose-2 at 48 and 72 HAT at dose-2 (1.5 ml) (Table 2). Dose-1 of Telakucha leaf extract (100%) exhibited the highest mean mortality percentage, followed by dose-2 (96.6%). Dose-3 showed the lowest mean mortality percentage with a value of 31% (Table 2).

3.3. Mortality test of Pulse beetle at 100% plant leaf extract

All the dose responses were obtained from 100% Telakucha leaf extract, which was significantly higher than control (0%). Dose-1 (2.0 ml) of Telakucha leaf extract demonstrated the maximum mean mortality percentage of Pulse Beetle, with a value of 100% (Table 2). Dose-2 (96.6%) was the second most effective. The maximum numbers of adult mortality of Pulse beetle (10) in 100% leaf extract were recorded in dose-2 (1.5 ml) at 24, 48, and 72 HAT, as well as similar numbers of adult mortality in dose-1 (2.0 ml) at both 24 and 72 HAT (Table 2).

Table 2. Numbers of adult mortality and mean mortality response of 100% Telakucha leaf extract against rice weevil, Red Flour Beetle, and pulse beetle at a 24-hour interval

Treatment	Rice weevil				Red Flour Beetle				Pulse Beetle			
	24 HAT	48 HAT	72 hr	Mean	24 hr	48 hr	72 hr	Mean	24 hr	48 hr	72 hr	Mean
Dose-1: 10% (2ml)	10.00a	10.0a	10.00a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.0a	10.0a	9.66ab
Dose-2: 7.5% (1.5ml)	10.00a	10.0a	10.00a	10.0a	9.00ab	10.0a	10.0a	9.66ab	10.0a	10.0a	10.0a	10.0a
Dose-3: 5% (1ml)	0.33b	0.66b	1.66b	0.88b	4.00c	2.66b	2.66b	3.10b	7.66ab	5.66b	1.33b	4.88c
Control	0.00b	0.00c	0.00c	0.0c	0.00d	0.00c	0.00c	0.0c	0.00c	0.00c	0.00c	0.00d
LS	*	**	*	*	***	***	***	*	*	**	*	*
CV (%)	5.67	5.58	5.32	6.85	8.3	5.09	5.09	6.66	9.21	7.29	4.32	7.55
SE (±)	1.24	1.33	0.96	1.06	1.06	0.98	1.07	0.86	1.27	1.08	1.42	1.05

In column, means followed by different letters are significantly different, *means at 5% level of probability, **means at 1% level of probability and ***means at 0.1% level of probability, LS= Least significant, CV= Co-efficient of variation, SE= Standard error.

3.4. Mortality test of Rice weevil at 70% plant leaf extract

All the dose responses of Telakucha 70% leaf extract against rice weevil were significantly higher than control (0%). The highest numbers of adult mortality of rice weevil (10) in 70% leaf extract were reported in both dose-1 (2.0 ml) and dose-2 (1.5 ml) at every 24, 48, and 72 HAT. Dose-1(2.0 ml) and dose-2 (1.5 ml) exhibited the highest mean mortality of Rice weevil with a both value of 100%, whereas it was lowest (25.5%) in dose-3 (Table 3).

3.5. Mortality test of Red Flour Beetle at 70% plant leaf extract

In contrast to the control, the number of adults mortality and mean mortality response of the Red Flour Beetle at 70% plant leaf extract were considerably greater in all dosages of 10% (2.0 ml), 7.5% (1.5 ml), and 5% (1.0 ml) of wheat flour, rice, and pulse seeds. Dose-1 (2.0 ml) was recorded as the presence of the highest numbers of adult mortality of Red Flour Beetle (10) in 70% leaf extract at 72 HAT (Table 3). Average mean mortality percentage of Red Flour Beetle at 24, 48, and 72 HAT indicated that dose-1 (2.0 ml) exhibited the maximum value (96.6%), followed by dose-2 (39.9%) and dose-3 (22%), respectively (Table 2).

