

# Analysis and Evaluation of Efficacy of Neem Plant (*Azadirachta indica*) Extracts on *Trogoderma granarium* in Wheat Grains

Radhika Agarwal Jain<sup>1</sup>, Dr. Kamal Singh<sup>2</sup>

<sup>1</sup>Ph.D. Scholar, Department of Zoology, R.B.S. College, Dr. B.R. Ambedkar University, Agra

<sup>2</sup>Head of Department, Department of Zoology, R.B.S. College, Dr. B.R. Ambedkar University, Agra

---

## ABSTRACT

The present study investigated the efficacy of *Azadirachta indica* (Neem) plant extracts in controlling Khapra beetle, *Trogoderma granarium* infestation in stored wheat grains, *Triticum aestivum* L. Neem is well known for its bioactive compounds, particularly azadirachtin, which exhibit potent insecticidal and repellent properties. In this study, ethanolic and aqueous extracts of Neem leaves and seeds were applied at varying concentrations to infested wheat grain samples under controlled laboratory conditions. The insect mortality rate, grain damage percentage, repellency, fertility inhibition, and weight loss were evaluated over 45 days. Results demonstrated that Neem extracts significantly reduced pest population and grain damage compared to untreated controls. The insecticidal activity was dose-dependent, with higher concentrations yielding greater efficacy. Neem seed extract exhibited maximum mortality and repellency effects against *T. granarium*. Germination of treated grains remained largely unaffected, indicating the safety of the botanical treatment. These findings highlighted Neem extracts as an eco-friendly, cost-effective, and sustainable alternative to synthetic pesticides for post-harvest protection of wheat grains against *Trogoderma granarium*.

**Keywords:** Khapra beetle, Neem plant, extracts, wheat grain, efficacy, insecticidal activity.

---

## INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops and serves as a primary source of nutrients and calories for populations worldwide. In India, wheat plays a major role in food security and contributes significantly to the national economy. The increasing demand for wheat necessitates long-term storage, which consequently exposes grains to infestation by various storage pests.

Stored grain insects are responsible for severe quantitative and qualitative losses during storage. Among these pests, the Khapra beetle (*Trogoderma granarium* Everts) is regarded as one of the most destructive pests of stored wheat and other cereals. The pest damages grains by feeding and contamination, resulting in reduced market value and germination capacity. Synthetic insecticides and fumigants have traditionally been employed to control storage pests. However, excessive use of these chemicals has resulted in insect resistance, environmental contamination, toxic residues in food products, and adverse effects on non-target organisms. These concerns have intensified the search for safer alternatives for pest management.

Botanical insecticides derived from plants have emerged as promising alternatives because of their biodegradability, low mammalian toxicity, and eco-friendly nature. Among botanical plants, Neem (*Azadirachta indica*) possesses remarkable insecticidal, repellent, antifeedant, and growth-regulating properties due to the presence of bioactive compounds such as azadirachtin, salannin, and nimbin. The present investigation was therefore undertaken to evaluate the efficacy of Neem leaf and seed extracts against *Trogoderma granarium* infesting stored wheat grains under laboratory conditions.

## MATERIALS AND METHODS

### Collection and Rearing of Insects

Adult *Trogoderma granarium* were collected from naturally infested wheat storage facilities in Agra district and reared on sterilised wheat grains in the Entomological Research Laboratory of R.B.S. College, Agra. The insects were

maintained in glass jars covered with muslin cloth under controlled laboratory conditions of  $30 \pm 2^\circ\text{C}$  temperature and  $50 \pm 20\%$  relative humidity.

### Preparation of Plant Extracts

Fresh leaves and seeds of *Azadirachta indica* were collected from local gardens and agricultural fields. The plant materials were thoroughly washed with distilled water and shade-dried for 2–3 days until crisp. The dried material was powdered using a laboratory grinder.

