Biological Forum – An International Journal 16(5): 118-121(2024)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Screening of Plant Powders Against Rice Weevil (*Sitophilus oryzae* L.)

***Sanskriti B. Maurya*[1], *M. Raghuraman*[2] *and Ranjeet Kumar*[3*]**
[1]Department of Entomology, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi (Uttar Pradesh), India.
[2]Department of Entomology, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi (Uttar Pradesh), India.
[3]Department of Entomology, Bihar Agricultural University, Bhagalpur (Bihar), India.

(Corresponding author: Ranjeet Kumar)*
(Received: 09 March 2024; Revised: 27 March 2024; Accepted: 20 April 2024; Published: 15 May 2024)
(Published by Research Trend)

ABSTRACT: *Sitophilus oryzae* commonly known as the rice weevil, (Coleoptera: Curculionidae) is a significant threat to stored cereals in India and other regions. On average 10% of overall losses of food commodities are caused by stored grain insect pests. In this study, we examined the insecticidal activity of different plant powders against adult emergence and percent inhibition of rice weevil *Sitophilus oryzae*. The insecticidal performance of botanical powders made from leaves of certain plants: *Lantana camara Curcuma longa, Callistemon citrinus, Melia azadirechta, Azadirechta indica, Murrya koenigii, Eucalyptus citriodora, Ocimum sanctum, Ageratum conyzoides, Chenopodium album, Trigonella foenum, Andrographis peniculata, Allium sativum* and *Jatropha curcas* at rates of 5, 7, 10, and 12 g /kg wheat grains were evaluated against *Sitophilus oryzae*. Among the different treatments applied, *M. koenigii, E. citrodora, O. sanctum, A. conozoides, C. album, T. foenum, A. peniculata, and A. sativum stood out in their effectiveness* against *S. oryzae*. At all doses (5, 7, 10, and 12 g/kg), these treatments ensured no adult population buildup and consistently recorded cent percent inhibition in both sets of tests followed by *J. curcas* leaf powder. Other treatments resulted in no emergence of *S. oryzae* adults and complete inhibition at doses of 10 and 12 g/kg, while at 5g/kg *C. citranus* showed maximum adult emergence and the least percent inhibition, thus recorded as the least effective among all the treatments. They are effective in managing the tested insect population. It is environmentally safe and does not affect human health.

Keywords: Stored grain pest, plant powders, *Sitophilus oryzae* adult emergence, percent inhibition.

INTRODUCTION

Food grains play a significant role in the vegetarian diet of India. The development of agricultural technologies has led to a steady increase in grain production, yet improper storage causes significant grain losses. These losses have a monetary value of more than Rs 50,000 crores yearly (Singh, 2010). In developed countries, insect-induced postharvest losses in stored products are 9-20%, while in developing countries like India, the losses are 2.0-4.2% (Anonymous, 2019). Wheat is a vital cereal for most people worldwide. In 2018-19, it ranked as the second-highest cereal produced in India, with an estimated yield of 107.18 million tonnes and a productivity of 3507 kg per hectare (Anonymous, 2019). Between the time of harvest and storage, wheat is susceptible to infestations by a range of insect pests. The rice weevil, scientifically known as *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), is the most prevalent and damaging primary insect pest that infests stored grains worldwide, with a particular emphasis on cereals (Mehta & Kumar 2020). To address the issue of stored grain pests, farmers currently use various synthetic insecticides and phosphine gas (Anwar *et al*., 2003). However, in India, persistent chemical usage has led insects to develop a strong resistance to phosphine (Mau *et al*., 2012). Chemical fumigants contaminate food products seriously endanger human health, cause environmental damage, and develop insect resistance (Kumar, 2022). Botanical products such as neem, jatropha, and garlic have demonstrated their insecticidal properties against stored grain pests, offering a range of effects like ovicidal, repellent, antifeedant, and insecticidal actions. While the use of botanicals in agriculture is currently limited in industrialized countries, there is potential for their commercial development targeting specific insects. These botanicals are often eco-friendly, biodegradable, and produce non-toxic byproducts, making them suitable for integrated pest management and the development of safer insect control methods. There is a lack of information regarding the use of plant extracts to control insect pests in stored grains, particularly when it comes to dealing with rice weevils. Therefore, this study was initiated to identify and suggest the most potentially efficient plant powders for controlling *Sitophillus oryzae* (L.).

