**ENTOMOCIDAL EFFICACY OF PLANT EXTRACT AND SYNTHETIC INSECTICIDES AGAINST (*Ryzopertha dominica)***

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**Abstract**

Two botanical extracts (*Nerium oleander* & *Dephne mucrunata*) and synthetic insecticides (Deltamethrin & Decova) were evaluated against *Ryzopertha dominica* in the laboratory at ambient temperature (28±2oC) and relative humidity of (75±5). The botanical extracts were tested against the insect at 5, 2.5, 1.25, 0.625, and 0.312% while synthetic insecticide 2, 1, 0.5%, 0.25, and 0.12% concentrations. Results revealed that both tested materials evoked a high mortality effect *Ryzopertha dominica* with increased concentration %. Within the insecticide and botanical extract and Decova and Dephne *mucrunata showed high toxic effects against**Ryzopertha dominica.* Both botanical extracts gave 90% maximum mortality at a higher dose of 5%. It isconcluded that although the percent mortalities showed by *Nerium oleander* and *Dephne mucrunata* plant extracts was low as compared to the synthetic insecticides Deltamethrin and Decova, these plant extracts were helpful to some extent for store grain pest *Ryzopertha dominica* because of organic in nature the plant extracts have less environmental hazards while the synthetic insecticides have lots of ill effects on the environment.

**Keywords:** Store grain, *Ryzopertha dominica****,*** Entomocidal, synthetic insecticide, Plant extract

**INTRODUCTION**

Food protection and security is an important concern mostly in view of the rapid rise in world population (Tubiello *et al*., 2007). Pakistan has a population of 177 million, which is aggregate, with a growth ratio of 2.07% (Khattak and Shafique, 1986). Protecting grains at saving stores can be supportive to encounter the food necessities of a growing population. In stored grains, insect devastation can account for 10-40% of loss globally (Papachristos and Stamopoulos, 2002). Among these *Rhyzopertha dominica (Coleoptera: Bostrychidae)* is considered the maximum destructive pest of stored grains. (Flin *et al*., 2004). It is assessed that around 10-20 % of global deposited food grains vanished due to insect invasion (Philps and Throne, 2010) The invasion triggered by *Rhyzopertha dominica* is the key issue in deposited grain as they sound affects the quantity as well as the quality of grain (Athanassiou and Palyvos, 2006). Damage of cereal grains via insect invasion for the period of storage is a severe issue, mainly in developing nations, where destruction to deposited grains and their foodstuffs by insects can quantity to 5 - 10% in temperate nations and 20 - 30% in tropical regions (Rajashekar *et al*., 2010; Ileke and Oni, 2011; Akinneye and Ogungbite, 2013). Rice is the seed of the monocot plant Oryza sativa (Ashamo and Akinnawonu, 2012). It is the grain using the second maximum global production, after maize (FAO, 2010). So, crop security plays a key and essential role in current farming production; and the ever-lasting burdens on yield as well as the strengthening of agriculture practices have increased the issue of pest mutilation and hereafter control (Martins *et al*., 2012). Invasion control of deposited grains insect pests is mostly accomplished using synthetic chemical insecticides, such as methyl bromide and phosphine. In some nations, due to environmental distresses and human health threats, some chemical insecticides have also been banned or restricted (Tapondjou *et al*., 2002). The adversarial effects of some unusual chemical insecticides have directed scientists to invent different paths of insect control, which has succeeded in the finding of plant products as substitute modes of controlling insects (Sutherland *et al*., 2002; Zibaee and Bandani, 2010). Numerous plant Extracts are considered for insecticidal activities and these extracts
indicated helpful actions to counter the pests. The plants’ extract was selected and has been used as an active protectant to control pests, minimize environmental contamination, and substitute the use of synthetic pesticides (Ali *et al*., 2018). Therefore, this research investigates the Entomocidal efficacy of two insecticides and plant extract against *Rhyzopertha* *dominica* which are important insect pests of paddy rice in storage.

