Efficacy of some essential oil for the management of Rice Weevil (*Sitophilus oryzae*) on stored wheat

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 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.
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.
Botanical insecticides have long been treated as attractive alternatives to synthetic chemical insecticides (Isman, 2006). 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 (Weaver and Subramanyam, 2000).
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 (Chauhan et al., 2005; Sahaf et al., 2008). Effective management of S. oryzae is mainly depending upon the use of conventional liquid and gaseous insecticides (White and Leesch, 1995).
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

Comment [PSCC1]: Italics

Comment [PSCC2]: italics

2. MATERIAL AND METHODS

Studies on *Sitophilusoryzae*were conducted at Entomology department SHUATS, Prayagrajduring 2022. Materials used and the techniques employed during the course of investigation for conducting experiment are presented below. The materials used and the methods followed in the present research are discussed in this chapter.

Comment [PSCC3]: *S. oryzae*

Comment [PSCC4]: Use the same font throughout the text

RearingoftestinsectS.oryzae: The cultures of *S. oryzae*were obtained from the local markets ofPrayagraj. 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 wereallowed 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.*

Othermaterials:

Petriplates,plasticjars,muslincloth,butterpaper,markerandrubberbands.

Preparationofplantproducts:

Allthetreatmentsusedwerecollectedfromthelocalmarkets.

Observation to be recorded

Evaluationbasedonmortality

The cereal grains (100g) 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*adultswerereleased in each plasticcontainerat an interval of24, 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.

$$\text{Percentadultmortality} = \frac{\text{Numberofdeadinsects}}{\text{Numberofinsectsreleased}} \text{X100}$$

Evaluationbasedonweightlossinfreechoicetest

100g 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

$$\text{Percentweightloss} = \frac{\text{Initialweightofseeds-Finalweightofseed}}{\text{Initialweightofseeds}} \text{X100}$$

Evaluationbasedongermination

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

$$\text{Percentageofseed germination} = \frac{\text{Numberofgerminatedseeds}}{\text{Totalnumberofseeds}} \text{X100}$$

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.

Results and Discussion

Percent adult mortality

The data pertaining to overall mean mortalityof rice weevil at intervals of24, 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 mortalityof 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_4karanj 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 T7tea 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.

treatments	dosage	mortality%			
		24HAT	48HAT	72HAT	Overallmean
Neemoil	5ml/kg	76.66	80	93.33	83.33
Clove oil	5ml/kg	63.33	66.66	73.33	67.77
Lavenderoil	4ml/kg	26.66	30	36.66	31.1
Karanjoil	4ml/kg	73.33	76.66	83.33	77.77
Eucalyptusoil	5ml/kg	53.33	56.66	63.33	57.77
Lemongrassoil	5ml/kg	50	53.33	60	54.44
Teatreeoil	5ml/kg	46.66	50	56.66	51.1
Untreatedcontrol		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

Comment [PSCC5]: (oil)

Comment [PSCC6]: ml/kg

Comment [PSCC7]: Include other fila Hours beore Treatemnt

weight loss of treated grain under free choicetest

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_4karanj 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 cloveoil (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.

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

Comment [PSCC8]: Equal the table 1

treatments	dosage	%weightloss			
		30DAT	60DAT	90DAT	Overallmean

Neem oil	5ml/kg	4.21	7.96	9.8	7.32
Clove oil	5ml/kg	12.41	17.85	20.13	16.79
Lavenderoil	4ml/kg	36.05	42.4	44.75	41.06
Karanjoil	4ml/kg	7.66	13.36	15	11.99
Eucalyptusoil	5ml/kg	18.60	24.06	25.66	22.77
Lemongrassoil	5ml/kg	22.28	28.13	29.8	26.73
Teatreeoil	5ml/kg	27.13	31.91	34.38	31.14
Untreatedcontrol		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

Effectongerminationpercentageofwheatgrains

Results revealed that highest germination percentage was recorded in T_1 neem oil (93.33%) followedbyT_4karanj 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.

Table 3: Effect on germination percent on wheat grains

Comment [PSCC9]: Equal table 1

Treatments	dosage	germination%
Neemoil	5ml/ kg	93.33
Clove oil	5ml/ kg	73.33
Lavenderoil	4ml/ kg	46.66
Karanjoil	4ml/ kg	86.66
Eucalyptusoil	5ml/ kg	66.66
Lemongrassoil	5ml/ kg	63.33
Teatreeoil	5ml/	53.33

	kg	
Untreatedcontrol		23.33
S.E.(d)		1.92
C.D		9.99
C.V		9.11

4. DISCUSSION

Efficacy of different essential oils on adult mortality of rice weevil, Sitophilus oryzae*Linn. on stored wheat.*

Comment [PSCC10]: Itlics only *S. oryzae*

All thetreatments were found to besignificantlysuperiorto control in enhancingadult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to **poudel*et al.* (2023)**. among all the treatments the next best treatment is T_4karanj 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 byT_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_7tea tree oilas supported by **yang *et al.* (2020).**lavender oil showed least effect and results are similar to **germinara*et al.* (2017).**

Efficacy of different essential oils on weight loss of treated grain under free choice test.

