International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 4248-4253, 2023; Article no.IJECC.107142
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Efficacy of Some Essential Oil for the Management of Rice Weevil (*Sitophilus oryzae*) on Stored Wheat

Abin Ghosh [a++*], Usha Yadav [a#], Chandan Kumar Panigrahi [a++] and Anindita Roy [a++]

[a] *Department of Entomology, Faculty of Agriculture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i103102

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107142

Original Research Article

Received: 21/07/2023
Accepted: 24/09/2023
Published: 28/09/2023

ABSTRACT

The experiment was conducted in Completely Block Design (CRD) at the laboratory of the Department of Entomology, Naini Agriculture Institute Sam Higginbottom University of Agriculture, Science and Technology, Prayagraj, Uttar Pradesh with three replications seven treatments and untreated control against Rice Weevil Sitophilus oryzae (L.) i.e.T1 (Neem Oil), T2 (Clove Oil), T3 (Lavender Oil), T4 (Karanj Oil), T5 (Eucalyptus oil), T6 (Lemongrass Oil), and T7 (Tea tree Oil) and T0 (control). The experiment was conduct on the efficacy of different essential oil for the management of rice weevil, Sitophilus oryzae and adult mortality at 24, 48 and 72 hrs of exposure. The treatments included Neem Oil (0.5ml/lit), Clove Oil (0.5ml/lit), Lavender Oil (0.4ml/lit), Karanja Oil (0.4ml/lit), Eucalyptus Oil (0.5ml/lit), Lemon grass Oil (0.5ml/lit) and Tea tree Oil (0.5ml/lit). Among the treatments the largest number of mortality was observed in neem oil (83.33%), followed by karanj oil (77.77%), and least mortality was observed in the lavender oil (31.11%), rest of the

---

[++]*M. Sc. Scholar;*
[#]*Assistant Professor;*
**Corresponding author: E-mail: abinghosh33@gmail.com;*

treatments were found intermediate as followed by clove oil (67.77%), followed by eucalyptus oil (57.77%), followed by lemon grass oil (54.44%) and tea tree oil (51.10%). Percent weight loss of treated wheat grains at intervals of 30, 60 and 90 days after treatment. The results revealed that neem oil (7.32%), followed by karanj oil (11.99%). Least weight loss was recorded in lavender oil (41.06%). Whereas rest of treatments were found intermediate. And the highest germination was found in neem oil treated wheat seeds. The present study clearly revealed that these naturally occurring indigenous plant products could be used to manage the storage insect pests in wheat.

Keywords: Sitophilus; storage; neem; eucalyptus.

1. INTRODUCTION

Wheat is one of the most important and widely cultivated staple food crops among the cereals and is contributing about 30% to the food basket of the country. It is agronomically and nutritionally most important cereal essential for the food security, poverty alleviation and improved lively hoods. Wheat is one of the most important and widely cultivated staple food crops among the cereals and is contributing about 30% to the food basket of the country. It is agronomically and nutritionally most important cereal essential for the food security, poverty alleviation and improved lively hoods. The world acreage under wheat crop accounts 223.11 million hectare with production of 737.83 million metric tons with an average productivity of 3.39 tons/ha (USDA report, 2022).

Uttar Pradesh ranks first in area (36.6%) and production (39.3%) of wheat in the country. Out of 100 leading wheat producing districts (each with more than lakh tons of production), 43 belong to Uttar Pradesh and of them 19 to the western part of the state in particularly wheat productivity is far lower than Punjab and Haryana. This is because of late sowing of wheat due to long duration rice varieties and late harvest of sugarcane, poor seed replacement rate, lack of quality seed at right time and place, lack of in-puts (fertilizers, irrigation water) due to limited resources and small holding size and poor mechanization, etc.

After China, India is leading producer of wheat in the world. In India, wheat comes second in number after rice among cereals and cultivated in an area 30 million hectare with the production of 97.44 metric tons recorded in 2016-17 (Kumar et.al)

Botanical insecticides have long been treated as attractive alternatives to synthetic chemical insecticides [1]. Different types of plant preparation such as powders, solvent, essential oils and whole plants are being investigated for their insecticidal activity including their action as fumigants, repellents, antifeedants, anti ovipositants, insect growth regulators [2].

The rice weevil, *Sitophilus oryzae* is a serious pest of products in India that cause severe damage in both quantity and quality of stored cereals so grains are non-viable as well as not suitable for human consumption [3,4].

