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Research Article

Repellency Effect of Different Plant Protectants against Lesser Grain Borer, *Rhyzopertha dominica* (Fabricius)

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ABSTRACT

A study was conducted to evaluate the repellent effect of different plant protectants against lesser grain borer, Rhyzopertha dominica (Fabricius). The repellent effect was evaluated by using the filter paper impregnation method and the observations were recorded after one hour and 24 hours of treatment. It was found that repellent activity was proportional to the time of exposure and longer time exposure had higher repellency effect. The mean repellency value revealed that eucalyptus oil (77.49 %), malathion (75.00 %), neem oil (73.33 %) and turmeric powder (66.66%) categorized repellent and comes under repellency class IV. Neem seed kernel (50%), diatomaceous earth (48.33%) and neem leaves (43.5%) categorized moderately repellent and come under repellency class III. Black pepper (31.66 %), red chilli (28.33%) and mustard oil (23.33 %) were low repellent and come under repellency class II. The lowest repellency was observed in sand (18.33%) which was categorized as very low repellent and repellency class was class I. In fact, it indicates the effect of plant protectants as repellent against insect pests of stored grains.

Keywords: *Rhyzopertha dominica, Repellency, Plant protectants, Exposure.*

INTRODUCTION

Food grain loss during storage periods due to the insect pest infestation is the worldwide problem. Food grain production in India has reached 250 million tonnes in the year 2010-2011, in which nearly 20 to 25 per cent food grains are damaged by stored grain insect pests (Rajashekar et al., 2010). In India, damage of stored grains by insect pests had reached to a level of 12 per cent of the total storage (Toke & Patil, 2015). Wheat is attacked by many insect pests in field as well as in storage condition. The lesser grain borer, *Rhyzopertha dominica*, a primary insect of stored products is capable of infesting stored grain kernels easily (Vayias et al., 2010). Females laid eggs outside the kernels, and the newly hatched larvae entered into the kernels and developed inside the kernels until they reach the adult stage (Arbogast, 1991).

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Therefore, the best method to manage this pest is to control adults before they colonize and reproduce in the stored grain, or control the larvae before they enter into the kernels. Synthetic chemical pesticides have been used for many years to control stored grain pests (Salem et al., 2007). Fumigation of stored food grains with toxic gases is effective but not applicable at the farm level because the storage structures are not airtight. Furthermore, control of insects by insecticides has serious drawbacks, such as the toxic residues on stored grains, development of resistance by target species, pest resurgence and lethal effects on non-target organisms in addition to direct toxicity to users and health hazard (Adedire & Lajide 2003, Adedire et al., 2011, Ileke & Oni 2011, Udo, 2011, Ileke & Olotuah 2012, & Ileke & Bulus 2012). The use of plant origins as traditional stored products protectants is an old practice used all over the world (Aslam et al., 2002). Applying the plant protectant may offer long term protection against adults and larvae of *R. dominica* in stored grain without development of resistance, toxic residues, increasing control measure costs and with environment safety. These strategies might be achieved by exploiting the plants of insecticidal property, which are also easily available and applicable to farmers. The aim of the present investigation was to screen out the insecticidal potency of some plant protectants to control the adult lesser grain borer by repellency test under laboratory conditions.

MATERIALS AND METHODS

This experiment was conducted in the storage laboratory, Department of Entomology, CCS HAU, Hisar, Haryana. The efficacy of different plant protectants was evaluated against *R. dominica*. There was 12 treatments namely neem leaf powder, neem seed kernel powder (NSKP), neem oil, eucalptyus oil, mustard oil, turmeric powder, red chilli powder, black pepper, Diatomaceous Earth (DE), sand, Malathion 5% D (Check) and control (without treatment). The observations on per cent repellency were recorded after one hour and 24 hours of treatment. The experiment was conducted with three replications under Completely Randomized Design (CRD) on wheat (variety WH 1105).

The per cent repellency of different plant protectants was worked out under laboratory conditions. For oil formulations a Whatman's No 1 filter paper was used. The filter paper was divided into two equal parts and rejoined by using cello tape. The rejoined filter paper was placed in the glass petri plate. The treatments were applied to half of the filter paper uniformly and another half was kept as control. In case of solid (powder) treatments, 2 g of wheat seeds were treated with respective treatments and placed on half of petri plate whereas other half had untreated grains. The10 pair of adults of test insects was released in centre of each petri plate and was kept covered. The total numbers of insects present on the control (Nc) and on the treated (Nt) area were recorded after 24 h of exposure. The per cent Repellence (PR) value was calculated by using the area preference test given by McDonald et al. 1970.

$$\mathbf{PR = [(Nc\text{-}Nt)/(Nc+ Nt)] \times 100}$$

The per cent repellence value and repellency class were grouped according to the following scale by the method of Jacob et al. (2020).