MATERIALS AND METHODS

Experiments were carried out in the Entomological Laboratory Department of Entomology and Agril. Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. Pure culture of test insects (*Sitophilus oryzae*) were cultured in an incubator at 27 ± 1 °C temp. and 70 ± 5% RH. Pure culture of test insects was reared in plastic jars, with proper aeration. Adults of *S. oryzae* were reared on wheat variety HD-2967. The moisture content of seeds was raised as per the formula of Pixton (1967)

$$\text{Quantity of water to be added} = \frac{W_1(M_2 - M_1)}{(100 - M_2)}$$

W_1= Initial weight of grain
M_1= initial moisture content
M_2= Required moisture content

The grain was maintained in tight polythene bags for a week to equilibrate its moisture content. Following this process, 500g of grains were put in a plastic jar, and 100 adults of insects with comparable sex ratios were released and placed in an incubator individually. For all experimental purposes, 0-7 days old (First generation) test insects were used. All of the experiments on *S. oryzae* were carried out on wheat variety HD-2967 untreated-grade seeds. Before usage, the grains were de-infested in a hot air oven at 60ºC for 12 hours. The moisture content of was determined after disinfestations and elevated to 13.5 percent by adding water in the needed quantity to the grains as per protocol. To ensure uniform moisture distribution, the grains were put on laboratory slabs and an adequate amount of water was sprayed on them using a hand sprayer. The grain was then well combined and sealed in a polythene bag for a week to allow the moisture content of the grains to equilibrate. To conduct the studies, the 100 g of wheat seed was placed in plastic vials with a volume of 200 ml. To test the efficiency of Plant Powders, the experiment was conducted on *S. oryzae*. The selected plant leaves were collected from different locations of the Varanasi, one kg of leaves of each plant was brought to the laboratory and dried under shade. The well-dried leaves are ground with a grinder and sieve with a 0.2 mm mesh-sized sieve. The prepared powder was kept in glass jars and used during experiments.

The experiment was carried out in a controlled environment with a temperature of 27 ± 1 °C and a relative humidity of 70 ± 5%. Each plastic vial was filled with 100 g wheat seed grains of variety HD-2967 (moisture content 13.5%). Each treatment was replicated three times. At the same time, the untreated wheat seed was used as a control. Different test insect sets were prepared, and ten *S. oryzae* were released in vials at 0-7 days old. After the insects had been released for 24 hours, a measurable amount of Plant Powders was mixed in each vial. After one month of treatment, the first progeny was counted from each treatment.

Table 1: Details of the plant and plant parts used as powders for experiment.

Sr. No.	Name of the Plant	Scientific Name	Family	Plant part used for powder	Dose G/Kg
1.	Lantana	*Lantana camera*	Verbenaceae	Leaves	5.0,7.0,10.0,12.0
2.	Turmeric	*Curcuma longa*	Zingerberaceae	Leaves	5.0,7.0,10.0,12.0
3.	Bottle Brush	*Callistemon citranus*	Myrtaceae	Leaves	5.0,7.0,10.0,12.0
4.	Neem	*Azadirechta indica*	Lamiaceae	Leaves	5.0,7.0,10.0,12.0
5.	Bakain	*Melia azadirechta*	Lamiaceae	Leaves	5.0,7.0,10.0,12.0
6.	Sweet Neem	*Murrya koenigii*	Rutaceae	Leaves	5.0,7.0,10.0,12.0
7.	Eucalyptus	*Eucalyptus citriodora*	Myrtaceae	Leaves	5.0,7.0,10.0,12.0
8.	Tulsi	*Ocimum sanctum*	Lamiaceae	Leaves	5.0,7.0,10.0,12.0
9.	Goat Weed	*Ageratum conyzoides*	Milliaceae	Leaves	5.0,7.0,10.0,12.0
10.	Bathua	*Chenopodium album*	Chinopodiaceae	Leaves	5.0,7.0,10.0,12.0
11.	Jatropha	*Jatropha curcas*	Euphorbiaceae	Leaves	5.0,7.0,10.0,12.0
12.	Meethi	*Trigonella foenum*	Umbelliferae	Leaves	5.0,7.0,10.0,12.0
13.	Kalmegh	*Andrographis peniculata*	Acanthaceae	Leaves	5.0,7.0,10.0,12.0
14.	Garlic	*Allium sativum*	Lilliaceae	Leaves	5.0,7.0,10.0,12.0
15.	Untreated Control				