3.6. Mortality test of Pulse beetle at 70% plant leaf extract

The response of the pulse beetle differed considerably (p<0.1) owing to the impacts of extract after a 24-hour interval under a laboratory environment. The response was substantially (P<0.1) stronger in the extract after 24 hours compared to control. Dose-1 (2.0 ml) had the highest numbers of adult mortality of pulse beetle (7.33) in 70% leaf extract at 72 HAT (Table 3). Dose-1 (2.0 ml) possesses the highest mean mortality (79.9%) compared to dose-2 (19.9%) and dose-3 (11.1%) (Table 3).

3.7. Mortality test of Rice weevil at 50% plant leaf extract

The mean mortality percent and the numbers of adult mortality response of the rice weevil at 50% plant leaf extract were significantly greater than that of the control across all dosages of

Table 3. Numbers of adult mortality and mean mortality response of 70% Telakucha leaf extract against rice weevil, Red Flour Beetle, and pulse beetle at a 24-hour interval

Treatment	Rice weevil				Red Flour Beetle				Pulse Beetle			
	24 hr	48 hr	72 hr	Mean	24 hr	48 hr	72 hr	Mean	24 hr	48 hr	72 hr	Mean
Dose-1: 10% (2ml)	10.0a	10.0a	10.0a	10.0a	9.33a	9.66a	10.0a	9.66a	8.66a	8.0a	7.33a	7.99a
Dose-2: 7.5% (1.5ml)	10.0a	10.0a	10.0a	10.0a	5.66b	2.66b	3.66b	3.99b	1.33bc	2.0b	2.66b	1.99b
Dose-3: 5% (1ml)	3.0b	2.66b	2.00b	2.55b	0.0c	0.33c	0.33c	0.22c	0.00d	2.0b	1.33bc	1.11b
Control	0.0c	0.00c	0.00c	0.00c	0.0c	0.00c	0.00d	0.00d	0.00d	0.0c	0.00c	0.00c
LS	**	*	***	*	*	**	*	*	***	*	*	*
CV (%)	5.09	8.94	6.3	7.45	7.21	5.78	6.32	8.02	8.65	7.3	5.29	6.85
SE (±)	0.78	1.29	0.96	1.25	1.05	0.94	1.15	1.06	1.22	1.08	0.88	1.12

In column, means followed by different letters are significantly different, *means at 5% level of probability, **means at 1% level of probability and ***means at 0.1% level of probability, LS= Least significant, CV= Co-efficient of variation, SE= Standard error

10% (2.0 ml), 7.5% (1.5 ml), and 5% (1.0 ml) of wheat flour, rice, and pulse seeds. The highest adult mortality of Rice weevil in 50% Telakucha leaf extract occurred in dose-1 (2.0 ml) at 24, 48, and 72 hours after treatment, with a count of 10 (Table 4). The highest mean mortality (100%) of rice weevil at 50% plant leaf extract was observed in Dose-1 (2.0 ml), followed by dose-2 (86.6%) (Figure 4).

3.8. Mortality test of Red Flour Beetle at 50% plant leaf extract

The mean mortality percentage and the numbers of mortality of adults of the Red Flour Beetle at 24, 48, and 72 HAT demonstrated a significant difference in the average mean mortality responses of the Red Flour Beetle to 50% plant leaf extract. The maximum numbers of adult mortality of Red Flour Beetle (1.33) were observed in dose-1 (2.0 ml) in 50% leaf extract at 72 HAT (Table 4). The highest mean mortality of rice weevils (88%) at 50% plant leaf extract was recorded in dose-1 (2.0 ml), whereas the lowest (55%) was noted in dose-2 (1.5 ml) (Figure 4).

3.9. Mortality test of Pulse beetle at 50% plant leaf extract

The mean mortality responses of Pulse beetle at 50% plant leaf extract considerably varied at all the dosages of 10% (2.0 ml), 7.5% (1.5 ml), and 5% (1.0 ml) of wheat flour, rice, and pulse seeds. Dose-1 (2.0 ml) demonstrated the greatest adult pulse beetle numbers of adult mortality (6.0) in 50% leaf extract at 72 HAT (Table 4). Dose-1 (2.0 ml) showed the maximum mean mortality, while dose-3 (1.0 ml) demonstrated the lowest with a value of 11% (Figure 4).