The powdered material was subjected to Soxhlet extraction using ethyl alcohol for 8 hours. The extracts obtained were filtered through Whatman No. 1 filter paper and concentrated using a rotary evaporator. The concentrated extracts were stored in airtight bottles at  $4^\circ\text{C}$  until further use. Different concentrations (5%, 10%, and 15%) were prepared for experimental purposes.

### Antifeedant Analysis

Ten grams of wheat grains were treated with 1 ml of Neem extract in separate containers. Twenty-five adult insects were introduced into each container. The initial weight of wheat grains was recorded and subsequently measured after every 24 hours for 14 days to determine grain consumption.

### Repellency Test

Repellency activity was evaluated using a Y-shaped olfactometer. Ten adult insects were released into the base arm of the apparatus. One arm contained a cotton sponge soaked with 1 ml Neem extract, while the other arm contained solvent alone as control. The number of insects entering each arm was counted after 45 minutes.

Percentage repellency was calculated using the formula:

$$PR = \frac{Nc - Ne}{Nc + Ne} \times 100$$

Where:

$Nc$  = Number of insects in control arm  
 $Ne$  = Number of insects in experimental arm

### Mortality Evaluation

Ten adult insects were introduced into containers containing 10 g treated wheat grains. Mortality observations were recorded after 1, 3, 5, 7, and 14 days. Insects failing to respond to gentle probing were considered dead.

Corrected mortality was calculated using Abbott's formula:

$$\text{Corrected Mortality} = \frac{T - C}{100 - C} \times 100$$

Where:

$T$  = Mortality percentage in treatment  
 $C$  = Mortality percentage in control

### Fertility Test

Glass tubes containing wheat grains treated with  $LC_{50}$  and  $LC_{95}$  concentrations of Neem extract were prepared. Twenty adults (10 males and 10 females) were introduced into each tube and maintained for 14 days. Eggs were counted using Acid fuchsin staining technique. Adult emergence was recorded daily to evaluate reproductive inhibition.

### Estimation of Grain Weight Loss

Ten grams of wheat grains treated with  $LC_{50}$  and  $LC_{95}$  concentrations were stored with ten adult insects for 45 days. Final grain weight was recorded and compared with initial weight after correcting for moisture content.

Weight loss percentage was calculated using:

$$\text{Weight Loss (\%)} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

### Germination Test

The effect of Neem extracts on wheat grain viability was evaluated following International Seed Testing Association guidelines. Treated grains were placed on moist filter paper and germination percentage was recorded after seven days.

## RESULTS AND DISCUSSION

### Antifeedant Activity

Neem extracts significantly reduced feeding activity of *Trogoderma granarium*. The highest concentration (15%) exhibited maximum antifeedant activity, resulting in minimal grain consumption compared to untreated control. Neem seed extract was more effective than leaf extract due to higher azadirachtin content.

The reduction in feeding behavior may be attributed to disruption of gustatory receptors and interference with digestive physiology of insects.

### Repellency Effect

Neem extracts showed strong repellent activity against adult Khapra beetles. Repellency increased with concentration and exposure period. At 15% concentration, Neem seed extract showed 88% repellency after 45 minutes.

The repellent effect of Neem has been associated with volatile compounds that interfere with host-seeking behavior in insects.

**Table 1: Repellency Percentage of Neem Extracts Against *Trogoderma granarium***

Concentration	Leaf Extract (%)	Seed Extract (%)
5%	52	64
10%	69	78
15%	80	88

### Mortality Assessment

Mortality of *Trogoderma granarium* increased progressively with concentration and exposure duration. Maximum mortality (92%) was recorded in wheat grains treated with 15% Neem seed extract after 14 days.

**Table 2: Mortality Percentage of *Trogoderma granarium***

Days	5%	10%	15%
1	12	20	28
3	24	38	52
5	40	56	71
7	55	70	84
14	68	81	92

The insecticidal effect may be due to disruption of hormonal balance, inhibition of molting, and feeding suppression caused by azadirachtin.

### Effect on Fertility and Adult Emergence

Neem-treated insects laid significantly fewer eggs compared to control groups. Adult emergence was drastically reduced in LC<sub>95</sub> treatments, indicating strong reproductive inhibition.