RESULTS AND DISCUSSION

Multiple screening of the efficacy of plant powder was evaluated against stored grain insect *Sitophilus oryzae.* To confirm the effectiveness of these plant powders, the experiment was conducted in two distinct sessions with different doses. The effectiveness of these powders was categorized based on the production of the initial offspring. In most storage setups, infestation typically starts with a small number of insects, and the final damage largely depends on their reproduction rate. Hence, greater emphasis was placed on the suppression of the first generation's development. Based on these criteria, treatments that inhibited over percent of the first generation were deemed highly effective. Treatments with inhibition rates of 80 to 90 and 70 to 79 percent were categorized as mandatory and less effective, respectively. Conversely, treatments that resulted in less than 70% reduction of the initial offspring were ranked as least effective for managing insect pests of stored grains.

The data recorded on adult emergence and the percent inhibition, when wheat was treated with plant powders during both preliminary and confirmatory tests, against *S. oryzae* were represented in Table 2 the studies revealed that among the different treatments applied, *Murrya koenigii, Eucalyptus citrodora, Occimum sanctum, Ageratum conyzoides, Chenopodium album, Trigonella foenum, Andrographis peniculata,* and *Allium sativum* stood out in their effectiveness against *S. oryzae*. At all doses (5, 7, 10, and 12 g/kg), these treatments ensured no adult population buildup and consistently recorded a complete 100% inhibition in both sets of tests followed by *Jatropha circus leave* powder. Other treatments resulted in no emergence of *S. oryzae* adults and complete inhibition at doses of 10 and 12 g/kg. At a 7g/kg dosage, *C. citranus* application resulted in no adult emergence, achieving a complete inhibition, followed by *A. indica, M. azadirechta L. camara,* and *C. longa* had adult emergence rates of 14.7, 16.4, 21.0, and 21.0 respectively, which is highly effective as compared to untreated control (194). The inhibition rates for *M. azadirechta, A. indica, L. camara*, and *C. longa* were 94.0, 91.0, 88.9, and 76.3 percent respectively.

When seeds were treated at a dose of 5g/kg, *C. citranus* demonstrated a maximum adult emergence (58.6). However, compared to untreated control (194), this treatment still proved effective, with the least inhibition (57.6), thus recorded as the least effective among all the treatments.

Table 2: Number of adults of *Sitophilus oryzae* emerged and percent inhibition in wheat treated with Plant powder in preliminary & confirmatory tests.

Treatments	Dose (g/kg)	Preliminary test		Confirmatory test	
		Adult emerged	Percent Inhibition	Adult emerged	Percent Inhibition
Lantana camera	5.0	41.0 (3.5)	70.70	36.0 (3.4)	82.60
	7.0	37.3 (3.2)	83.60	21.0 (3.1)	88.90
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Curcuma longa	5.0	38.2 (3.7)	83.20	34.0 (3.1)	81.60
	7.0	29.7 (2.8)	78.50	(2.8)	76.30
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Callistemon citranus	5.0	62.3(5.8)	64.20	58.6 (4.9)	57.60
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Azadirechta indica	5.0	63.4 (4.2)	64.00	28.0 (3.0)	79.00
	7.0	38.2 (3.3)	83.20	14.7 (2.6)	91.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Melia azadirechta	5.0	42.3 (2.8)	86.20	26.3 (2.5)	76.50
	7.0	30.1 (3.2)	77.60	16.4 (2.4)	94.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Murrya koenigii	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Eucalyptus citriodora	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Ocimum sanctum	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Ageratum conyzoides	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Chenopodium album	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Jatropha curcas	5.0	10.3 (1.8)	96.10	08.1 (1.4)	99.80
	7.0	7.7 (1.1)	98.30	2.34 (0.7)	99.99
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00

