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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 687-690

www.thepharmajournal.com
Received: 16-06-2023
Accepted: 26-07-2023

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Efficacy of different botanicals against Rice weevil, (*Sitophilus oryzae* L.) under storage condition in rice (*Oryza sativa* L.)

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Abstract
The laboratory experiments were conducted to study the host preference of Rice weevil *Sitophilus oryzae* (L.) on different cereal grains (Rice, pearl millet, Barley and Soyabean) and also to study the efficacy of some indigenous plant products such as Neem leaf powder, tulsi leaves powder, tobacco leaf powder, pepper nigrum powder, ginger rhizome powder, garlic powder, cypermethrin against rice weevil, *Sitophilus oryzae* (L.) on stored Rice by undertaking various parameters *viz.*, percent adult mortality, percent weight loss after three months of storage. The research was carried out at Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, U.P. in department of Entomology 2022-2023. This experiment was conducted under Complete Randomized block Design (CRD). After 90 days of storage for observation of host preference, highest weight loss was observed in pearl millet followed by barley and rice and least weight loss was counted in soyabean. Among the various plant-based products assessed for their effectiveness against the rice weevil (*Sitophilus oryzae*) in stored rice grains, neem leaf powder exhibited remarkable results. It demonstrated a substantial adult mortality reduction of 72.22% and minimized seed weight loss to a significant degree. Following neem leaf powder, the hierarchy of efficacy was observed as tobacco leaf powder, black pepper (*Piper nigrum*) powder, tulsi (holy basil) powder, ginger powder, and garlic powder. Whereas, the minimum efficacy was recorded in garlic powder and ginger rhizome powder. The current investigation has effectively demonstrated that these naturally existing native plant products hold the potential to be employed in the control of storage insect pests in rice.

Keywords: Host preference, mortality, rice weevil, weight loss, wheat

Introduction
Rice (*Oryza sativa*) is an edible starchy cereal grain that originates from the grass plant in the Poaceae family. Approximately half of the global population, encompassing nearly all of East and Southeast Asia, relies heavily on rice as a fundamental dietary staple. Human consumption accounts for 95% of the total rice harvest worldwide.

Cooked unenriched long-grain white rice is composed of 68% water, 28% carbohydrates, 3% protein, and negligible fat. A 100gram reference serving of it provides 540 kilojoules (130 kilocalories) of food energy and contains no micronutrients in significant amounts, with all less than 10% of the Daily Value (DV). Singh 2013 [9]. When cooked, short-grain white rice offers comparable food energy and contains moderate quantities of B vitamins, iron, and manganese, ranging from 10% to 17% of the Daily Value (DV) in a 100-gram serving. Studies proposing rice fortification strategies to address malnutrition have outlined various approaches involving micronutrients. These strategies include fortifying rice with iron alone, iron combined with zinc, vitamin A, folic acid, or a blend of iron and other B-complex vitamins such as thiamine, niacin, vitamin B6, and pantothenic acid. An exhaustive analysis of clinical research investigating the effectiveness of rice fortification revealed that this approach primarily reduced the risk of iron deficiency by 35% and elevated hemoglobin levels in the blood. The established guideline underscores a significant recommendation: "Fortification of rice with iron is recommended as a public health strategy to improve the iron status of populations, in settings where rice is a staple food. Yadav *et al.* (2017) [10]

The rice weevil holds considerable economic significance as a highly detrimental insect pest. Originally emerging from India, it has spread worldwide, becoming cosmopolitan in nature. Its primary targets are whole grains, including wheat, corn, barley, and rice, where it has been observed to engage in active breeding. Over time, its host range has expanded to encompass split legumes as well. (Deepthi and Manjunatha, 2016) [3].

Both larvae and adults of the rice weevil exhibit internal feeding behavior, causing a detrimental impact on both the quality and quantity of grains. This species demonstrates a relatively short developmental period, facilitating the rapid buildup of high populations. If not effectively controlled, this can lead to substantial infestations. Conversely, external feeders, lacking the ability to infest sound grains, contribute to an accelerated escalation of damage. Adult female weevils lay an average of 4 eggs daily and up to a total of 300 throughout their lifespan, which spans four to five months. While the entire life cycle can be as short as 26 to 32 days during hot summer months, cooler weather extends this period significantly. Eggs typically hatch within 3 to 5 days. The larval stage, which involves feeding within the grain kernel, ranges from 18 to 25 days, contingent on prevailing climatic conditions. The pupal phase, characterized by a naked pupa, lasts approximately 6 to 8 days. Following pupation, the emerging adult remains within the seed for 3 to 4 days as it undergoes the processes of hardening and maturation. The name "rice weevil" stems from its initial discovery in rice crops.

