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Screening of Plant Powders Against Lesser Grain Borer (*Rhyzopertha dominica* Fab.)

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ABSTRACT: *Rhyzopertha dominica* is a highly destructive insect pest that inflicts severe damage on stored wheat grains all over the world. Recently, botanical pesticides have emerged as an eco-friendly alternative to synthetic chemicals. This study was carried out to determine the toxicity of leaf powders obtained from different plants are *Lantana camara Curcuma longa, Callistemon citrinus, Melia azadirechta, Azadirechta indica, Murrya koenigii, Eucalyptus citirodora, Ocimum sanctum, Ageratum conyzoides, Chenopodium album, Trigonella foenum, Andrographis peniculata, Allium sativum, Jatropha curcas,* and untreated wheat seed as a control in the control of *R. dominica* infestation on stored wheat grains. When four doses (5.00, 7.00, 10.00, and 12.00 g) per Kg seed of all the treatments were applied to wheat grain, it resulted in zero adult emergence and complete inhibition in both Preliminary and Confirmatory tests. This indicates their strong effectiveness against the lesser grain borer in stored wheat. In contrast, the untreated grain displayed an emergence (37.26) and an inhibition percent (29.62).

Keywords: Stored grain pest, Plant Powders, *Rhyzopertha dominica,* adult emergence, percent inhibition.

INTRODUCTION

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). In India, insect pests are responsible for damaging 20-25% of the stored food grains (Rajashekar *et al*., 2010). Wheat is vulnerable to approximately 39 species of insect pests, both in the field and during storage. Among these, the lesser seed borer stands out as a primary menace to stored wheat (Mark *et al*., 2010), and this results in substantial annual losses, varying from 15% to 66%. (Singh, 2010). To overcome this challenge, farmers are presently utilizing a combination of synthetic insecticides and the application of phosphine gas as standard approaches for controlling insect pests that impact stored grains (Anwar *et al*., 2003). To prevent these issues, it is essential to establish management techniques that are both more efficient and environmentally friendly. The utilization of plant-based products is regarded as ecologically sound and poses no harm to humans or beneficial organisms. Positive results have been observed concerning the application of particular indigenous plant products for protecting grains (Sundria *et al*., 2001; Bhargava and Meena 2002). Therefore, various botanical oils and leaf powders that are readily accessible locally demonstrated significant fumigation, repellent, antifeedant, and ovicidal capabilities. (Moses *et al*., 2020) which are considered a cost-effective and environmentally safe alternative to synthetic insecticides and fumigants. This study reports on the use of some Plant Powders against lesser grain borer on wheat

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. A pure culture of test insects (*Rhyzopertha dominica*) was 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 *Rhyzopertha dominica* 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 *R. dominica* 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 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 *R. dominica.* 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 *R. dominica* 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.

RESULTS AND DISCUSSION

The study assessed the effectiveness of various plant powders against stored grain insect pests, *Rhyzopertha dominica*. The experiments were carried out in two separate sessions, to confirm the efficacy of different doses of plant powders. The results revealed that the plant powders had a deterrent effect on the feeding and reproductive activities of the tested insects. The degree of deterrence was closely linked to the dosage of the plant powders applied. The effectiveness of these powders was categorized based on their impact on the initial offspring production, as infestations often begin with a small number of insects, and the extent of damage depends on their reproduction. The primary focus was on suppressing the development of the first generation of insects. Treatments that inhibited over a certain percentage of the first generation were considered highly effective, with inhibition rates of 80-90% categorized as mandatory and rates of 70-79% as less effective. Conversely, treatments resulting in less than a 70% reduction of the initial offspring were considered least effective in managing insect pests in stored grains.

The results of adult emergence and percent inhibition obtained are represented in Table 1. When various doses of all the treatments were applied to wheat grain, it resulted in zero adult emergence and complete inhibition in both early and later tests. This indicates their strong effectiveness against the lesser grain borer in stored wheat. In contrast, the untreated grain displayed an emergence (37.26) and an inhibition percent (29.62). No adult emergence and cent percent inhibition were observed when treated with sweet neem leaf powder at doses from highest to least one and this result is in proximity with Khan and Marwat (2004) who reported that the bark powder of Bakain was the most effective, repelling 98.95%. Neem leaf powder-treated wheat grain showed no adult emergence and complete inhibition at all concentrations from highest to lowest and these results were in close accordance with Samyal and Sharma (2006) who revealed that a relatively low concentration (1.5%) of neem leaf powder was potent in inhibiting the emergence of *R. dominica* progeny and ensured complete safety of the seeds and Kumawat and Naga (2013) also reported that maximum protection was provided by Neem oil at 1.0 percent (no adult emerged up to 270 days. *L. camara* at doses 5,7,10 and 12 g/kg of seed acts as an effective grain protectant with no adult population buildup and complete inhibition and it was also reported by Mon *et al.* (2015) that lantana was effective against the adult *R. dominica.* The studies revealed that both *Murraya koenigii* and *Curcuma longa* acted as effective grain protectants and the same was reported by Joshi and Tiwari (2019). The present study revealed no *R. dominica* adult emergence and cent percent inhibition when stored wheat treated with *Ageratum conyzoides*. Negbenebor *et al.* (2021) also assessed the toxicity. In summary, the study demonstrates the potential of various plant-based substances, such as neem leaf powder, Bakain bark powder, lantana camara, *Murraya koenigii, Curcuma longa*, and *Ageratum conyzoides*, as effective grain protectants against *R. dominica* infestation, with consistent results across different research studies.

Sr. No.	Name of the Plant	Scientific Name	Family	Plant part used for powder	Dose G/Kg
1	Lanatana	*Lanatana 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	*Murryakoenigii*	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
					12.00
15	Untreated Control				

Table 1: Number of adults of *Rhyzopertha dominica* 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	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
Curcuma longa	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
Callistemon citranus	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
Azadirechta indica	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
Melia azadirechta	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
Murryakoenigii	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
Occimum 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	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
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		37.26 (3.7)		29.62 (3.2)	
S. Em±		(4.50)		(0.46)	
CD (p=0.05)		(1.48)		(1.53)	

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

CONCLUSIONS

In recent years, the use of synthetic insecticides in the fight against agricultural pests has inflicted unintended damage on both human life and the environment. Plant materials with insecticidal properties have been traditionally used for generations in some parts of the world. These studies provide an interesting opportunity to develop bioinsecticides, repellents, and antifeedant formulations based on the extracts from plants.

When various doses of all the treatments were applied to wheat grain, it resulted in zero adult emergence and complete inhibition in both early and later tests. This indicates their strong effectiveness against the lesser grain borer in stored wheat. In contrast, the untreated grain displayed an emergence (37.26) and an inhibition percent (29.62).

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