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Screening of Diatomaceous Earth Against Lesser Grain Borer (*Rhyzopertha dominica* Fab.)

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ABSTRACT: On an average 10% overall losses of food commodities caused by stored grain insect pests. The storage commodities of agriculture and horticulture are infested by several species of pests worldwide. For management of such huge number of stored grain insect pests only old age traditional chemical fumigants e.g., Aluminium phosphide are used throughout the world. Chemical fumigants are not only contaminating the food commodities but also lead to serious health risk and environmental pollution in addition to development of resistance in insect. The *Rhyzopertha dominica* (F.), is a severe pest of raw materials that are kept in storage all over the world. It often infests grain in warehouses. Typically, the grain infestation starts at the top and moves downward. Because the majority of its life cycle spent inside the grain kernel, control of the pest is difficult. The first instar larva chews its way inside the grain kernels where it feeds after laying eggs externally on the grain. After the grub is fully grown, it drills a sizable hole to escape. While grading and marketing grain, this exit hole is typically a sign of an insect-damaged kernel (IDK), which is frequently taken into consideration. Organic or eco-friendly management are not available to manage this pest in storage. Taking all these measures an experiment were conducted to evaluate the effectiveness of Diatomaceous Earth in reducing adult emergence. Results shows that all the treatments were effective against lesser grain borer particularly 1.00 and 1.25 & 1.5 g DE/kg of seed.

Keywords: Stored grain insect pest, Aluminium phosphide, *Rhyzopertha dominica*, Diatomaceous Earth

INTRODUCTION

Rhyzopertha dominica (F.) is a major pest of raw materials stored all over the world. After grain has been harvested and stored, it is infected by this pest (Potter 1935). Typically, the grain mass's first infestation starts at the top and moves downward (Sharangapani and Pingale 1957; Sutrees 1965; Keever 1983; Hagstrum *et al.,* 1994; Vela-Coiffier *et al.,* 1997; Hagstrum 2001). When the insect reaches adult stage, it bores a large escape hole in the kernel (Potter 1935). Historically, malathion was employed to manage stored pest but it was now reported no longer effective. To control insects in storage, new formulations of diatomaceous earths, a low-risk insecticide are being created. A natural substance called diatomaceous earth is extracted from fossilised diatom deposits (Quarles 1992; Golob, 1997). By absorbing cuticular lipids, the dust prevents water from transpiring and leads to desiccation (Korunic 1998; Subramanyam and Roesli 2000). According to certain studies, the lesser grain borer is one of the insects that are difficult to kill with DE from stored products (Quarles 1992; Fields and Korunic 2000; Subramanyam and Roesli 2000). Other more recent studies suggested that it may be less vulnerable to new European commercial DE chemicals than the red flour beetle (Athanassiou and Kavallieratos 2005; Kavallieratos *et al.,* 2005). However, the lesser grain borer is likely to have more significant economic pest of grain in the United States than the red flour beetle since it causes a real IDK. DE efficacy is affected by environmental factors, and it typically declines as moisture content in grain or relative humidity rises. However, inter-specific variance has been documented and demonstrates how the effectiveness fluctuates with temperature (Fields and Korunic 2000).

MATERIALS AND METHODS

The experiment was conducted in Entomological laboratory, Department of Entomology, V.K.S.C.O.A, Dumraon, Buxar, Bihar Agricultural University, Sabour, Bhagalpur in 2021-22. A pure culture of test insects was maintained in an incubator at a temperature of 27±1°C and a relative humidity of 70±5%. In plastic jars with a 1.0 kg capacity, pure insect cultures were cultured with optimal aeration provided with copper wire net of 30-mesh size. Adults of *Rhyzopertha dominica* were reared on wheat variety HD-2967. The moisture content of seeds was raised as per formula of Pixton (1967). To balance the grain's moisture content, it was kept in tight polythene bags for seven days. Following this procedure, 100 adults of test insect with comparable sex ratios were released in plastic jars contains 500 grams grain and individually placed in a BOD incubator. The initial generation of adult test insects (aged 0–7 days) was employed for all experiments. All the experiments on *Rhyzopertha 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 60°C for 12 hours. Following de-infestations, the moisture content was measured, and the prescribed amount of water was added to the grains to raise it to 13.5%. The grains were placed on laboratory slabs and an adequate amount of water was sprayed on them using a hand sprayer to ensure uniform moisture distribution. 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 DE, the experiment was conducted on *Rhyzopertha dominica*. Each plastic vial was filled with 100 g wheat seed grains of variety HD-2967 (moisture content 13.5%). Three replication of each treatment were carried out, while for comparison, untreated wheat seed was used as control. Different test insect sets were prepared, and ten *Rhyzopertha dominica* were released in vials at 0-7 days old. After the insects had been released for 24 hours, the measurable amount of diatomaceous earth was mixed in each vial. The first offspring from each treatment were counted after a month of treatment. Data was analyzed in CRD after suitable log (X + 1) transformation.