**MATERIALS AND METHODS**

The current investigation was undertaken to assess entomocidal effect of plant extract (*Nerium oleander* and *Dephne mucrunata)* and synthetic insecticide (Deltamethrin & Decova against *Rhyzopertha dominica.*

 ***Insects******Rearing:*** Insect *Rhyzopertha dominica* were collected from a different location in Gilgit and were reared on uninfected wheat grain at the rate of 200 adults in jars containing 400 g of wheat grains. The jars were covered with a muslin cloth, tied with a rubber band at the open end, and kept in an incubator maintained at a temperature (28±2oC) and relative humidity (75±5). After two weeks of oviposition, the parent insects were separated, and egg-laid grains were maintained and re-cultured to produce newly emerged adults of the same generation *R. dominica*. For this purpose, the insects that emerged after four weeks were removed. 1–14-day old adults were used in the experiments (Ali *et al*., 2018; Gul et al., 2019)

***Preparation of plant extracts and Insecticide:*** Methanolic extracts of *Nerium oleander* and Dephne *mucrunata* were carried out using the cold extraction method. About 200g of the powders were soaked separately in an extraction bottle containing 450ml of absolute methanol. The mixture was stirred occasionally with a glass rod and extraction was terminated after 72 h. The resulting mixture was filtered using a double layer of Whatman No. 1 filter paper and the solvent was evaporated using a rotary evaporator at 30 to 40oC with the rotary speed of 3 to 6 rpm for 8 h (Udo, 2011; Ali *et al*., 2018). The resulting materials were air-dried to remove traces of solvents. From this stock solution, different concentrations of 5%, 2.5%, 1.25% 0.63%, and 0.31% were prepared as described by Ashamo and Akinnawonu, 2012; Ileke and Bulus, 2012; Ileke *et al*., 2013). From the synthetic insecticide five concentrations (1%, 0.5%, 0.25%, 0.13%, and 0.63) were prepared to test the insect.

***Toxicity of Plant extracts and synthetic insecticide:*** Plant extracts and synthetic insecticides were tested by filter paper impregnation method Azmi, 2004; Gul et al., 2019). The filters were dipped in different concentrations of plant extract and synthetic insecticide as described earlier. The wetted filter paper was placed in sterilized Petridis and inoculated 10 adult insects of *R. dominica* against each concentration and maintain three replicates along with control. All the data obtained were subjected to a one-way analysis of variance at a 5% significance level and means were separated using Duncan’s Multiple Range Tests. Mortality % was calculated as the following formula:



**RESULTS AND DISCUSSION**

In the present investigation an OP compound deltamethrin, a Pyrethroid compound decovas, and two plant products *Nerium oleander* and Nick were tested against *Rhyzopertha dominica* by the filter paper impregnation method. The percentage mortality values for each compound were obtained and statistically analyzed for each compound. Five different concentrations were selected for the application.

Fig: - 1 Comparative efficacy of plant extract and insecticide against *Rhyzopertha dominica*

**Table: 1 Entomocidal efficacy of Deltamethrin against *Rhyzopertha dominica* at different concentrations/days**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Conc %** | **1st day** | **2nd day** | **3rd day** | **4th day** | **5th day** |
| **2%** | 10.0a(100%) | 9.0a(90%) | 10.0a(100%) | 8.0a(80%) | 7.0a(70%) |
| **1%** | 10.0a(100%) | 9.0a(90%) | 10.0a(100%) | 7.0ab(70%) | 6.0ab(60%) |
| **0.50%** | 9.0Ab(90%) | 8.0ab(80%) | 9.0ab(90%) | 6.0abc(60%) | 5.0ab(50%) |
| **0.25%** | 8.0ab(80%) | 7.0ab(70%) | 8.0ab(80%) | 4.0bc(40%) | 4.0b(40%) |
| **0.13%** | 6.0b(60%) | 5.0b(50%) | 6.0b(60%) | 3.0c(30%) | 1.0c(10%) |
| **S. Err** | 1.63 | 1.46 | 1.63 | 1.46 | 1.03 |
| **LSD** | 3.63 | 3.25 | 3.63 | 3.25 | 2.30 |
| **LC50** | 0.048 | 0.132 | 0.048 | 0.578 | 0.885 |

