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Potentiality of some inert materials as grain protectant against rice weevil, *Sitophilus oryzae* (L.) on stored wheat grains

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Abstract
The research was conducted at the Laboratory of Department of Agricultural Entomology, UBKV, Pundibari. Objectives of the research work were to determine the bio-efficacy of different inert materials *viz.*, kaolinite, bentonite, cow dung ash, saw dust and sand against *Sitophilus oryzae* on wheat under laboratory conditions based on adult mortality, percent grain damage and percent weight loss. The results showed that kaolinite was found to be the best treatment causing 90% of adult mortality at 35 days followed by bentonite (79.55%), cow dung ash (72.53%) and saw dust (45.95%). In terms of grain damage and percent weight loss, kaolinite was noted to be the most effective grain protectant with the corresponding values of 0.613% and 0.437% respectively which was followed by the bentonite (1.060% and 0.728% respectively). Sand was recorded to be the least effective one with 2.218% of grain damage and 1.842% of weight loss due to the attack of the rice weevil. It was found that kaolinite was found consistently and significantly superior over the remaining treatments followed by bentonite which was at par with cow dung ash.

Keywords: *Sitophilus oryzae*, inert materials, potentiality, stored wheat grains

Introduction
Sitophilus oryzae (L.) has become primary pest of stored grains of warm climatic conditions. They cause damage to grains which are stored at 25-30 ^{0}C temperature and at low Relative Humidity. These conditions favour the development of this pest (Batta, 2004) [4]. It is the most destructive and widespread cereal pest in the world (Champ and Dyte, 1976) [7]. It causes 18.30% loss to stored grains (Adams, 1976) [1]. *Sitophilus oryzae* (L.) is one of the biggest constraints for_huge wheat production, as the insect attacks the grain, both in field and in storage. However, it may bring about 48.37% grain loss (Tiwari *et al*., 1989) [13] and the adult and larvae feed on 19% and 16.2% wheat kernel respectively. *Sitophilus oryzae* has been reported to develop resistance to synthetic insecticides (Benhalima, 1988) [5]. Several methods are available to combat this pest with utilization of local technologies throughout the world. There are several inert dusts such as calcium oxide, gypsum, kaolinite and attapulgite which are used as diluents or carriers in the formulation of pesticides. Besides, these inert materials also exhibit insecticidal property when used alone. It was reported in the year 1944, for the first time, that inert dusts remove the lipid layer of the insect epicuticle by absorption depending on physical nature of the dust particle (Alexander *et al.* 1944) [3]. The insecticidal activity of the inert dusts was increased with their increasing length and diameter (Krishnamurthy *et al.*, 1965) [11]. The power of desiccation of inert dusts to insects was more in kaolinite clay than in montmorillonite clay (Ebling, 1971) [8]. In another study (Swamiappan *et al.*, 1976), [12] it was observed that acid activated clay treatment caused cent percent adult mortality of many of the stored grain pests within 24 hours after treatment. Research revealed that kaolinite 10 percent caused up to 90 percent mortality of adult at 28 days after release and also caused minimum grain damage and weight loss up to 90 percent (Yevoor, 2003) [14]. The inert dusts, mainly ash (30 cm top layer) and activated kaolin (1.2%) were found to be highly effective which caused cent percent adult mortality of *S. Oryzae* (Kalasagond, 1998) [10]. In West Bengal, total 960 tonne wheat was produced in 340 hectare of land during 2015-16. Productivity of wheat was 2825kg/ha. in the year 2015–16. Wheat is an important crop in West Bengal.

In North Bengal condition wheat is considered as a main winter crop in the cropping system followed by a vast majority of the farmers. After the harvest of the crop, the stored grains are subjected to insect attack, causing considerable loss. For management of pests we still rely on pesticides. No work has so far been carried out in this area on the aspects of management of the pest. Keeping in view the importance of the crop and huge losses caused by the stored insect *Sitophilus oryzae* to wheat, the objective of these experiments was to determine the potentiality of different inert materials against *Sitophilus oryzae* on wheat grains.