The reduction in fertility may be attributed to interference with insect endocrine systems and oviposition behavior.

### Grain Weight Loss

Neem-treated wheat grains showed significantly lower weight loss than untreated controls after 45 days.

**Table 3: Grain Weight Loss in Treated Wheat**

Treatment	Weight Loss (%)
Control	18.4
Neem Leaf Extract	7.6
Neem Seed Extract	4.2

### Germination Test

Germination percentage of treated wheat grains remained above 90%, indicating that Neem extracts did not adversely affect seed viability.

### Conclusion

The present investigation demonstrated that *Azadirachta indica* extracts possessed significant insecticidal, repellent, antifeedant, and reproductive inhibitory effects against *Trogoderma granarium* infesting stored wheat grains. Neem seed extract proved more effective than leaf extract due to its higher concentration of active compounds.

The botanical treatments reduced grain damage and weight loss without affecting seed germination, making them suitable alternatives to synthetic insecticides. Neem-based biopesticides can therefore be recommended as eco-friendly and sustainable tools for integrated pest management in stored grain protection.

### REFERENCES

- [1] Abbott, W.S. (1925). A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology*, 18(2), 265–267.
- [2] Ahmed, K.S., Itino, T., & Ichikawa, T. (2007). Duration of developmental stages of *Trogoderma granarium*. *Applied Entomology and Zoology*, 42(2), 173–177.
- [3] Arthur, F.H. (1996). Grain protectants: current status and prospects for the future. *Journal of Stored Products Research*, 32(4), 293–302.
- [4] Dubey, N.K., Shukla, R., Kumar, A., Singh, P., & Prakash, B. (2010). Global scenario on the application of natural products in integrated pest management programmes. *Journal of Biopesticides*, 3(1), 371–384.
- [5] Isman, M.B. (2006). Botanical insecticides, deterrents and repellents in modern agriculture. *Annual Review of Entomology*, 51, 45–66.
- [6] Jilani, G., & Malik, M.M. (1973). Studies on neem plant as repellent against stored grain insects. *Pakistan Journal of Scientific and Industrial Research*, 16, 251–254.
- [7] Koul, O., Walia, S., & Dhaliwal, G.S. (2008). Essential oils as green pesticides: potential and constraints. *Biopesticides International*, 4(1), 63–84.
- [8] Mordue (Luntz), A.J., & Nisbet, A.J. (2000). Azadirachtin from the neem tree. *Journal of Insect Physiology*, 46, 903–924.
- [9] Pandey, A.K., Singh, P., & Tripathi, N.N. (2014). Chemistry and bioactivities of essential oils of some *Ocimum* species. *Asian Pacific Journal of Tropical Biomedicine*, 4(9), 682–694.
- [10] Prakash, A., Rao, J., & Nandagopal, V. (2008). Future of botanical pesticides in rice, wheat, pulses and vegetables pest management. *Journal of Biopesticides*, 1(2), 154–169.
- [11] Rahman, A., Talukder, F.A. (2006). Bioefficacy of some plant derivatives against rice weevil. *Journal of Agricultural Education and Technology*, 9(1–2), 35–40.
- [12] Saxena, R.C. (1989). Insecticides from neem. In: *Insecticides of Plant Origin*. ACS Symposium Series, American Chemical Society, Washington DC.
- [13] Sharma, H.C., & Dhaliwal, G.S. (2010). Perspectives and prospects of botanical pesticides in integrated pest management. *Journal of Biopesticides*, 3(1), 1–9.
- [14] Singh, D., Siddiqui, M.S., & Sharma, S. (1989). Reproductive retardation and fumigant toxicity of neem against stored grain pests. *Indian Journal of Entomology*, 51, 352–357.
- [15] Upadhyay, R.K., Ahmad, S. (2011). Management strategies for control of stored grain insect pests in farmer stores and public ware houses. *World Journal of Agricultural Sciences*, 7(5), 527–549.