4. Discussion

Botanical pesticides are regarded as a good alternative to synthetic insecticides (Pavela, 2016), many of which are selective and have little or no harmful impact on non-target creatures and the environment (Dharmagadda *et al.*, 2005; Kar *et al.*, 2024). Plant leaf extract is most effective against the insect and exhibited the maximum mortality. Mortality outcomes are inconsistent across all treatments. Treatments of 100% and 70% are more efficacious than the 50

Table 4. Numbers of adult mortality responses of 50% Telakucha leaf extract against rice weevil, Red Flour Beetle, and pulse beetle at a 24-hour interval

Treatment	Rice weevil			Red Flour Beetle			Pulse Beetle		
	24 hr	48 hr	72 hr	24 hr	48 hr	72 hr	24 hr	48 hr	72 hr
Dose-1: 10% (2ml)	10.0a	10.0a	10.0a	1.0a	0.33b	1.33a	4.00a	5.66a	6.00a
Dose-2: 7.5% (1.5ml)	8.0ab	9.66a	8.33ab	0.0b	1.0a	0.66ab	0.33b	0.33b	0.00b
Dose-3: 5% (1ml)	1.0c	1.0b	2.66bc	0.0b	0.0b	0.00b	0.00c	0.33b	0.00b
Control	0.0d	0.0b	0.00d	0.0b	0.0b	0.00b	0.00c	0.00c	0.00b
LS	***	*	*	*	**	*	**	*	***
CV (%)	6.3	8.11	5.67	6.3	8.6	9.09	6.07	5.69	7.73
SE (±)	1.17	1.08	1.41	0.94	0.54	1.21	1.95	1.3	1.16

In column, means followed by different letters are significantly different, *means at 5% level of probability, **means at 1% level of probability and ***means at 0.1% level of probability, LS= Least significant, CV= Co-efficient of variation, SE= Standard error

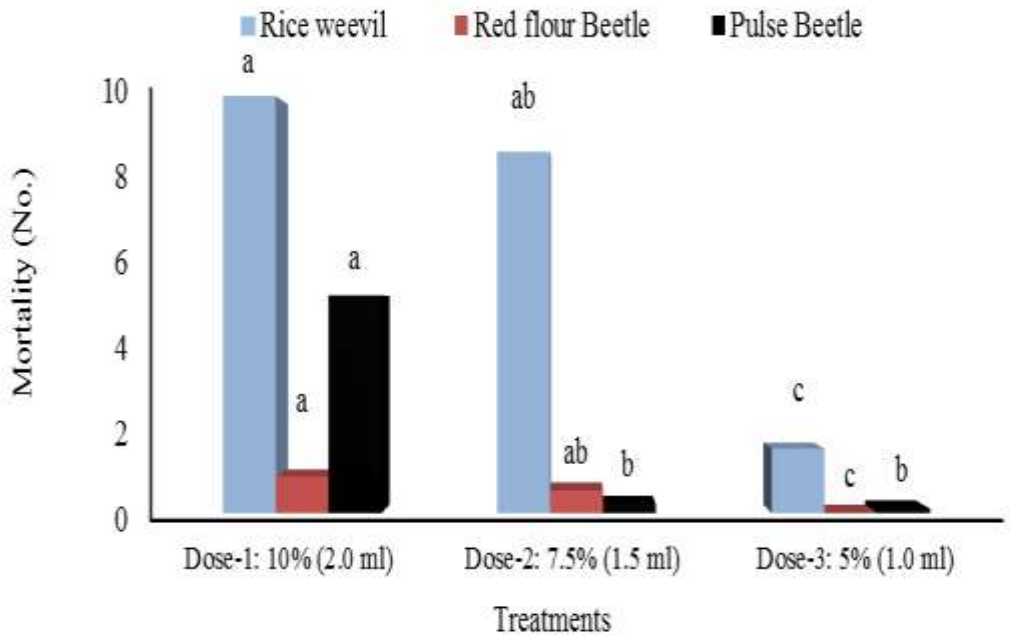

Figure 4. Mean mortality response of Telakucha leaf extract 50% against rice weevil, Red Flour Beetle, and pulse beetle.