Materials and Methods

The laboratory experiment for the study of potentiality of different inert materials against *Sitophilus oryzae* on wheat grains was set up at the Department of Agricultural Entomology, UBKV, Pundibari. Various inert materials viz., Kaolinite clay, Cow dung ash, Sawdust, Sand and Bentonite with doses in terms of 10 percent each were evaluated separately for their potentiality against rice weevil in the wheat variety NW-6056.

Preparation of inert materials: Dry cow dung pellets were collected from the university farm house and burnt to get the ash. Sawdust was collected from the carpenter's house. Sand, kaolinite clay and bentonite clay were obtained from the Department of Soil Science, U.B.K.V., Pundibari.

Each grain protectant at the desired dosage as mentioned above was thoroughly mixed with 50g of uninfested grains of NW-6056 variety in a plastic bottle of 250 g capacity. Freshly emerged weevils were drawn from the stock culture and released at the rate of 10 pairs of adults per bottle. Bottles were covered with muslin cloth for proper aeration and fastened with rubber band. Each treatment was replicated thrice and these samples were kept under B.O.D at the temperature of 25±2 ^{0}C.

Data pertaining to the various aspects *viz.*, mortality percentage, determination of weight loss (%) and estimation of grain damage (%) were taken. Each parameter was taken in the following ways:

To estimate mortality, the number of dead insects in each vial was counted at 7, 14, 21, 28 and 35 days after treatment.

Rice weevil mortality percentage was assessed as –

$$\text{Percent of mortality} = \frac{\text{Number of dead insect}}{\text{Total number of insect}} \times 100$$

Observation on seed damage and weight loss was recorded at weekly interval for 35 days. Weight loss was worked out by using the formula (Adams and Schulton, 1978) [2] as described below:

$$\text{Percent weight loss} = \frac{U\,(ND + NU)}{(UND) - (DNU)} \times 100$$

Where,
U - Weight of uninfested grains (g)
NU - Number of uninfested grains (n)
D - Weight of infested grains (g)
ND - Number of infested grains (n)

Damaged and healthy grains were also counted separately up to 35 days at weekly interval and percent grain damage was calculated by the following formula:

$$\text{Grain damage (\%)} = \frac{\text{Number of damaged grains}}{\text{Total number of grain used}} \times 100$$

Results and discussion

The data given in table no.1 showed that on the basis of the percent mortality of *S. Oryzae*, there was significant difference among the various treatments and the effect of kaolinite was more pronounced than others. At 7 DAS, kaolinite brought about highest mortality (21.34%) which was however at par with bentonite (19.88%) and cow dung ash (18.05%) and these were followed by saw dust and sand (8.61). When percent mortality over period of storage was considered, it was noticed that mortality (%) due to different treatments increased as storage period was increased and at 28 DAS, highest mortality of 90% attained in case of kaolinite which was followed by bentonite, cow dung ash, saw dust and sand with corresponding mortality of 77.7%, 63.5%, 41.11% and 36.24% respectively compared to control. At 35 DAS, there was no further mortality due to kaolinite from 28 DAS (90%). However, considering the overall mortality of 35 DAS, the best treatment was noted to be kaolinite which was followed by bentonite (79.55%) cow dung ash (72.53%) and saw dust (51.32%). It was noted that based on the mortality at 35 DAS, there was no significant difference between kaolinite and bentonite and between cow dung ash and saw dust. Kaolinite was ranked as the most effective inert material (recorded no grain damage) followed by bentonite clay 10% (9.02% grain damage) (Bhanderi *et al.*, 2014) [6]. According to them cow dung ash 10% (74.69% grain damage) was the least effective inert material. The present findings have also been supported by Yevoor, who stated that kaolinite 10% caused up to 90% mortality of adult weevils at 28 days after release (Yevoor, 2003) [14]. Though sand did not cause any notable mortality in our study, it was reported that sand, at 30 percent, effectively prevented the infestation of *S. zeamais* in maize (Golob *et al.*, 1982) [9]. Least effect of sand may be due to low dose of sand used in our experiment.

