

Effect of *Linum usitatissimum* Seed Powder on the Mortality Rate of *Sitophilus oryzae* (Rice Weevil)

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Abstract: Stored-grain insects cause considerable quantitative and qualitative losses in cereal grains during storage. The rice weevil, *Sitophilus oryzae*, is a common storage pest that causes considerable damage to rice and other cereal grains during storage. The present study is proposed to evaluate the insecticidal potential of *Linum usitatissimum* L. (linseed/flaxseed) seed powder against adult *Sitophilus oryzae*. Different concentrations of linseed seed powder can be mixed with wheat or rice grains and the mortality of adult weevils can be recorded at predetermined exposure periods. Mortality may be corrected using Abbott's formula. Previous research has demonstrated significant insecticidal activity of *L. usitatissimum* seed powder against another stored-grain pest, *Rhyzopertha dominica*, with corrected mortality increasing from 16.67% to 81.67% as the dose increased from 1 to 9 g per 20 g wheat after 24 hours. The proposed investigation will determine whether a similar botanical effect occurs against *S. oryzae*. The study helps to understand the potential of locally available plant materials for controlling insect pests in stored grains through a plant-based method.

Keywords: *Linum usitatissimum*, linseed, flaxseed, *Sitophilus oryzae*, rice weevil, mortality, botanical insecticide, stored grain pest

1. Introduction

Insect pests commonly infest stored grains and cause reductions in grain quantity, nutritional value, and commercial quality. Among stored-product insects, *Sitophilus oryzae* L. (Coleoptera: Curculionidae), commonly known as the rice weevil, is an important pest of stored cereals.

The extensive use of synthetic insecticides for stored-grain protection can create concerns related to residues, resistance and environmental effects. Consequently, plant-derived materials are being investigated as potential alternatives or components of integrated stored-product pest management.

Linum usitatissimum L., commonly called linseed or flax, is an economically important plant whose seeds contain oil and various biologically active compounds. Dang and Rela (2020) conducted a laboratory study to evaluate the effectiveness of *L. usitatissimum* seed powder in controlling the lesser grain borer, *Rhyzopertha dominica*. After 24 hours of treatment, adult mortality was recorded as 16.67%, 50.00%, 73.33%, 76.67%, and 81.67% at seed powder concentrations of 1, 3, 5, 7, and 9 g per 20 g of wheat, respectively, according to the study.

The same study also cited earlier research concerning plant products and *S. oryzae*, including work on grain protectants and plant-derived materials.

However, direct experimental evidence for *L. usitatissimum* seed powder against *S. oryzae* should be generated experimentally rather than assumed from results obtained with *R. dominica*. The present investigation aims to evaluate the impact of varying concentrations of *L. usitatissimum*

seed powder on the mortality of adult *S. oryzae* under laboratory conditions.

2. Aim and Objectives

Aim

To evaluate how different concentrations of *Linum usitatissimum* seed powder affect the mortality of adult *Sitophilus oryzae*.

Objectives

- 1) To prepare *L. usitatissimum* seed powder for experimental treatment.
- 2) To expose adult *S. oryzae* to different concentrations of the seed powder.
- 3) To record mortality at different exposure periods.
- 4) To determine the concentration-dependent effect of the plant powder.
- 5) To determine the corrected mortality percentage using Abbott's formula.
- 6) To assess the potential of *L. usitatissimum* as a botanical grain-protection material.

3. Hypothesis

- **Null hypothesis (H₀):** Different concentrations of *L. usitatissimum* seed powder do not significantly influence the mortality rate of adult *S. oryzae*.
- **Alternative hypothesis (H₁):** Higher concentrations of *L. usitatissimum* seed powder lead to a significant increase in the mortality rate of adult *S. oryzae*.

4. Materials and Methods

4.1 Experimental insect

Adult *Sitophilus oryzae* was be maintained on clean, untreated cereal grains under controlled laboratory conditions. Healthy adult insects of similar age and good condition are selected for the experiment.

4.2 Plant material

Mature seeds of *Linum usitatissimum* were collected and cleaned to remove foreign materials. The seeds were properly dried and finely ground into a powder for experimental use. The powder will be stored in a clean, airtight container until use.

4.3 Experimental design

Different quantities of *L. usitatissimum* seed powder are evaluated against adult *S. oryzae*. A concentration series may be selected based on the previously published linseed experiment, for example:

Treatment	Linseed powder	Grain quantity
T ₀	0 g	20 g
T ₁	1 g	20 g
T ₂	3 g	20 g
T ₃	5 g	20 g
T ₄	7 g	20 g
T ₅	9 g	20 g

A suitable untreated control (T₀) should be maintained. Each treatment should be replicated to permit statistical analysis.

4.4 Mortality observation

The treated grain samples will be exposed to adult *S. oryzae*. Mortality will be recorded at predetermined intervals such as 24, 48 and 72 hours. An insect will be considered dead when it does not respond to gentle stimulation.

4.5 Calculation of corrected mortality

If mortality occurs in the untreated control, corrected mortality can be calculated using Abbott's formula:

$$\text{Corrected mortality (\%)} = [(T - C) / (100 - C)] \times 100$$

Where:

- T = mortality percentage in the treatment
- C = mortality percentage in the untreated control

Abbott's correction was also used in the published *L. usitatissimum*–*R. dominica* study.

4.6 Statistical analysis

The mortality data can be expressed as mean $\pm$ standard error. Differences among treatments can be tested using an appropriate statistical method such as one-way ANOVA, followed by a suitable post-hoc test where applicable. The relationship between concentration and mortality can also be examined using regression analysis.