	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Trigonella foenum	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Andrographis peniculata	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Allium sativum	5.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	7.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	10.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
	12.0	0.0 (0.5)	100.00	0.0 (0.5)	100.00
Untreated Control		154.0 (5.0)	00.00	194.7 (5.2)	00.00
S. Em±		(0.81)		(0.87)	
CD (p=0.05)		(1.90)		(2.0)	

* Data in parenthesis indicate log (X+1) transformed values

CONCLUSIONS

Stored grain pests pose a significant and serious issue by causing extensive damage to stored grains. *Sitophilus oryzae* L., as a primary pest, can result in severe grain losses. Currently, there are limited widely adopted practices for pest management, with only a small number of chemical options being used, such as aluminum phosphide tablets. These chemicals not only harm the environment but also pose health risks to humans. The Plant Powders used as treatment are *Lantana camara Curcuma longa*, *Callistemon citrinus, Melia azadirechta*, *Azadirechta indica, Murrya koenigii, Eucalyptus citriodora, Ocimum sanctum, Ageratum conyzoides, Chenopodium album, Trigonella foenum, Andrographis peniculata*, *Allium sativum, Jatropha curcas,* and untreated wheat seed as a control. Among the different treatments applied, *M. koenigii, E. citriodora, O. sanctum, A. conozoides, C. album, T. foenum, A. peniculata,* and *A. sativum* stood out in their effectiveness against *S. oryzae*. At all doses (5, 7, 10, and 12 g/kg), these treatments ensured no adult population buildup and consistently recorded cent percent inhibition in both sets of tests followed by *J. curcas* leaf powder. Other treatments resulted in no emergence of *S. oryzae* adults and complete inhibition at doses of 10 and 12 g/kg, while at 5g/kg *C. citranus* showed maximum adult emergence and the least percent inhibition, thus recorded as the least effective among all the treatments.

Acknowledgment. The author expresses his heartful gratitude to, the Department of Entomology, Prof. (Dr). M. Raghuraman, Dr. Ranjeet Kumar, Department of Entomology, and my batchmate who have helped me out in the successful completion of my research work in Entomological Laboratory Department of Entomology and Agril. Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh.

REFERENCES

Anonymous (2019). *Agricultural statistics at a glance*, *50.* https://eands. dacnet. nic. in.

Anwar, M., Ahmad, F., Hassan, M., and Ahmad, M. (2003). Control of insect pests of stored wheat by prolonged exposure to phosphine gas under polyethylene cover. *Pakistan Entomology*, *25,* 33-36

Kumar, R., Pandey, P. S., and Pandey, P. (2022). Career Opportunities in Sustainable and Eco-friendly Management of Stored Grain Insect Pests. Career Opportunities in Entomological Science. *International Books and Periodical Supply Services*, Chapter 14, 181-198 pp.

Mau, Y. S., Collins, P. J., Daglish, G. J., Nayak M. K., and Elbert, P. R. (2012). The rph2 gene is responsible for high-level resistance to phosphine in independent field strains of *Rhyzopertha dominica*. *PloS One 7,* p.e34027.

Mehta, V., and Kumar, S. (2020). Influence of different plant powders as grain protectants on *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) in stored wheat. *Journal of Food Protection, 83*(12), 2167-2172.

Pixton, S. W. (1967). Moisture content–its significance and measurement in stored products. *Journal Stored Product Research*, *3***,** 35-37.

Singh, P. K. (2010). A decentralized and holistic approach for grain management in India. *Current science, 99*(9), 1179- 1180.

How to cite this article: Sanskriti B. Maurya, M. Raghuraman and Ranjeet Kumar (2024). Screening of Plant Powders Against Rice Weevil (*Sitophilus oryzae* L.). *Biological Forum – An International Journal, 16*(5): 118-121.