Materials and Methods

Studies on the "Efficacy of different botanicals against Rice weevil, (*Sitophilus oryzae* L.) under storage condition in rice (*Oryza sativa* L.)" 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. The materials used and the methods followed in the present research are discussed in this chapter.

Rearing of test insect *S. orzyae*

The cultures of S. oryzae were sourced from local establishments in Prayagraj. For insect rearing, plastic containers with a capacity of 2 kg were utilized. Each container held approximately 500 grams of grains, accompanied by the separate release of around 600 adult insects. These insects were allowed to lay eggs over a span of 3 to 5 days and were subsequently removed after 7 days, once the egg-laying phase concluded. These containers were maintained at room temperature to facilitate the emergence of adult S. oryzae. To initiate the culture, healthy rice seeds were placed within cylindrical jars measuring 32 × 22.5 cm. Within each jar, 10 pairs of adult weevils were isolated and released. The jar's opening was covered with a muslin cloth, securely fastened with a rubber band. Fresh seeds were intermittently provided to facilitate weevil development. Following the emergence of new adult weevils after a few days, these weevils were introduced to healthy rice seeds within a series of cylindrical jars. This process aimed to establish a consistent population. The population density per jar was standardized to prevent overcrowding, as excessive crowding had been observed to lead to diminished reproductive activity. Such measures were essential to avoid transient changes in insect behavior or biology that might arise due to alterations in the host grain. These studies were conducted at 30 °C temperature and 80 per cent relative humidity in laboratory.

Preparation of plant products

The plant products of neem leaves powder *Azadirachta indica*, Tulasi leaf powder *Ocimum santum*, Tobacco leaves powder *Nicotiana tabacum*, Pepper powder *Pepper nigrum*, Ginger rhizome powder *Zingiber officinale*, Garlic powder *Allium sativum* and chemical Cypermethrin all treatments were dried under shade and grinded into fine powder.

Mixing of grain protectants

Ten glass jars, each with a capacity of one kg, were selected for the experiment. Each jar was loaded with 100g of ice and subjected to the application of the aforementioned plant products. The treated seed material was placed within the glass jars, which were then covered by muslin cloth and securely fastened with rubber bands. In order to establish a control group, untreated seeds were utilized. To replicate the treatments, 100g of rice grains were evenly distributed across various jars, resulting in three repetitions for each treatment. For each replication, ten pairs of newly emerged adult insects were introduced. Adult mortality was noted for 3, 7and 14 days after treatments and percent weight loss and seed damage was noted at 30, 60 and 90 days after release. Abhijith *et al*. (2018) [1].

Efficacy based on weight loss

The observations were recorded on % weight loss of treated rice grains. The weight loss caused by one generation of *S. oryzae* was compared with weight loss obtained in untreated (control) and is be recorded for 30, 60 and 90 days after treatment application and is calculated by using the formula:

$$\text{Percent weight loss} = \frac{\text{Initial weight} - \text{final weight}}{\text{Initial weight}} \times 100$$

Balmain *et al*. (2001) [2]

Efficacy based on seed damage

The number of seeds infested by *S. oryzae* counted and per cent infestation was worked out on the basis of seeds with characteristic holes made by weevils. The seed infestation was recorded for 30, 60 and 90 days after treatment application and is calculated by following formula:

$$\text{Percent seed damage} = \frac{\text{Number of damaged seeds}}{\text{Number of seeds taken}} \times 100$$

Deepthi *et al.* (2016) [3]

Statistical analysis

The collected data, which was averaged for each specific parameter, underwent appropriate transformations. Following the analysis, the data was organized into a table according to the objectives' requirements for result interpretation. The established protocols outlined in agricultural statistics resources were consistently followed. The interpretation of the data was carried out using the critical difference value calculated at a 0.05 probability level. The level of significance was expressed at 0.05 probability.

Results and discussion

Among all botanicals evaluated for efficacy over 14 days of storage, the significantly best treatments were T7 Cypermethrin retained its residual toxicity and caused significantly maximum adult mortality (100.00%). While, *S. oryzae* were less susceptible to T6 garlic powder (21.10%). However, the effectiveness of the various botanicals in descending order was T_7 Cypermethrin (100%) > T1 neem leaf powder (72.22%) >T3 tobacco leaves powder (53.33%) > T4 piper leaf powder (46.66%) > T2 tulsi leaves powder (36.66%) > T5 ginger rhizome powder (34.44%) >T6 garlic powder (21.10%) > T 8 control treatment (00.00%) patel *et al.* (2006) [8].