Rice weevil has got economic importance. It is the most destructive insect pest originated from India and now it has a cosmopolitan. Rice weevil is a serious grain pest which attack on rice, wheat, sorghum, maize, barley, pulses, dried beans and cereal products. Larvae and adults are internal feeders affecting quality and quantity of grains. This species has a relatively short developmental period and high populations can easily be built up. Thus, unless control measures are taken, heavy infestations may take place. Additionally, the kernel damage caused by S. oryzae larvae enables other species, the external feeders, which are not capable of infesting sound grain, so increase the damage rapidly.

The adult weevil female lays 4 eggs per day and up to 300 over their life time and may live for four to five months. The grub stage is more injurious than adult, it makes small hole into the grain, enters inside and feeds on the starchy content of the grain leaving only shell intact. It has been found that rice weevil infestation alone resulted in sorghum grain damage upto 83.5 per cent over a period of six months.

Effective management of *S. oryzae* is mainly depending upon the use of conventional liquid and gaseous insecticides [5].

The growing awareness of environmental hazards caused by synthetic insecticides has led to search for safe and environment friendly alternatives. In this regard, a number of studies are being carried to find out the plant origin

chemicals for their insecticidal properties against wide-range of insect pest including stored grain insect pests [6-11].

2. MATERIALS AND METHODS

Studies on *Sitophilus oryzae* were conducted at Entomology department SHUATS, Prayagraj during 2022-2023. Materials used and the techniques employed during the course of investigation for conducting experiment are presented below.

Rearing of Test Insect *S. oryzae*: The cultures of *S. oryzae* were obtained from the local markets of Prayagraj. Plastic containers of 1.5 kg capacity were used for insect rearing. About 500 gm of grains were kept in each container and about 600 adults of insects were released separately. They were allowed to lay eggs for 3 to 5 days and removed after 7 days, when the egg laying was over. These containers were kept at room temperature for the adult emergence of *S. oryzae.*

Other Materials: Petri plates, plastic jars, muslin cloth, butter paper, marker and rubber bands.

Preparation of Plant Products: All the treatments used were collected from the local markets.

2.1 Observation to be recorded

Evaluation Based on Mortality: The cereal grains (100 g) were kept in plastic jar of 500gm capacity and test materials were mixed at respective doses thoroughly and properly by manual agetation until the materials are evenly distributed among the grains and ensure homogenous mixture, which was considered as one replication. Three replications were used in each case. Ten pairs of *Sitophilus oryzae* adults were released in each plastic container at an interval of 24, 42 and 72 hours after treatment. The plastic jars were covered with muslin cloth and tied with rubber bands. The percent adult mortality was calculated based on the number of dead insects. The percentage mortality of the adults was calculated by using formula and then subjected to ANOVA.

> Percent adult mortality= (Number of dead insects / Number of insects released) X 100

Evaluation Based on Weight Loss in Free Choice Test: 100 g of wheat grains were taken and placed in a container at equi distance from the center. Approximately 50 pairs of 12 days old adult rice weevils are released in the center through giving free choice to the adults of orientation and then the containers were covered with muslin cloth. Same procedure was repeated for three replications. and the readings were counted at 30, 60 and 90 days after release. And the readings were calculated by using the formula mentioned below

> Percent weight loss = ((Initial weight of seeds- Final weight of seed) / Initial weight of seeds) X 100

Evaluation Based on Germination: To find out the effect of treatments on seeds germination test was conducted at 90 Days after treatment. Germination of the seeds was tested by paper towel method by maintaining three replications of each treatment. 50 seeds were selected randomly and kept on moist paper for 7 days and germination Percentage was calculated by using formula

> Percentage of seed germination = (Number of germinated seeds / Total number of seeds) X 100

2.2 Statistical Analysis

Data will be subjected to Complete Randomized Design (CRD) after suitable transformations. The per cent data will be subjected to angular transformation before statistical analysis. Similarly, the data based on mean number of insects will undergo square root transformation with X+0.5 adding factor.

3. RESULTS

3.1 Percent Adult Mortality

The data pertaining to overall mean mortality of rice weevil at intervals of 24, 48 and 72 hours after treatment are mentioned in below table. The results revealed that T_1 neem oil was found effective and have highest mortality of 83.33% over the rest of the treatments. The minimum mortality was observed in T_3 lavender oil with 31.10 % mortality. Rest of the treatments were found intermediate as T_4 karanj oil (77.77%) followed by T_2 clove oil (67.77%) followed by T_5 eucalyptus oil (57.77%) followed by T_6 lemon grass oil (54.44%) and T7 tea tree oil (51.10%). whereas no mortality was observed in T_0 untreated control.