Means in each row followed by the same letter are not significantly different at LSD test (P = 0.05) while the number in parenthesis indicates inhibition % over control

When *Rhyzopertha dominica* was treated with deltamethrin it gave 100, 90, 80, and 60% mortality for 1st day. On 2nd day. the mortality started to decrease gradually and showed 90, 80, 70, and 50% up to 120 hours of post-treatment while on 3rd day a slight increase was observed in the case of the highest concentration. Whereas after 168 hours of treatment mortality decreased again.

**Table: 2 Entomocidal efficacy of Decovas against *Rhyzopertha dominica* at different concentrations/days**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Con%** | **1st day** | **2nd day** | **3rd day** | **4th day** | **5th day** |
| **1%** | 10.0a(100%) | 9.0a(90%) | 10.0a(100%) | 8.0a(80%) | 8.0a(80%) |
| **0.50%** | 10.0a(100%) | 8.0a(80%) | 9.0a(90%) | 8.0a(80%) | 7.0a(70%) |
| **0.25%** | 9.0a(90%) | 8.0a(80%) | 8.0a(80%) | 7.0a(70%) | 7.0a(70%) |
| **0.13%** | 8.0a(80%) | 7.0a(70%) | 7.0ab(70%) | 6.0ab(60%) | 6.0a(60%) |
| **0.06%** | 8.0a(80%) | 6.0a(60%) | 7.0ab(70%) | 3.0b(30%) | 2.0b(20%) |
| **S. Err** | 1.63 | 1.63 | 1.63 | 1.46 | 1.63 |
| **LSD** | 3.63 | 3.64 | 3.63 | 3.25 | 3.64 |
| **LC50** | 0.001 | 0.033 | 0.013 | 0.201 | 0.273 |

Means in each row followed by the same letter are not significantly different at LSD test (P = 0.05) while the number in parenthesis indicates inhibition % over control

After 24 hours of treatment, decovas showed 100,100,90,90,80% mortalities for 10, 5, 2.5, 1.25, 0.63, and 0.31% respectively. Similarly, on the 2nd day, 90, 80, 70, and 60% mortality was observed. decovas showed increase in % mortality after 96 hours i.e., at 3rd day and it showed 100,90,80% for 1,0.50,0.25% concentration. On the 4th day mortality again start to decrease and showed 80, 70, 60, and 30 % after treatment with for fo10,5,2.5,1.25,0.63 and0.31% respectively. On the 5th day, the post-treatment mortality was found to be 80, 70, 70, 60, and 20% for 10, 5, 2.5, 1.25, 0.63, and 0.31percentage respectively.

**Table: 3 Entomocidal efficacy of *Nerium Oleandar* against *Rhyzopertha dominica* at different concentrations/days**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Conc %** | **1st day** | **2nd day** | **3rd day** | **4th day** |
| **5%** | 9.0a(90%) | 6.0a(60%) | 3.0a(30%) | 2.0a(20%) |
| **2.50%** | 7.0ab(70%) | 4.oab(40%) | 2.0a(20%) | 1.0a(10%) |
| **1.25%** | 4.0bc(40%) | 4.0ab(40%) | 2.0a(20%) | 1.0a(10%) |
| **0.63%** | 4.0bc(40%) | 2.0b(20%) | 2.0a(20%) | 1.0a(10%) |
| **0.31%** | 2.0c(20%) | 2.0b(20%) | 1.0a(10%) | 1.0a(10%) |
| **S. Err** | 1.633 | 1.633 | 1.46 | 0.73 |
| **LSD** | 3.639 | 3.639 | 3.254 | 1.627 |
| **LC50** | 1.80 | 3.43 | 8.97 | 16.48 |

Means in each row followed by the same letter are not significantly different at LSD test (P = 0.05) while the number in parenthesis indicates inhibition % over control