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Table 1: Mortality of rice weevil as influenced by different botanicals in Rice

Treatments no	Treatments	Percent Mortality			
		3DAT	7DAT	14DAT	Mean
T1	Neem leaf powder	60.000	73.333	83.333	72.220
T2	Tulsi leaf powder	30.000	33.333	46.667	36.663
T3	Tobacco leaf powder	50.000	53.333	56.667	53.330
T4	*Piper nigrum*	40.000	46.667	53.333	46.663
T5	Ginger powder	23.333	33.333	46.667	34.440
T6	Garlic powder	13.333	23.333	26.667	21.107
T7	Cypermethrin	100.000	100.000	100.000	100.000
T8	Control	0.000	0.000	0.000	0.000
S.E(m) ±		2.54	1.66	1.66	2.51
C.D.		13.22	8.65	8.65	13.05
C.V.		19.29	11.00	9.67	16.56

Table 2: Loss in weight due to rice weevil as influenced by different botanicals in Rice.

Treatments no	Treatments	Percent weight loss			
		30DAS	60DAS	90DAS	Mean
T1	Neem leaf powder	0.233	0.433	0.667	0.440
T2	Tulsi leaf powder	0.533	0.967	0.367	0.783
T3	Tobacco leaf powder	0.300	0.467	0.867	0.630
T4	*Piper nigrum*	0.367	0.767	1.133	0.827
T5	Ginger powder	0.867	1.333	1.667	1.150
T6	Garlic powder	0.567	0.767	1.267	0.993
T7	Cypermethrin	0.083	0.233	0.517	0.273
T8	Control	0.933	1.867	2.467	1.750
S.E.		0.01	0.01	0.01	0.14
C.D.		0.08	0.09	0.09	0.77
C.V.		10.30	6.43	4.41	52.15

Conclusion

Ensuring the secure storage of rice is imperative due to its susceptibility to damage by rice weevils during storage. Drawing from laboratory experiments, it can be inferred that cypermethrin, a chemical agent, exhibits toxicity against rice weevils. Notably, tobacco leaf powder demonstrates a more pronounced activity, with nicotine swiftly eradicating the insects within a short timeframe. Similarly, other botanicals such as neem leaf powder, Tulasi leaf powder, pepper powder, ginger rhizome powder, and garlic powder manifest insecticidal properties through bioactive compounds. These compounds induce paralysis, convulsions, and ultimately death in weevils. Treating rice grains with these botanicals has proven efficacy against the primary insect pests affecting stored rice. This approach is advantageous for its cost-effectiveness, environmental friendliness, and feasibility for small-scale farmers. Furthermore, these botanicals offer a viable alternative to synthetic insecticides, particularly for shorter storage durations. While these conclusions stem from a single laboratory experiment, conducting additional repetitions would enhance the confirmation and recommendation of these findings

References

1. Abhijith N, Mohan S, Nelson SJ. Bioassay to detect the toxicity of sweet flag (*Acorus calamus*) 6 EC formulation against pests of stored spices *viz.*, rusty grain beetle, *C. ferrugineus* (Stephens) cigarette beetle, *L. serricorne* (F.) and red flour beetle, *T. castaneum* (Herbst). Journal of Entomology and Zoology Studies. 2018;6(5):1921-1924.
2. Balmain SR, Neal GE, Ray DE, Golop A. Insecticidal and vertebrate toxicity associated with ethnobotanicals used as postharvest protectants in Ghana. Food Chemistry and Toxicology. 2001;39:287-291.
3. Deepthi N, Manjunatha M. Evaluation of selected botanicals against *Sitophilus oryzae* (L.) in stored grains. Journal of Eco-friendly Agriculture. 2016;11(1):62-64.
4. Devi KC, Devi SS. Insecticidal and oviposition deterrent properties of some spices against coleopteran beetle, *Sitophilus oryzae*. Journal of Food Science and Technology. 2013;50:600-604.
5. Govindan K, Nelson SJ. Insecticidal activity of twenty plant powders on mortality, adult emergence of *Sitophilus oryzae* L. and grain weight loss in paddy. Journal of Bio-pesticides. 2009;2:169-172.
6. Ghosh SK, Durbey SL. Integrate management of stored grain pest. International Book Distributing Company, Lucknow. 2003, p. 125-126.
7. Kumar R, Gangwar S, Yadav K, Tyagi S, Ramesh. Survey and surveillance of major insect-pests of basmati rice in western Uttar Pradesh (India). International Journal of Research in Applied, Natural and Social Sciences. 2015;3(3):1-8.
8. Patel Y. Characterization of relative susceptibility of

wheat varieties against rice weevil (*Sitophilus oryzae* Lin.). Asian Journal of Bio Science. 2006;1(2):106-108.
9. Singh JM, Grover DK. Post-harvest Losses in Wheat Crop in Punjab: Past and Present. Agricultural Economics Research Review. 2013;26(2):293-297.
10. Yadav U, Tiwari R. Eco-friendly management of *Sitophilus oryzae* and *Rhyzopertha dominica* in stored wheat at Pantnagar, Uttarakhand. Journal of Applied and Natural Science. 2017;9(2):736-743.