All thetreatments were found to besignificantlysuperiorto control in enhancingadult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to **poudel*et al.* (2023)**. among all the treatments the next best treatment is T_4karanj 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 byT_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_7tea tree oilas supported by **yang *et al.* (2020).**lavender oil showed least effect and results are similar to **germinara*et al.* (2017).**

Effectongerminationpercentageofwheatgrains.

Allthetreatments werefoundtobesignificantlysuperiorto control inenhancing adult mortality. From the results maximum mortality was recorded in T_1 neem oil and results are similar to **poudel*et al.* (2023)**. among all the treatments the next best treatment is T_4karanj 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 byT_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_7tea tree oilas supported by **yang *et al.* (2020).**lavender oil showed least effect and results are similar to **germinara*et al.* (2017).**

Conclusion

In the research, it was the percent mortality was highest in treated grains with treatment T_1 neem oil followed byT_4karanj oil. The least mortality was observed in T_3 lavender oil. Efficacyofdifferentessentialoilsonweightlossoftreatedgrainunderfreechoicetest the percent weight losswas highest in treated grains with treatment T_1 neem oil followed by T_4karanj oil. The least mortality was observed in T_3 lavender oil. Effectongerminationpercentageofwheatgrains

ThegerminationpercentagewashighestintreatedgrainswithtreatmentT_1neemoil followed by T_4karanj oil. The least mortality was observed in T_3 lavender oil.

Reference

Benhalima,H.,Chaudhry,M.Q.,Mills,K.A.andPrice,N.R.2004. Phosphineresistance in stored-product insects collected from various grain storage facilities in Morocco. *Journal ofStored Product Research*, **40**: 241-249.

Collins, P. J., Daglish, G. J., Pavic, H. and Kopittke, R.A. 2005. Response of mixed-age cultures of phosphine resistance and susceptible strains of Lesser Grain Borer, *Rhizoperthadominica*to phosphine at a range of concentrations and exposure periods. *Journal of Stored Products Research*, **41**: 373-385.

Chauhan, P. Jakhmola, S. S., Bhadauria, N.S. and Dwivedi, U.S. 2005. Influence ofwheat varieties on biological activities of rice weevil, *Sitophilus oryzae*. *Indian Journal of Entomology*,**67**(4): 366-368.

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

Isman, M. B., &Seffrin, R. (2014). Natural insecticides from the Annonaceae: a unique example for developing biopesticides. *Advances in plant biopesticides*, 21-33.

Klocke, J. A. (1989) Plant compounds as source and models of insect control agents. In: Hostettmann, K. (Ed.), *Economic and Medicinal Plant Research*, Academic press, London,PP.103-144.

Patil, N., Guru-Pirasanna-Pandi, G., Adak, T., Gowda, B., Annamalai, M., Jena, M. (2018). Toxicological effect of underutilized plant, *Cleistanthuscollinus* leaf extracts against two major stored grain pests, the rice weevil, Sitophilus oryzae and red flour beetle, *Triboliumcastaneum*. *Ecotoxicology and environmental safety*, *154*, 92-99.

Poudel, P.K., Bhattarai, A., Khadke, Poudel, N.K., Gouli, S., and Singh, N.B. 2023 Efficacy of essential oils against Maize Weevil (*Sitophilus zeamais*) under laboratory conditionof Lamjung Campus. *Malaysian Journal of Halal Research* 6(**1**) (2023) 05- 08.

Rajendran, S. andSriranjini, V. 2008. Plantproductsasfumigantsforstoredproductinsect control. *Journal of Stored-Product Insect Control*, *Journal of stored product research.***44**:126-135.

Sahaf, B. Z., Moharramipour, S. and Meshkatalsadat, H. 2008. Fumigant toxicity of essential oil from *Vitex pseudo-negundo* against pulse beetle, *Triboliumcastaneum*(Hurbst) and *Sitophilus oryzae*(L.), *Journal of Asia Specific Entomology*, **11**: 175- 179.

Weaver, D. K., & Subramanyam, B. (2000). Botanicals. *Alternatives to pesticides instored-product IPM*, 303-320.

White,N.D.G.and Leesch, J.G.1995. Chemicalcontrol.In:Subramanyam,B.,Hagstrum.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

Here is the Definitions section. This is an optional section.
Term: Definition for the term