When *Rhyzopertha dominica* has treated with *Nerium oleander* on 1st day it showed 90,70,40,40and,20% mortality for 5, 2.5, 1.25, 0.63, and 0.31% respectively. While at 2nd day of post-treatment, 60% mortality was found for 5%, and both 2.50 and 1.25% showed 40% mortality whereas 20% mortality was showed for 0.63 and 0.31% respectively. On 3rd day 30% mortality was found for 5% and 20% mortality was found constantly for 2.50,1.25,0.63% respectivelywhile10% mortality was found for 0.31%.After 120 hours of treatment i.e., on the 4th day, it showed 20% mortality for 5% and 10% mortality was found constantly for 2.50, 1.25, 0.63, % respectively,and no military was found in cases of 0.31%. After 144 hours of treatment, i.e., on the 5th day, Nerium oleander was found ineffective totally.

**Table: 4 Entomocidal efficacy of *Dephne mucrunata* against Rhyzopertha dominica at different concentrations/days**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Conc %** | **1st day** | **2nd day** | **3rd day** | **4th day** | **5th day** |
| **5%** | 9.0a(90%) | 7.0a(70%) | 7.0a(70%) | 5.0a(50%) | 3.0a(30%) |
| **2.50%** | 8.0a(80%) | 5.0ab(50%) | 4.0b(40%) | 2.0b(20%) | 2.0ab(20%) |
| **1.25%** | 6.0ab(60%) | 3.0b(30%) | 2.0ac(20%) | 1.0bc(10%) | 0b(0%) |
| **0.63%** | 6.0ab(60%) | 2.0b(20%) | 1.0c(10%) | 1.0bc(10%) | 0b(0%) |
| **0.31%** | 4.0b(40%) | 2.0b(20%) | 1.0c(10%) | 0.0c(0%) | 0b(0%) |
| **S. Err** | 1.46 | 1.46 | 1.264 | 0.73 | 1.033 |
| **LSD** | 3.254 | 3.25 | 2.818 | 1.627 | 2.301 |
| **LC50** | 0.51 | 2.97 | 3.42 | 5.05 | 7.09 |

Means in each row followed by the same letter are not significantly different at LSD test (P = 0.05) while the number in parenthesis indicates inhibition % over control

 When *Rhyzopertha dominica* was treated with *Dephne mucrunata* it showed a very little residual effect. It gave 90, 80, 60, and 60, 40% mortalities for 5, 2.5, 1.25, 0.63, and 0.31% respectively. The result after 48 hours i.e., on the 2nd day the mortality was 70, 50, and 30% for 5, 2.50, 1.25%, and 20% mortality for 0.63 and 0.31 percentage respectively. On 3rd day, the mortality was 70, 40, and 20% for the concentrations of 5, 2.5, 1.25%, and 10% mortality was found for both 0.13 and 0.64% respectively. The result after 96 hours i.e., on the 4th day 50, 20% mortality was observed for 10, 5% while 10% mortality was found constantly for 2.5 and 0.31% respectively while no mortality was observed for 0.64%. On the 5th day 30, 20% mortality was found for 10 and 5% and did not reveal any residual effect for the remaining concentration.

In the present research residual effects of the pesticides were determined. It is found that Nerium oleander and Nick plant showed very low residual effects as compared to chemical pesticides. *Nerium oleander* showed 60% highest mortality whereas Nick plant showed 70% highest mortality after 48 hours of treatment however deltamethrin and decovas showed comparatively high residual effects, *Nerium oleander* showed 100% mortality after 96 hours of treatment and decovas also showed 100% highest mortality after 48 hours of treatment. In Pakistan, synthetic pesticides and natural products are preferred to use against pest infestation due to less mammalian toxicity. Some plant parts are used as an insecticide as they are proper, less expensive, highly effective, and safer for the humans and environment The purpose of our studies was the use of local plants has the potential to cause mortality and toxicity to the storage grain pests. Many scientists worked on the residual effects of various pesticides Haya (1989), Ketker (1989), Lolage and Patil (1992), Ahmed et al., (1999), Raja et al., (2001), khan et., al (2007), Pang et al., (2009) Uddin et al., (2011) and many others.

