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A review on bio-efficacy of inorganic inert matters on stored grain insect pest *Sitophilus oryzae L*

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ABSTRACT

A number of insect pests attack stored grains, but Sitophilus oryzae L. (Coleoptera: Curculionidae) has got economic importance and it is the most destructive insect pest of the stored raw cereal grains in the world. Sitophilus oryzae causes substantial storage losses to the grains. As S. Oryzae has been reported to develop resistance to synthetic insecticides, in many areas of the World locally available inorganic inert matters have been used to protect the stored product against damage by insect attack. These products are usually non-phytotoxic, nontoxic to mammals, eco-friendly, less prone to pesticide resistance and relatively less expensive. Several technologies are available with the utilization of local technologies but the use of locally available inert or raw materials in practices is meager. Hence significant research work is required to carry out indigenous practices for protecting the stored products from the attack of stored grain insect pests.

Keywords: *Sitophilus oryzae, bio-efficacy, inorganic inert matter, stored grain*

INTRODUCTION

The use of inert dust to control stored grain pests is a technique with a long history and has been reviewed by many authors [3]. The inert dust already exist in nature but are usually over looked by households. Besides being very safe and presenting low toxicity in mammals, the inert dust does not affect the grain quality [3] [10].

The main advantages of using botanicals and inorganic inert materials easy production by farmers, less expensive, biodegradable, broad-spectrum, safe to apply and unique in action. The use of these product is non-hazardous and non-toxic to humans. In India, few scientific research works have been done to explore locally available plant materials and inorganic inert material for the management of harmful insect pests in storage by farmers. So the present study was undertaken to study the bio efficacy of certain plant products and inorganic inert materials against rice weevil under the coastal climatic condition of Odisha.

INERT MATERIALS

The major advantages of these inert dust are that they leave no chemical residue, have no withholding period and minimize selection for resistance. They are accepted by some organic markets.

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1. Diatomaceous earth

Diatomaceous earth inert dusts derive from deposits of diatomaceous algae fossils, which possess a thin silica layer. Small particles of this dust adhere to the insect's body and remove the *epicuticular* wax, causing death by dehydration [26]. It was reported that treatment of diatomaceous earth @ 750 and 1000 mg/kg caused highest mortality of *Sitophilus zeamais* in stored corn at 25 and 300C, but there was no significant difference between them. [8]

Diatomaceous earth (DE) was also used to protect food grains. It is mainly composed of opaline silica which shows very toxicity to mammals [26]. Besides natural DE artificially modified CaDE are also being made which have shown insecticidal repellent and *ovicida*l activity against *Callasobruchus maculates*. [24]

The high rates of mortality of the insects, even in the smallest dosages of 200 and 400 g/t, also were observed [4]. Using the dosage of 300 g/t, the author verified the mortality which is superior to 82 % after a week of exposure of the insects to diatomaceous earth. [4]

In the dosage of 1,000 g/t, to reach 95 % of mortality, 5 days of exposure of the insects to diatomaceous earth were necessary [16]. Using the same dosage it was also verified that mortality above 95 % of the population of S. oryzae, after 7 days of exposure to diatomaceous earth. [5]

Also it has been reported that the larval mortality of *Plodia interpunctella* was 28.30% and 71.70% after seven days of exposure to 500 and 2000 ppm diatomaceous earth respectively.[15]

The LC50 value of diatomaceous earth was 7.409 g/m2 against adult male german cockroach *(Blatella germanica)* [14]. But the LC50 value of diatomaceous earth was 260 ppm and 204 ppm against *Sitophilus* oryzae and *Sitophilus* granaries in wheat at 10% moisture content after 7 days of treatment. [18]

The highest inhibition rate (IR) of the adult S. oryzae population

was recorded with the diatomaceous earth treatment of 93.27% [25]. This high rate of inhibition rate may be due to the mechanism that the small particles of this dust adhere to the insect's body and remove the *epicuticular* wax, causing death by dehydration [26]. However it has also been reported that treatment of diatomaceous earth @ 750 and 1000 mg/kg caused the highest mortality of *Sitophilus zeamais* in stored corn at 25 and 300C. [8]

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2. Camphor

Camphor has been demonstrated to exhibit contact and fumigant toxicity against several stored product insects [12] & [23]. It also exhibited insecticidal activity against many important pest insects/mites, e.g., adults of German cockroaches, *Blattella germanica* (LD50 = 0.10–0.14 mg/cm2) [15], and cotton leafworm, *Spodoptera littoralis* (the 3rd larvae stage, LC50 = 5.61 mg/L) [1].

The Camphor (LD50 = 207.26 µg/cm2 and the essential oil of *Curcuma wenyujin* rhizomes (LD50 value of 208.85 µg/cm2) exhibited contact toxicity against booklouse *Liposcelis bostrychophila Badonnel.* Camphor possessed fumigant toxicity against L. bostrychophila adults with LC50 values of 1.03 mg/L air. [21] Again during it has been reported LC50 value of camphor to be 0.43mg/l against adults of *Liposcelis bostrychophila*.[20]

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3. Salt

The efficacy of salt (1.0ml/kg) as grain protectant against S. *oryzae* in Basmati rice and found significant decrease in weevil population and grain damage as compared to the untreated check. [9]

Salt was mixed with rice during storage and after sun drying. It was used for the storage of *kharif* crops which was demonstrated for the protection of stored grains. [7]

About 200gm of salt was mixed for a kg of red gram manually .These treated grains were then stored in jute gunny bags and the bags were stitched. Due to this practice, insect were kept away from the stored grains. As salt had abrasive action on insect skin prevent its movement inside red gram grain, for short term inside the storage container. [19]

4. Boric acid

One advantage of using boric acid is that, it destroys the cellular lining of the foregut. This effect induces death to the insects by starvation and the cockroaches have difficulty showing any resistance to boric acid. After 7 days of exposure, the LC50 value of boric acid against the 2nd instar nymphs of German cockroach, *B. germanica* were 8.82 % and against 6th instar nymphs was 9.87% and The LC50 of boric acid against the adult males was 12.3%. [2].

5. Ash

Ash treatment during storage was found effective for controlling the storage losses up to 80% [17].

Ash was mixed with the Sorghum *bicolor* seed at a ratio of 1: 4 and then tied air-tight in the jute gunny bags during storage grains can prevent the grains damaged by various stored grain pests for 6 months [19].

6. Sand

Sand, kaolin, paddy husk ash, wood ash and clays constitute a group of materials which are used commonly by small-scale farmers in the developing world as grain protectants. Characteristically, large quantities, over 5% by weight, are required for application to exert an effect [11].

7. Sodium bicarbonate

When sodium bicarbonate used @ 2% (w/w), the grain weight loss by S. *zeamais* was only 50 g/ 200g sample maize grain over the control, where as when a mixture of 2% (w/w) of neem leaves powder and sodium bicarbonate was used against S. *zeamais* there was only 25 g/ 200g sample maize grain weight loss was observed.[22]

Moreover, S. *Oryzae* has been reported to develop resistance to synthetic insecticides [6]. The increasing serious problems of resistance and residue to pesticides and contamination of the biosphere associated with large-scale use of broad spectrum synthetic pesticides have led to the need of effective biodegradable inorganic inert matters with greater selectivity.

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