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ORIGINAL ARTICLE

Efficacy of Sand as Protectant from Cowpea Pulse Beetle, *Callosobruchus maculatus Fab*. for Cowpea Seed under Storage

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ABSTRACT
In current scenario there is an utmost need to search a natural compound, which can serve as an alternative to chemical pesticides due to their untoward environmental and health issues. In this study uninfested cowpea seeds (250 g) of susceptible variety EC-4216 were provided with 8 treatments viz., mixed with fine sand (20 and 40% w/w), coarse sand (20 and 40% w/w), and sand layer (fine and coarse) of 1 cm and 2 cm, respectively to find out suitable alternative against the cowpea beetle, Callosobruchus maculatus, on stored cowpea. The data was recorded for % seeds with eggs laid, number of eggs per seed, perforations per seed, % damaged seeds as well as Weevil Perforation Index (WPI). The efficacy of the treatment has been worked out on the basis of adult emergence holes and WPI. Fine sand layer of 2 cm provided absolute protection of stored seeds as these treatments did not show a single damaged seed. The percent germination in all treated seeds was also worked out. Maximum germination percentage was 100% in the treatment with 2 cm layer of fine sand. The results of this study suggested that the fine sand found to be able to provide protection from seed weevil. So fine sand can be explored as an alternative to chemical insecticides against pulse beetle, C. maculatus in cowpea seed under storage.
Key words: *Callosobruchus maculatus, Cowpea, Insecticide, Sand, Germination*

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INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) is grown throughout tropical and subtropical regions of the world where it is an important source of human dietary protein and livestock feed. During the post harvest storage period, insects are major constrains for crop expansion and year-round availability. The cowpea weevil, *Callosobruchus maculatus Fab*. (Coleoptera: Bruchidae), is the main storage pest of cowpea seeds (Huignard *et al.*, 1985; Appleby and Credland, 2003). Unprotected cowpea seeds are subject to serious infestation from this pest during 3-5 months storage period (Fig.1). Therefore, the difficulty in storing cowpeas in the presence of bruchids causes financial burden on farmers as they have to sell their crops at reduced prices (Sanon *et al.*, 2010; Shade *et al.*, 1999). Current control strategies against pest infestation in stored products are mainly based on the use of chemicals, which are hazardous to environment (Aboua *et al.*, 2010; Rajendran and Sriranjini 2008; Karabörklü *et al.*, 2011; Bandara *et al.*, 2005).
The indigenous traditional knowledge (ITK) of protecting cereals and pulses utilizing locally available material is time tested and effective method. One of the commonly used practices of protecting gram and pea seeds in North India is to mix with sand during

storage period. The sand has been found to possess deterrent and / or repellent properties against insects when mixed with grain (Javaid and Ramatlakapela 1995). This study was undertaken with the view to understand the mechanism and observe the impact of sand on oviposition by *Callosobruchus maculatus* and overall, its utility in protecting cowpea seeds from damage.

MATERIALS AND METHODS

Cowpea germ plasm having desired production potential and representing diverse seed characteristics *viz* seed shape, length, width, eye pattern, seed coat texture, seed coat colour and 100 seed weight was obtained from Indian Grassland and Fodder Research Institute (IGFRI), Jhansi and used in the present study.

TREATMENTS:

Uninfested cowpea seeds (250 g) of susceptible variety EC-4216 were provided with 8 treatments viz., mixed with fine sand (20 and 40% w/w), coarse sand (20 and 40% w/w), and sand layer (fine and coarse) of 1 cm and 2 cm, respectively was placed above the stored seeds. Further, uninfested cowpea seeds (250 g) of susceptible variety EC-4216 were kept in a transparent polypropylene container and act as Control (Untreated).

METHODOLOGY:

Uninfested seeds (250 g) of susceptible variety EC-4216 received different treatments and were kept in polypropylene containers. In all containers of each group, five pairs of freshly emerged (0-24h old) bruchid were released in the container and the top was covered with muslin cloth. These jars were kept under ambient storage conditions for 3 months. This testament was replicated thrice. All these treatments were at par with the chemically treated seeds with 0.1% Malathion. The data recorded included % seeds with eggs laid, number of eggs per seed, perforations per seed, % adult emergence etc. All the data collected in this study was subjected to computer based statistical analysis software M stat C programme. Analysis of variance was calculated for percent seeds with eggs and percent seeds with emergence holes.

RESULTS AND DISCUSSION

The results obtained in all these treatments indicated different degree of control against this pest as compared to untreated seeds. The observations were recorded for number of seeds with eggs, and the emergence holes for adult weevils. The percent seeds with eggs and seeds (%) with number of eggs were tabulated for each treatment (Table 1). The percent of damaged grains was calculated with the following formula:

$$\% \text{ Damaged grains} = \frac{\text{Number of bored grains}}{\text{Total number of grain counted}} \times 100$$

Table 1: % seeds with eggs, number of eggs/seed and % damaged seeds in different treatments

S. No.	Treatment	% Seeds with eggs	Number of eggs/seed			% Damaged seeds
			1-4	5-9	10-15	
1.	Sand fine 20%	95.67	2.33	6.67	86.33	53.00
2.	Sand fine 40%	83.00	16.67	16.33	49.33	56.67
3.	Sand coarse 20%	95.00	15.33	23.67	54.00	60.33
4.	Sand coarse 40%	51.67	16.33	60.67	32.33	32.00
5.	Sand fine layer 1 cm	7.33	2.00	3.00	2.33	5.67
6.	Sand fine layer 2 cm	0.00	0.00	0.00	0.00	0.00
7.	Sand coarse layer 1 cm	12.33	3.33	12.33	5.33	7.67
8.	Sand coarse layer 2 cm	5.00	1.67	6.33	1.67	4.33
9	Untreated control	100.00	9.00	78.33	12.33	80.33