Class	Repellence Rate (%)	Interpretation
0	>0.01-0.10	Non repellent
I	0.10 to 20.00	Very low repellence
II	20.10 to 40.00	Low repellence
III	40.10 to 60.00	Moderately repellent
IV	60.10 to 80.00	Repellent
V	80.10 to 100.00	Very repellent

RESULTS AND DISCUSSION

The repellency of various plant protectants against lesser grain borer was presented in (Table 1). It ranged from 10 to 68.33 per cent after one hour exposure, whereas 26.66 to 86.66 per cent after 24 hours of exposure. After one hour of exposure, the highest repellency (68.33%) was recorded in eucalyptus oil followed by (66.67%) in malathion 5% D, (66.66%) in neem oil and (63.33%) in turmeric powder. These four treatments were categorized as repellent and come under repellency class IV. These treatments were at par with each other except turmeric powder. Very low repellency (10%) was found in sand followed by mustard oil and these comes under the repellency class I. The repellency per cent in different treatments after 24 hours showed that maximum repellency (86.66%) was recorded in eucalyptus oil and followed by (83.33%) in malathion 5% D and (81%) in neem oil. These were categorized as very repellent and repellency class was V. Turmeric powder categorized repellent with 70% repellency and repellency class was class IV. Diatomaceous earth (56.66%), neem seed kernel (50%) and neem leaves (47%) categorized moderately repellent and comes under repellency class III. Black pepper (36.66%), mustard oil (36.66%), red chilli (33.33) and sand (26.66%) had low repellecy and their repellency class was class II. The mean repellency value revealed that eucalyptus oil (77.49%) malathion (75.00%), neem oil (73.33%) and turmeric powder (66.66%) categorized repellent and comes under repellency class IV. Neem seed kernel (50%), diatomaceous earth (48.33%) and neem leaves (43.5%) categorized moderately repellent and come under repellency class III. Black pepper (31.66%), red chilli (28.33%) and mustard oil (23.33%) were low repellent and come under repellency class II. The lowest repellency was observed in sand (18.33%) which was categorized as very low repellent and repellency class was class I.

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The current findings are similar with those of Khan and Marwat (2003) who reported that application of neem seed and leaves powder to the stored wheat grains against adults of *R. dominica*, gave 96.00 per cent insect deterrent or repellent. Moreover Khemira et al. (2012) found the strong repellency of *Eucalyptus astringens* against *R. dominica* and *Oryzaephilus surinamensis.* At the lowest concentration 0.08 µl/cm^2, the repellent activity of euclatyus oil was found to be 42.5 per cent within 36 hours. When dose was increased to 0.16, 0.24, and 0.32 µl/cm^2 the repellent activities were high to be 43.5, 47.5 and 62.5 per cent, respectively after 36 hours of exposure. In fact, the repellent activity had increased with the increase in concentration but become less with exposure period. Khatre et al. (1993) also showed that grains treated with neem oil, castor oil and karanj oil showed a significant repellent action against egg laying in wheat. The current findings are supported by findings of Joshi et al. (2019) they evaluated the different neem oil concentrations against *R. dominica* and showed 80.49, 85.10 and 87.51 per cent repellent activity at 1, 2 and 3 per cent concentrations, respectively. Khan & Marwat (2003) reported that insect (*R. dominica*) was repellent from neem seed and leaves powder with 96.0 per cent repellency.

Table 1: Effect of plant protectants on repellency per cent of *Rhyzopertha dominica*

Treatments	Dose (g or ml /kg)	Repellency (%)								
		After one hour			After 24 hours			Mean		
		Repellency (%)	Classes	Repellency Category	Repellency (%)	Classes	Repellency Category	Repellency (%)	Classes	Repellency Catagory
Red Chilli	10	23.33(28.76)*	II	Low repellent	33.33(35.20)	II	Low repellent	28.33(31.98)	II	Low repellent
Turmeric Powder	5	63.33(52.75)	IV	Repellent	70 (56.76)	IV	Repellent	66.66(54.73)	IV	Repellent
Neem leaves	20	40.00 (39.21)	II	Low repellent	47.00 (43.06)	III	Moderately repellent	43.5 (41.09)	III	Moderately repellent
Neem Seed Kernel Powder	20	50 (44.98)	III	Moderately repellent	50.00 (44.98)	III	Moderately repellent	50 (44.98)	III	Moderately repellent
Eucalyptus oil	20	68.33(56.45)	IV	Repellent	86.66(66.82)	V	Very Repellent	77.49(61.63)	IV	Repellent
Neem oil	10	66.66(54.73)	IV	Repellent	81.00 (64.39)	V	Very Repellent	73.33(59.29)	IV	Repellent
Mustard oil	20	13.00 (20.30)	I	Very Low repellent	36.66(37.12)	II	Low repellent	23.33(27.77)	II	Low repellent
Diatomaceous Earth(DE)	2	40.00(39.21)	II	Low repellent	56.66(48.82)	III	Moderately repellent	48.33(43.97)	III	Moderately repellent
Black Pepper	20	30 (33.19)	II	Low repellent	36.66(37.18)	II	Low repellent	31.66(34.19)	II	Low repellent
Sand	10	10.00(18.42)	I	Very Low repellent	26.66(30.98)	II	Low Repellent	18.33 (24.7)	I	Very low Repellent
Malathion 5% D	2.5	66.67 (54.76)	IV	Repellent	83.33 (66.11)	V	Very Repellent	75.00(60.43)	IV	Repellent
C.D @ 1%		4.76			3.49			4.74		

** Figures in parenthesis are angular transformed values

CONCLUSION

The results of the present study show that all the plant protectants have different repellency effects on *R. dominica* but varied with the exposure period. The repellent activity had increased with exposure period. The mean repellency value revealed that eucalyptus oil neem oil and turmeric powder categorized repellent and comes under repellency class IV. This study proved that traditional plant protectants were effective to protect stored grain pests.

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