Table 1. Mortality of rice weevil as influenced by different essential oils in stored wheat

Treated oil	Dose in (ml/kg)	Mortality%			
		24 Hours after treatment	48 Hours after treatment	72 Hours after treatment	Overall mean
Neem oil	5 ml/kg	76.66	80	93.33	83.33
Clove oil	5 ml/kg	63.33	66.66	73.33	67.77
Lavender oil	4 ml/kg	26.66	30	36.66	31.1
Karanj oil	4 ml/kg	73.33	76.66	83.33	77.77
Eucalyptus oil	5 ml/kg	53.33	56.66	63.33	57.77
Lemon grass oil	5 ml/kg	50	53.33	60	54.44
Tea tree oil	5 ml/kg	46.66	50	56.66	51.1
Untreated control		0	0	0	0
S.E.(d)		2.041	1.8	1.66	1.8
C.D		10.6	9.348	8.655	9.349
C.V		12.561	10.453	8.571	10.207

3.2 Weight Loss of Treated Grain under Free Choice Test

The data pertaining to overall mean percent weight loss of rice weevil at intervals of 30, 60 and 90 days after treatment are mentioned in below table. The results revealed that T_1 neem oil (7.32%) followed by T_4 karanj oil (11.99%). least weight loss was recorded in T_3 lavender oil (41.06%). whereas rest of the treatments were found intermediate as T_2 clove oil (16.79%) followed by T_5 eucalyptus oil (22.77%) followed by T_6 lemon grass oil (26.73%) and T_7 tea tree oil (31.14%). Whereas in T_0 untreated control it was observed that 47.32% of weight loss was recorded.

3.3 Effect on Germination Percentage of Wheat Grains

Results revealed that highest germination percentage was recorded in T_1 neem oil (93.33%) followed by T_4 karanj oil (86.66%). Least germination was recorded in T_3 lavender oil (46.66%), Remaining treatments found intermediate as T_2 clove oil (73.33%) followed by T_5 eucalyptus oil (66.66%) followed by T_6 lemon grass oil (63.33%) and T_7 tea tree oil (53.33%). whereas T_0 untreated control has 23.33% was observed.

4. DISCUSSION

4.1 Efficacy of Different Essential Oils on Adult Mortality of Rice Weevil, *Sitophilus oryzae* Linn. on Stored Wheat

All the treatments were found to be significantly superior to control in enhancing adult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to Poudel et al. [6] among all the treatments the next best treatment is T_4 karanj oil and the

Table 2. weight loss of treated seed grains under free choice test

Treated oil	Dose in (ml/kg)	Mortality%			
		24 Hours after treatment	60 DAT	90 DAT	24 Hours after treatment
Neem oil	5 ml/kg	4.21	7.96	9.8	7.32
Clove oil	5 ml/kg	12.41	17.85	20.13	16.79
Lavender oil	4 ml/kg	36.05	42.4	44.75	41.06
Karanj oil	4 ml/kg	7.66	13.36	15	11.99
Eucalyptus oil	5 ml/kg	18.60	24.06	25.66	22.77
Lemon grass oil	5 ml/kg	22.28	28.13	29.8	26.73
Tea tree oil	5 ml/kg	27.13	31.91	34.38	31.14
Untreated control		41.36	48.46	52.15	47.32
S.E.(d)		0.268	0.221	0.23	1.353
C.D		1.393	1.15	1.197	7.028
C.V		3.794	2.481	2.388	15.831

Table 3. Effect on germination percent on wheat grains

Treated Oil	Dose (ml /kg)	Germination%
Neem oil	5 ml/kg	93.33
Clove oil	5 ml/kg	73.33
Lavender oil	4 ml/kg	46.66
Karanj oil	4 ml/kg	86.66
Eucalyptus oil	5 ml/kg	66.66
Lemon grass oil	5 ml/kg	63.33
Tea tree oil	5 ml/kg	53.33
Untreated control		23.33
S.E.(d)		1.92
C.D		9.99
C.V		9.11

results are similar to Gayatree et al. (2022). the next best treatment T_2 clove and results are supported by Bhattaraj et al. (2023) followed by T_5 eucalyptus oil as supported by Yang et al. (2020) followed by T_6 lemongrass oil as supported by Poudel et al. [12] followed by T_7 tea tree oil as supported by Yang et al. (2020). lavender oil showed least effect and results are similar to Germinara et al. (2017).

