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Screening of diatomaceous earth against rice weevil (*Sitophilus oryzae* L.)

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Abstract
Stored product pests may cause heavy losses in agricultural and horticultural products after harvesting. On an average 10% overall losses of food commodities caused by stored grain insect pests. Diatomaceous earth is a non-toxic pesticide that is used to preserve stored goods as well as to manage pests in the home and garden. It is popular among organic gardeners since it is a natural substance that doesn't harm the environment or humans. Diatomaceous earth is applied in different doses to check the population of the *Sitophilus oryzae.* Observation was taken at different interval during the course of study. Each dose of diatomaceous earth was effective in reducing the population of the tested insect. Dose of (1.25, 1.5, 2.25 and 2.50) g/kg DE has been found highly effective against *Sitophilus oryzae*. Diatomaceous Earth is the silica based amorphous powder that act as a physical poison for insect body. They are the effective in managing the tested insect population. It is environmentally safe do not affect human health.

Keywords: Stored grain pest, aluminium phosphide, *Sitophilus oryzae*, diatomaceous earth

Introduction
Stored product insects are serious menace of global food security because of they cause qualitative and quantitative losses of agricultural and horticultural produces. On an average 10% overall losses of food commodities caused by stored grain insect pests. It is assumed that seventy percent produce stored by farmer while thirty percent by different government agencies. The farmers of India storing maximum food commodities but they do not have adequate scientific storage facility as well as grain/seed production technology. The storage commodities of agricultural, horticultural, animal origin are infested by stored pests. The management of such huge number of stored grain insect pests only old age traditional chemical fumigants e.g., aluminium phosphide is used in all over the world. The chemical fumigants not only contaminating the food commodities but also leads to health and environmental hazard and resistance (Kumar, 2022) [8]. Inorganic pesticides have been used since post independence (Subramanyan and Hagstrum, 1995) [13]. In place of chemical control, diatomaceous earth (DE) has been largely used over the last few decade and play an important role in IPM (Korunic, 1999) [7]. DE is a soft rock of diatoms remains. Depending upon geological source contains silicon dioxide and non toxic to other animals (IARC, 1997). Diatomaceous earth acts on insect cuticle and cause desiccation (Ebeling, 1971; Rigaux *et al*., 2001) [1, 111]. The efficiency of diatomaceous earth depend upon several biotic and a biotic factors (Fields and Muir, 1995; Fields and Korunic, 2000) [3, 2]. Efficiency of diatomaceous earth also depends upon its origin and mining procedure (Snetsinger, 1988; Katz, 1991; McLaughlin, 1994) [12, 9], it is due to the different parameters of diatoms (Korunic, 1998) [6].

Materials and Methods
Experiments were carried out in Entomological laboratory, Department of Entomology, V.K.S.COA Dumraon, Bihar Agricultural University. Pure culture of test insects (*Sitophilus oryzae* were cultured in 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 formula of Pixton (1967) [10].

Quantity of water to be added = W1 $= \frac{M2-M1}{100-M2}$

Where, W1= Initial weight of grain
M1= initial moisture content
M2= 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 plastic jar, and 100 adults of insects with comparable sex ratios were released and placed in 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 60^0C 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 DE, the experiment was conducted on *S. oryzae*. 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. While, untreated wheat seed used as 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, the measurable amount of diatomaceous earth was mixed in each vial. After one month of treatment the first progeny was counted from each treatment.

Results and Discussion

The efficacy of DE was evaluated against *S. oryzae*. The experiment was conducted twice to confirm to efficiency of diatomaceous earth at different doses. The study revealed that DE inhibits the feeding & breeding of tested insect. The level of inhibition was highly correlated with dose of DE at which treatment was used. The efficacy of DE was classified in different categories on the basis of first progeny production. In majority of the storage system only few individuals begin the infestation & the final losses greatly depends on the rate of their multiplication. Therefore, more weightage has been given to suppression of first progeny development, with this assumption the treatment inhibiting more than 90 percent first progeny was classified as highly effective while inhibition of 80 to 90 and 70 to 79 percent were ranked as moderately & less effective respectively, similarly treatment showing less than 70 percent first progeny suppression were ranked as least effective for the management of insect pests of stored grain.

Table 1: Number of adults of *Sitophilus oryzae* 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	80.2(4.3)	64.6	72.2(4.2)	60.6
	1.00	119.4(4.7)	47.2	6.8(2.0)	96.2
	1.25	82.0(4.3)	63.7	0.0(0.0)	100.0
	1.50	84.0(4.4)	65.8	0.0(0.0)	100.0
	1.75	161.4(5.1)	28.7	106.4(4.7)	42.0
	2.00	120.4(4.8)	46.8	59.6(4.1)	67.5
	2.25	116.6(4.8)	48.4	0.0(0.0)	100.0
	2.50	95.8(4.5)	57.6	0.0(0.0)	100.0
Untreated Control	00.00	226.4(5.4)	-	183.6(5.2)	-
S.Em±		(0.2)	-	(0.2)	-
CD(p=0.05)		(0.6)	-	(0.6)	-

Number of adults of *Sitophilus oryzae* emerged and percent inhibition due to treatment of diatomaceous erath in stored wheat in plastic jars presented in table. The table reveal that the diatomaceous earth at doze (1.25, 1.5, 2.25 and 2.50) g/kg of seed can completely check the feeding and breeding of *S. oryzae* and inhibit 100% population as compared to untreated control during confirmatory test of wheat stored in plastic jars. Almost all the doses are effective in inhibiting the population as compared to the untreated control during the test but at some doze it might not work properly in inhibiting the population.

Summary

Stored grain pests are the serious problem in storage as it destroy large amount of grains in storage. As *Sitophilus oryzae* L. is a primary pest of the stored grain it may cause serious damage to the grains. For management of the pest not much practice was popular in these days, only a few chemicals are popular among farmers like Aluminium phosphide tablets. These chemicals are not only harmful to the environment but also to the human health. In these aspects the research has been conducted to find out the better alternative of the Aluminium Phosphide. Diatomaceous earth was used in stored grain to evaluate the effectiveness of the powder. Diatomaceous Earth are effective for the stored grain insects as they can effectively reduce the population of tested insect. They can be used in storage because they are neither affect environment nor human health. Dose of (1.25, 1.5, 2.25 and 2.50) g/kg DE has been found highly effective against *Sitophilus oryzae*.

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