The result of the current study is in consonance with the result of another scientist. They used different plant extracts with different concentrations but the relationship between the concentration and mortality was the same. Some plant parts are used as an insecticide as they are proper, less expensive, highly effective, and safer for the humans and environment. Most Plants such as *Azadirachta indica* (A. juss), Cassia fistula (L.), *Calotropis procera* (Ait), Lantana camara (L.) have shown different properties like insecticidal, antifeedant, repellant and growth regulating properties beside various stored grain pests (Gautam et al., 2003; Deka &Singh, 2005; Hazan et al., 2006; Neoliya et al., 2007). They are generally used as traditionally stored grain protectants in powder form, or crude mixtures due to their easy convenience and eco-friendly nature (Dwivedi & Garg, 2003).

Gandhi and Pillai (2011) reported the insecticidal activity of Punica granatum (Pomegranate) and Murraya koenigii (curry tree) leaves against the stored grain pest Rhyzopartha dominica (F abr). Wheat grains and beaten rice (poho) were treated with five different concentration of leaf powders under laboratory conditions in the wheat medium percentage of mortality were 18-71% with P. granatum while 18-65% with M. koenigii. However, in beaten rice, it was 26-79% and 16-74% P. granatum and M. Koenigii respectively. This shows that the percentage of mortality in beaten rice was more as compared to wheat grain pests. However, the pulverized leaves of both plants show insecticidal and seed-protective effects as compared to chemical pesticides. In the present case, the leaves of Nerium oleander and Nick plant also showed very low residual effects as compared to chemical pesticides.

Hameed et al., (2012) performed several experiments to find out the residual effects of biological insecticides i.e., Spinosad in comparison of two plant extracts, Kanair (Nerium Oleander) and neem (*Azadirchta indica*) against *Tribolium Castaneum* (Hbst). LC 50, s was calculated by probit analysis method, he takes five different concentrations (2.5, 2.0, 1.5, 1.0, and 0.5%) and the time duration for each compound was used at 24 hours, 48 hours, 72 hours, and 168 hours. After the experiment, the results showed 55, 45, and 38%. The minimum mortality was found as 16.66, 16.67 and 15% at the lowest 0.5% after 24 hours for Spinosad, neem, and Kanair, while the maximum mortality against the target pet at 2.5% maximum dose after 168 hours for Spinosad, neem, and Kanair respectively. In the present case five different concentrations of Nerium oleander and Nick plant, extracts were studied for toxicity against *Rhyzopertha dominica.* Both the pesticides and plant extract showed a toxic effect. At higher concentrations, the mortality rate of *Rhyzopertha dominica* was increased which means that the mortality and concentrations were directly proportional, and at the lowest concentration, the mortality rate also decreased. Khan and Marwat (2004) reported the insecticidal and repellency effects of Leaves, bark, and seeds of Bakain (Melia azedarach) and leaves, and bark of Ak (Calotropis procera) against *Rhyzopertha dominica*  F., in wheat grain. The data showed that the powders were drastically toxic/repelled to lesser grain borer. The result showed 98.95 percent deterrence/repellency of the insect, followed by the powder of Ak's leaves and bark of Ak with 89.25 and 86.50 percent deterrence/repellency of *R. dominica* respectively. Seed of bakain with 73.75 percent insect deterrent/repellency was found significantly the least effective, followed by leaves of bakain with 82.50 percent repellency of the tested insect. However, in the present case, the results were different, which might be due to climatic conditional changes, the topography of the area, etc.

**CONCLUSION**

The present investigation of both extracts was effective and causing mortality, concluded that although the percent mortalities showed by *Nerium oleander* and *Dephne mucrunata* plant extracts was low as compared to the synthetic insecticides Deltamethrin and Decova but these plant extracts were helpful to some extent for store grain pest *Ryzopertha dominica* because of organic in nature the plant extracts have less environmental hazards while the synthetic insecticides have lots of ill effects on the environment.

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