5. Results

- The study aims to assess the impact of varying concentrations of *Linum usitatissimum* seed powder on adult *Sitophilus oryzae* mortality over different periods of exposure. The mortality increased progressively with both increasing concentration of seed powder and exposure duration.
- In the untreated control (T₀), mortality remained very low, with 0% mortality at 24 hours and 3.3% mortality at both 48 and 72 hours. At the T₁ dose (1 g seed powder per 20 g of grain), the mortality rate reached 16.7% after 24 hours, 26.7% after 48 hours, and 36.7% after 72 hours.
- At 3 g/20 g grain (T₂), mortality increased to 30.0% at 24 hours, 43.3% at 48 hours and 56.7% at 72 hours. The 5 g treatment (T₃) produced 46.7%, 60.0% and 70.0% mortality at the respective exposure periods.
- At the T₄ concentration (7 g seed powder per 20 g of grain), mortality increased to 60.0% after 24 hours, 73.3% after 48 hours, and 83.3% after 72 hours. The highest mortality was observed at 9 g/20 g grain (T₅), with 70.0% mortality after 24 hours, increasing to 83.3% after 48 hours and 93.3% after 72 hours.
- Overall, the results indicate a clear concentration- and time-dependent increase in mortality of *S. oryzae*. The highest mortality in the simulated dataset was recorded at 9 g/20 g grain after 72 hours.

Summary of mortality

Treatment	24 h	48 h	72 h
Control (T ₀)	0.0%	3.3%	3.3%
1 g/20 g (T ₁)	16.7%	26.7%	36.7%
3 g/20 g (T ₂)	30.0%	43.3%	56.7%
5 g/20 g (T ₃)	46.7%	60.0%	70.0%
7 g/20 g (T ₄)	60.0%	73.3%	83.3%
9 g/20 g (T ₅)	70.0%	83.3%	93.3%

6. Discussion

- The simulated results indicate that *Linum usitatissimum* seed powder may have potential insecticidal activity against adult *Sitophilus oryzae*. Mortality increased consistently as the concentration of seed powder increased. The control group showed the minimum mortality, while the maximum mortality occurred at the highest seed powder concentration of 9 g per 20 g of grain.
- The increase in mortality with exposure time suggests that the effect of the plant material may become more pronounced with prolonged contact. At 9 g/20 g grain, mortality increased from 70.0% at 24 hours to 83.3% at 48 hours and 93.3% at 72 hours. The same pattern was noted across the remaining treatment concentrations.
- The possible insecticidal effect may be associated with biologically active constituents present in linseed and with physical effects of the powder on insects. However, the mechanism by which *L. usitatissimum* seed powder causes mortality in *S. oryzae* remains unclear and needs further biochemical and toxicological studies for confirmation.
- The concentration-dependent pattern observed here is consistent with the general findings of earlier botanical

insecticide research. In particular, previous work with *L. usitatissimum* seed powder against another stored-grain pest, *Rhyzopertha dominica*, reported increasing mortality with increasing amounts of seed powder. However, results obtained against *R. dominica* cannot be directly considered equivalent to results against *S. oryzae*, because insect species may differ in their susceptibility to plant-derived materials.

- The low mortality observed in the control group suggests that any higher mortality in the treated groups may be related to the seed powder treatment rather than handling or laboratory conditions. However, statistical analysis of replicated experimental data is required to confirm whether the differences between treatments are significant.
- A similar concentration-related trend was reported by Dang and Rela (2020), who investigated *L. usitatissimum* seed powder against *Rhyzopertha dominica*, another important stored-grain insect pest. Their results offer useful supporting information for evaluating the potential of linseed powder as a plant-based method for protecting stored grains. However, the susceptibility of *R. dominica* cannot be assumed to be identical to that of *S. oryzae*.
- The present findings therefore suggest that *L. usitatissimum* seed powder deserves further investigation as a botanical material for management of stored-grain insects. Additional studies should examine different concentrations, longer exposure periods, effects on grain quality, persistence of activity, adult emergence and effects on seed germination.

7. Conclusion

- The study indicates a **clear concentration- and exposure-time-dependent trend** in the mortality of *Sitophilus oryzae* following treatment with *Linum usitatissimum* seed powder.
- Among the simulated treatments, the highest mortality was recorded at **9 g/20 g grain**, reaching **70.0% after 24 hours**, **83.3% after 48 hours** and **93.3% after 72 hours**. The control showed only minimal mortality.
- These observations suggest that *L. usitatissimum* seed powder has potential as a **plant-based grain-protection material** against *S. oryzae*. However, because the values used here are simulated, these findings should be treated as a model for data presentation rather than as experimentally verified results. Actual laboratory observations and statistical analysis are required before making definitive conclusions about its insecticidal effectiveness.

References

- [1] Dang K, Rela D. Ecofriendly management of stored grain pest *Rhyzopertha dominica* Fab. (Coleoptera: Bostrichidae). **Journal of Entomology and Zoology Studies**. 2020;8(6):811–813.
- [2] Abbott WS. A method of computing the effectiveness of an insecticide. **Journal of Economic Entomology**. 1925; 18: 265–267.
- [3] Rao CVR, Sarangi RK. Control of *Sitophilus oryzae* (L.) through certain plant products. **Indian Journal of Plant Protection**. 1998;26(2):182–185.
- [4] Singh YP, Mall NP. Various grain protectants on germination and damage of wheat grains by *Sitophilus oryzae* Linn. **Bulletin of Grain Technology**. 1991;29(1):50–54.
- [5] Al-Moajel NH, El-Baki SMA. Brassica seed extracts as protectants to wheat grains against the lesser grain borer *Rhyzopertha dominica*. **Annals of Agricultural Sciences**. 2000;45(1):353–362.