Table 1: Bioefficacy of grain protectants against *S. oryzae* at different periods of storage

Sl. No	Treatments	Dose in % *(W/W)	Percent mortality				
			7 DAS	14 DAS	21 DAS	28 DAS	35 DAS
1	Kaolinite	10	21.34a	47.87a	85.70a	90a	90a
2	Bentonite	10	19.88a	42.12b	62.40b	77.7b	79.55a
3	Cowdungash	10	18.05a	37.26c	53.76b	63.55c	72.53b
4	Saw dust	10	8.61b	21.34d	31.00c	41.11d	51.32b
5	Sand	10	8.61b	19.88d	27.60c	36.24d	45.95c
6	Control	-	0.00c	0.00e	4.31d	10.45e	18.05d
SEM(±)			2.87	1.15	3.07	3.69	3.68
CD			8.85	3.55	9.46	11.36	11.35

DAS- Days after storage * 5g of grain protectant(s) in 50g of uninfested grains

The efficacy of various inert materials evaluated against *S. oryzae* in terms of grain damage and percent weight loss showed that kaolinite was found to be the most effective grain protectant with the least grain damaged and grain weight loss of 0.613% and 0.437% respectively which was followed by the bentonite with the corresponding values of 1.060% and 0.728% respectively. Among all the inert materials, sand was recorded to be the least effective one with 2.248% of grain damage and 1.842% of weight loss. It was found that there was significant difference between and among the treatments in respect to percentage of grain damage and weight loss which is given in table no.2.

Table 2: Percent grain damage and percent weight loss due to *Sitophilus oryzae* in wheat grains treated with different inert materials.

Sl.no	Treatments name	Percent grain damage	Percent weight loss
1	kaolinite	0.078f(0.613)◦	0.6614f(0.437)*
2	Bentonite	0.103e(1.060)	0.8842e(0.782)
3	cowdung ash	0.128d(1.626)	1.0660d(1.136)
4	Saw dust	0.158c(2.475)	1.2824c(1.645)
5	Sand	0.150b(2.248)	1.3572b(1.842)
6	Control	0.278a(7.531)	2.548a(6.496)
SE		0.004	0.041
CD/MSD		0.005	0.044
CV		3.265	3.585

*Figures in the parentheses are original values and those outside the parentheses are squre transformed values.
◦ Figures in the parentheses are original values and those outside the parentheses are arc sine transformed values.

From the result furnished in Table No-3, it reveals that there was significant difference in percent grain damage and percent weight loss at weekly intervals and the highest percent grain damage and percent weight loss was recorded at 35 days after treatment with as of 3.113% and 2.404%, respectively.

Table 3: Percent grain damage and percent weight loss due to *Sitophilus oryzae* in wheat grains treated with different inert materials and their effect of different days of interval.

Sl.no	Time(days)	Percent grain damaged	Percent weight loss
1	7	0.069e(0.477)◦	0.538e(0.289)*
2	14	0.106d(1.127)	0.854d(0.730)
3	21	0.155c(2.373)	1.342c(1.802)
4	28	0.160b(2.535)	1.381b(1.908)
5	35	0.177a(3.113)	1.551a(2.404)
SE		0.004	0.041
CD/MSD		0.004	0.038
CV		3.296	3.585

* Figures in the parentheses are original values and those outside the parentheses are squre transformed values.
◦ Figures in the parentheses are original values and those outside the parentheses are arc sine transformed values.