The number of cowpea seeds perforated in treated and control were counted for determination of Weevil Perforation Index (WPI) (Table 2). This was determined by using the following formula:

$$\text{WPI} = \frac{\text{\% of treated cowpea seeds perforated}}{\text{\% of control seeds perforated} + \text{\% of treated cowpea seeds perforated}} \text{ X } 100$$

Table 2: Weevil perforation index (WPI) in different treatments during storage

S. No.	Treatment	% Seeds with eggs	% Damaged seeds	Weevil perforation index (WPI)
1.	Sand fine 20%	95.67	53.00	39.89
2.	Sand fine 40%	83.00	56.67	41.36
3.	Sand coarse 20%	95.00	60.33	42.89
4.	Sand coarse 40%	51.67	32.00	28.48
5.	Sand fine layer 1 cm	7.33	5.67	6.59
6.	Sand fine layer 2 cm	0.00	0.00	0.00
7.	Sand coarse layer 1 cm	12.33	7.67	8.71
8.	Sand coarse layer 2 cm	5.00	4.33	5.11
9	Untreated control	100.00	80.33	--

Table 3: % Seed germination in cowpea seed under different treatments

S. No.	Treatment	% Seed germination
1.	Sand fine 20%	87.33
2.	Sand fine 40%	89.66
3.	Sand coarse 20%	86.66
4.	Sand coarse 40%	82.33
5.	Sand fine layer 1 cm	99.33
6.	Sand fine layer 2 cm	100.00
7.	Sand coarse layer 1 cm	98.66
8.	Sand coarse layer 2 cm	98.33
9	Untreated control	87.33

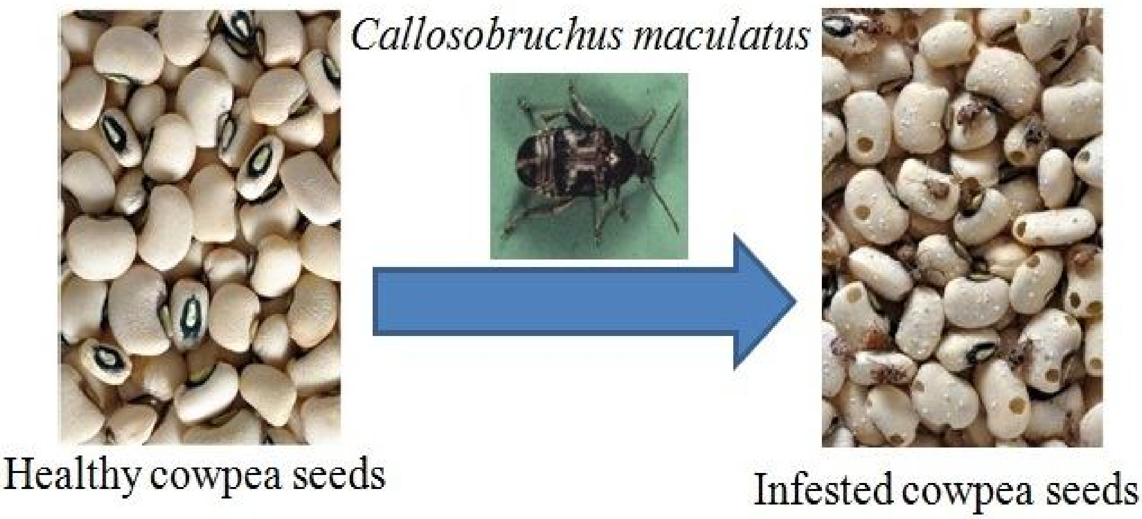

Fig. 1: Healthy cowpea seeds and *Callosobruchus maculatus* infested cowpea seeds

The results indicated that as compared to the control (untreated), all the treatments of mixing sand with cowpea seed, fine sand (20 and 40% w/w), course sand (20 and 40% w/w) and sand layers (1 cm and 2 cm), respectively above the seed surface, gave different levels of protection from pulse beetle *C. maculates*. Maximum germination percentage was 100% in the treatment with 2 cm layer of fine sand. 1 cm layer of fine sand followed this with 99.33% germination. The percent germination in all other treatments was worked out as Coarse sand layer 1cm (98.66%), Coarse sand layer 2 cm (98.33%), Fine sand 40% (89.66%), Fine sand 20% (87.33%), Coarse sand 20% (86.66%), Coarse sand 40% (82.33%), and Control (87.33%). In all these cases is at par or superior then the control. This is one more advantage related to the storage with sand, which provides good protection. However, the treatment of putting the sand layer over the stored seeds (both types of sand and the layers) gave the absolute protection from this pest. It seems that the sand fills in the spaces between the seeds and does not allow this insect to penetrate and reach in to the deeper surface to lay the eggs there and thus provide protection to grain.

CONCLUSION

There is an immense capacity for replacement of chemical pesticides with naturally available materials for the management of commonly occurring insect pests in commodities under storage. It is also important while making a recommendation, to ascertain the availability of these particular materials locally. The final identification of non-chemicals to be recommended for use particularly for seeds should include in addition to its performance as protectant, the effect on germination also. The importance can be understood because of the fact that some of the protectants are seen to affect seed germination adversely. These may be good for other stored commodities but does not qualify as appropriate protectant for seeds in particular. Further, the ethnic knowledge at farmers' level as well as at household level needs to be properly documented, scientifically validated for use and integrated in different agricultural package of practices.

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