RESULTS AND DISCUSSION

The efficacy of DE was evaluated against *Rhyzopertha dominica*. The effectiveness of DE at various doses was confirmed by repeating the experiment twice. The study showed that DE inhibited test insects from feeding and breeding. However, the degree of inhibition was highly correlated to the DE dose. Only a few individuals start the infestation in most storage systems and the amount of damage relies heavily on how quickly they reproduce. Therefore, more weightage has been given to suppression of first progeny development, According to this assumption, the treatment was classified as extremely effective if it inhibited more than 90% of first-generation offspring, moderately effective if it prevented 80 to 90% of offspring, and less effective if it prevented 70 to 79%, similarly The least effective treatment for controlling insect pests of stored grain were those with first progeny suppression rates of less than 70%.

Table 1: Number of adults of *Rhyzopertha dominica* emerged and percent inhibition in wheat with Diatomaceous earth in preliminary and confirmatory tests.

Treatments	Dose (g/kg)	Preliminary test		Confirmatory test	
		Adult emerged	Percent Inhibition	Adult emerged	Percent Inhibition
Diatomaceous Earth	0.75	46.4(3.8)	76.9	42.5(3.6)	74.0
	1.00	0.6(0.4)	99.7	0.0(0.0)	100.0
	1.25	00.00	100.00	0.0(0.0)	100.0
	1.50	00.00	100.00	0.2(0.1)	99.9
	1.75	57.8(5.1)	81.6	16.0(2.8)	91.8
	2.00	74.8(4.3)	62.8	12.0(2.6)	93.9
	2.25	14.4(2.7)	92.8	11.6(2.5)	94.1
	2.50	12.8(2.6)	93.6	11.6(2.4)	94.1
Untreated Control	00.00	201.4(5.3)	-	196.8(5.3)	-
S.Em±		(0.2)	-	(0.2)	-
CD(p=0.05)		(0.5)	-	(0.6)	-

The number of adults of *Rhizopertha dominica* emerged and percent inhibition due to treatment of diatomaceous earth in stored wheat in plastic jars presented in Table 1. The table shows that the diatomaceous earth at different doses can able to inhibit the feeding and breeding of the test insect. During confirmatory test of experiment diatomaceous earth at dose (1.00 and 1.25)g/kg of wheat can completely check feeding and breeding of *R.dominica* and inhibit 100% population as compare to untreated control. Diatomaceous earth at dose 1.5, 1.75, 2.00, 2.25 and 2.5 g/kg of wheat show 99.9, 91.8, 93.9, 94.1 and 94.1% respectively. These doses are also highly effective in inhibiting the population of *R. dominica* as compare to untreated control.

Kavallieratos *et al.* (2005) observed >90% mortality of *Rhizopertha dominica* with diatomaceous earth in stored wheat. Wakil *et al.* (2010) found that susceptibility of *Rhizopertha dominica* to diatomaceous earth cause 100% mortality. Paponja *et al.* (2020) observed that natural formulation of diatomaceous earth at 600ppm can cause 100% mortality to *Rhizopertha dominica.* All these previous findings supported my observed result.

CONCLUSION AND FUTURE SCOPE

The above experiment tends to find out an alternative of the chemical pesticide against lesser grain borer in storage. Chemical pesticides are not only harmful for human health but also harmful for environment. Diatomaceous earth used in this experiment is of food grade which is safe for human beings. Above results shows that diatomaceous earth can effectively inhibit the feeding and breeding of the test insect and can be used in managing the pests. This indicates that we can use diatomaceous earth instead of chemical fumigant for better management of grains in storage. This also advocates that prior treatment of grains can yield effective results. Farmers can also use diatomaceous earth during storage of grains instead of harmful chemicals. Food Corporation of India, Central Warehousing Corporation and State Warehousing Corporation can also use this diatomaceous earth for managing the pest during bulk storage of grains.

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Conflict of Interest. None.

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