4.2 Efficacy of Different Essential Oils on Weight Loss of Treated Grain under Free Choice Test

All the treatments were found to be significantly superior to control in enhancing adult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to Poudel et al. [12]. among all the treatments the next best treatment is T_4 karanj oil and the results are similar to Gayatree et al. (2022). The next best treatment T_2 clove and results are supported by Bhattaraj et al. (2023) followed by T_5 eucalyptus oil as supported by Yang et al. (2020) followed by T_6 lemongrass oil as supported by Poudel et al. (2023) followed by T_7 tea tree oil as supported by Yang et al. (2020). lavender oil showed least effect and results are similar to Germinara et al. (2017).

4.3 Effect on Germination Percentage of Wheat Grains

All the treatments were found to be significantly superior to control in enhancing adult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to Poudel et al. [12] among all the treatments the next best treatment is T_4 karanj oil and the results are similar to Gayatree et al. (2022) the next best treatment T_2 clove and results are supported by Bhattaraj et al. (2023) followed by T_5 eucalyptus oil as supported by Yang et al. (2020) followed by T_6 lemongrass oil as supported by Poudel et al. [12] followed by T_7 tea tree oil as supported by Yang et al. (2020). lavender oil showed least effect and results are similar to Germinara et al. (2017).

5. CONCLUSION

In the research, it was the percent mortality was highest in treated grains with treatment T_1 neem oil followed by T_4 karanj oil. The least mortality was observed in T_3 lavender oil. Efficacy of different essential oils on weight loss of treated grain under free choice test the percent weight loss was highest in treated grains with treatment T_1 neem oil followed by T_4 karanj oil. The least mortality was observed in T_3 lavender oil. Effect on germination percentage of wheat grains the germination percentage was highest in treated grains with treatment T_1 neem oil followed by T_4 karanj oil. The least mortality was observed in T_3 lavender oil.

ACKNOWLEDGEMENT

I would like to thank Mrs. Usha Yadav for her motivation and guidance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Isman MB. The role of botanical insecticides, deterrents and repellents in modern agriculture and an increasingly regulated world. Annual Reviews of Entomology. 2006;51:45-66.

2. Weaver DK, Subramanyam B. Botanicals. Alternatives to pesticides in stored product IPM. 2000;303-320.
3. Chauhan P, Jakhmola SS, Bhadauria NS, Dwivedi US. Influence of wheat varieties on biological activities of rice weevil, *Sitophilus oryzae*. Indian Journal of Entomology. 2005;67(4):366-368.
4. Sahaf BZ, Moharramipour S, Meshkatalsadat H. Fumigant toxicity of essential oil from Vitex pseudo-negundo against pulse beetle, T*ribolium castaneum* (Hurbst) and *Sitophilus oryzae* (L.), Journal of Asia Specific Entomology. 2008;11:175-179.
5. White NDG, Leesch JG. Chemical control. In: Subramanyam, B., Hagstrum; 1995.
6. Benhalima H, Chaudhry MQ, Mills KA, Price NR. Phosphine resistance in stored-product insects collected from various grain storage facilities in Morocco. Journal of Stored Product Research. 2004;40:241-249.
7. Collins PJ, Daglish GJ, Pavic H, Kopittke RA. Response of mixed-age cultures of phosphine resistance and susceptible strains of Lesser Grain Borer, *Rhizopertha dominica* to phosphine at a range of concentrations and exposure periods. Journal of Stored Products Research. 2005;41:373-385.
8. Isman MB, Seffrin R. Natural insecticides from the Annonaceae: A unique example for developing biopesticides. Advances in Plant Biopesticides. 2014;21-33.
9. Klocke JA. Plant compounds as source and models of insect control agents. In: Hostettmann, K. (Ed.), Economic and Medicinal Plant Research, Academic press, London. 1989;103-144.
10. Patil N, Guru-Pirasanna-Pandi G, Adak T, Gowda B, Annamalai M, Jena M. Toxicological effect of underutilized plant, *Cleistanthus collinus* leaf extracts against two major stored grain pests, the rice weevil, *Sitophilus oryzae* and red flour beetle, *Tribolium castaneum*. Ecotoxicology and Environmental Safety. 2018;154:92-99.
11. Rajendran S, Sriranjini V. Plant products as fumigants for stored product insect control. Journal of Stored-Product Insect Control, Journal of Stored Product Research. 2008;44:126-135.
12. Poudel PK, Bhattarai A, Khadke Poudel NK, Gouli S, Singh NB. Efficacy of essential oils against Maize Weevil (*Sitophilus zeamais*) under laboratory condition of Lamjung Campus. Malaysian Journal of Halal Research. 2023;6(1):05-08.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/107142