% methanol extract. 100% methanol extract is highly active than the 70% extract, and diminished activity is shown in the experiment. The mortality rate of insects in botanical extracts is generally increased by higher concentrations and longer exposure durations, which may result in inconsistently higher mortality (Zibaee and Stoytcheva, 2011). The complex interplay of insect physiology, environmental conditions or factors, phytochemical diversity, and application methodologies is the reason for the inconsistency in insect mortality across botanical extracts. *Coccinia grandis* reduces the growth of neighboring plant species, and the pharmacological property of *C. grandis* is significant; however, there is no report of its allelopathic effect (Das and Kato-Noguchi, 2018). Hasan *et al*. (2025) found that *Coccina grandis* root extract had the highest mortality rate (73.3%) at 100 mg/mL after 72 HAT, followed by 66.6% at the same concentrations after 48 hours, and no mortality (0.0%) at 12 mg/mL after 24 hours. Govindan *et al.* (2013) found comparable findings that suggested that at seven days after treatment, the mortality percent of pulse beetle was 80.50% in *Coccinia indica*, but the untreated control recorded only 36.66%. Amin *et al*. (2017) observed the toxicity, and the mortality order of the plant extracts was *Azadirachta indica* > *Eucalyptus globulus* > *Coccinia indica* > *Swietenia macrophylla* > *Hibiscus rosa-sinensis* against the larvae of *Bactrocera cucurbitae*. The most sensitive insects to the protein-rich pea (*Pisum sativum* L.) flour combined with wheat kernels were *Sitophilus oryzae*, *Sitophilus zeamais*, and *Sitophilus granarius*, followed by *Cryptolestes ferrugineus*, which was more sensitive than *Tribolium castaneum* and *Rhyzopertha dominica* (Fields, 2006). Akbar *et al.* (2022) selected five plant extracts, namely *Melia azedarach*, *Nicotiana rustica*, *Azadirachta indica*, *Nicotiana tabacum*, and *Thuja orientalis*, which are investigated at six distinct concentrations (0.5, 1.0, 1.5, 2.0, 2.5, and 3.0%) against *Callosobruchus maculatus* (Coleoptera: Bruchidae) and reported that maximum mortality was triggered by *N. tabacum* and *N. rustica* (100%), followed by *A. indica* (82%), whereas minimum mortality was observed in *T. orientalis* (64%) at 2.5%. Rahman *et al.* (2020) discovered that the maximum mortality rate of pulse beetle (100%) and rice weevil (83.3%) was in Polygonum hydropiper L. leaves, while the lowest mortality rate of pulse beetle and rice weevil was both detected in control (0.00%). Our study demonstrated that the efficacy of *Coccina grandis* leaf extract increased proportionately with dosage, and was substantially greater than the control group.

5. Conclusion

The results of this investigation indicated that the 100% methanol extract is significantly more active than the 70% extract. The experiment exhibited that the mortality rate for dose-1 (10% of grain weight, 2 ml) was higher than that of dose-2 (7.5% of grain weight, 1.5 ml) and dose-3 (5% of grain weight, 1 ml) at all treatments. The results were highly encouraging, and there is significant potential for the application of plant products in the storage of insect pest control.

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Conflict of Interest

All authors declared there was no conflict of interests.

Author Contribution

Md. Shohag Ali- Data collection and data curation, Md. Abdullah Al Masum- Data curation, Shaikh Nazmul- Funding, Krishna Rany Das- Supervision, conceptualization, validation and review, Nayan Chandra Howlader- Writing- original draft, formal analysis, data curation, software, review and editing, Md. Mahfuzul Hasan- Writing- original draft, formal analysis, data curation, software, review and editing.

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