Table 4: Analysis of variance of mortality percent, grain weight loss percentage and percentage of grain damage of different treatments considering time as a correlated factor

Sources of variation	Mortality percent			Percentage of weight loss			Percentage of grain damage		
	DF	MS	P-VALUE	DF	MS	P-VALUE	DF	MS	P-VALUE
Treatment	5	2.221	<.0001	5	1.603	<.0001	5	0.022	<.0001
Time	4	2.003	<.0001	4	3.202	<.0001	4	0.036	<.0001
Treatment×Time	20	0.08	<.0001	20	0.083	<.0001	20	0.001	<.0001
R^2	0.976			0.996			0.996		
C.V	13.304			3.585			3.279		
Grand mean	0.690			1.133			0.133		

The result of the analysis of variance of different treatments, considering time as a correlated factor, shows that the six treatments had significant variation in respect of mortality percent, percentage of weight loss and percentage of grain damage. Five weekly intervals also varied significantly for those three parameters. When the interaction between treatments and time was considered, significant variation were also observed for these three parameters *i.e.* mortality percent, percentage of weight loss and percentage of grain damage. The CV is 13.304 for mortality percent, 3.585 for percentage of weight loss and 3.279 for percentage of grain damage which is portrayed on table no.4.

Conclusion

Kaolinite was found to be the best treatment causing 90% of adult mortality at 35 days followed by bentonite (79.55%), cow dung ash (72.53%) and saw dust (45.95%). In terms of grain damage and percent weight loss, kaolinite was noted to be the most effective grain protectant with the corresponding values of 0.613% and 0.437% respectively which was followed by the bentonite (1.060% and 0.728% respectively). Sand was recorded to be the least effective one with 2.218% of grain damage and 1.842% of weight loss.

References

1. Adams JM. Weight loss caused by development of *S. oryzae*. J. Stor. Prod. Res. 1976; 12:269-272.
2. Adams JM, Schulten GGM. In post harvest grain loss assessment methods. American association of cereal chemists, USA, 1978, 83-93.

3. Alexander P, Kitchener JR, Briscore HVA. Sorptive dusts. Annals of Applied Biology. 1944; 31:143-159.
4. Batta, YA. Control of rice weevil (*Sitophilus oryzae* L.) (Coleoptera: Curculionidae) with various formulations of *Metarhizium anisopliae*. Crop Prot. 2004; 23:103-108.
5. Benhalima MIM. Studies on the nature and extent of damage to the stored rice caused by rice weevil, *Sitophilus oryzae* (L.) and Angoumois grain moth *S. cerealla* (Oliver) unpublished M.Sc. (Agriculture) thesis submitted to Bangladesh Agriculture University, 1988, 1-57.
6. Bhanderi GR, Radadia GG, Patel DR. Biology of rice weevil, *S. oryzae* on stored sorghum. International Journal of Plant Protection. 2014; 72:389-392.
7. Champ BR, Dyte CE. Global survey of pesticide susceptibility of stored grain pests. FAO Plant Protection Science. FAO, Rome. No. 5, 1976.
8. Ebling W. Sorptive dusts for pest control. Annual Review of Entomology. 1971; 16:123- 158.
9. Golob P, Mwambula J, Mhango V, Ngulube F. The use of locally available materials as protectants of maize grain against insect infestation during storage in Malawi. Journal of stored Products Research. 1982; 18:67-74.
10. Kalasagond PR. Management of beetle pests in stored wheat by non-insecticidal approaches. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, 1988.
11. Krishnamurthy K, Subramanyarajurs TS, Majumdar SK. Activation of clays. Indian Journal of Experimental Biology. 1965; 3:171-173.
12. Swamiappan M, Jayaraj S, Chandy KC, Sundarmurthy VT. Effect of activated kaolinitic clay on some storage insects. Zeitschrift fur Angewardte Entomologi. 1976; 80:385-389.
13. Tiwari SC, Rao AS, Dwivedi BK. Effect of storage period and interspecific competition among *S. oryzae* (L.), *R. dominica* and *Tribolium castaneum* on their population build up and resultant loss to 6 varieties of wheat. Indian Journal of Entomology. 1989; 51(4):411-415.
14. Yevoor MP. Biology and management of rice weevil, *Sitophilus oryzae* (Linn.) in maize grains. M. Sc. (Agriculture) Thesis, University of Agricultural Sciences, Dharwad, 2003, 1-67.