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The effectiveness of inert dusts against lesser grain borer in wheat, *Rhyzopertha dominica* Fab.

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Abstract
The present study entitled 'the effectiveness of inert dusts against lesser grain borer, *R. dominica* Fab.' was conducted in the laboratory of Department of Entomology, College of Agriculture, Gwalior, Madhya Pradesh during the year 2019-2020. with a Number of 10 varieties. Seeds of 10 wheat varieties were collected from Department of Genetics and Plant Breeding, RVSKVV, Gwalior. Sound and healthy grains of each variety were stored in the same manner as those of stock culture grains were stored. The study is done by taking 100g of grains of each variety in plastic containers of 250g capacity for each replication to evaluate resistance/susceptibility against lesser grain borer. The observations were recorded at 30, 60, 90 and 120 days after storage to evaluate the per cent weight loss, per cent grain damage and progeny development (no. of adults emerged). The grain damage ranged from 0% to 8.18% in different inert dusts. There was no grain damage observed in the grains treated with silica 0.5 per cent and 1.0 per cent and rice husk ash 1 per cent. While, significantly maximum (8.18%) grain damage was observed in fly ash 0.5 per cent. While, weight loss ranged between 0% to 15.67% in wheat grains treated with different inert dusts. There was no weight loss observed in the grains treated with silica 0.5 per cent and 1.0 per cent and rice husk ash 1 per cent. Fly ash at 0.5 per cent (15.67%) was found least effective. The population build up ranged from 0 to 24.33 in different inert dusts. There was no population recorded in silica 1.0 per cent, 0.5 per cent 6.66 and rice husk ash at 1 per cent. While, significantly maximum (22.30) population was observed in grains treated with fly ash at 0.5 per cent.

Keywords: lesser grain borer, wheat, dusts

Introduction
Wheat is a grain cereal belonging to the monocot Triticum spp. and it is one of the most important cereal crops in the world with respect to its production and also consumption. Wheat occupies the highest cropping area compared to any other commercial crop. It is staple food for many humans and is of prime importance on that basis when compared to other cereals. The export and import of wheat occupies major share in terms of trade when compared to all other crops combined. It supersedes other grain cereals like rice and maize in its source of protein and is considered important after rice as a source of calories. Wheat comprises of higher protein content than maize or rice and other cereal grains. In India, wheat is the second most important cereal crop after rice and it contributes nearly 25 per cent to the national food basket (Wheat.org). Wheat is one of the largest cultivated crops globally under an estimated area of 220.19 million hectare with a production estimated up to 932.89 million tons for the year 2018-19 (USDA, 2019). In India different species of wheat are grown viz., Triticum aestivum, Triticum durum and Triticale hexaploide. Wheat is cultivated during rabi season and grown under an area of 29.55 million hectare, producing 101.20 million tons and an average national productivity of 3424 kg/ha. Madhya Pradesh is the third highest wheat producer in india with an annual production of 17.35 million tons (AICRP wheat and barley, 2019). The store grain insects can lead to decline in weight, quality, commercial value and seed viability. Majority of the store grain pests infesting wheat are coleopterans. Among these pests, the lesser grain borer, *Rhyzopertha dominica* (Fab.) (Bostrichidae: Coleoptera) causes considerable damage to stored grains (Campbell and Sinha, 1976) [1]. Nearly 39 insect species act as pests against stored grains and grain products. Lesser grain borer, *R. dominica* incidence is seen in both field and storage, which leads to the cause of economic damage during storage (Adedire, 2001). The powdered grains produced due to the adult insects feedings in turn acts as nourishment to the younger larval instars i.e. grubs until the older grubs bore into the grain. The insect pest effects both quality and quantity of grain and its products (Atwal 1994) [3].

Currently only two fumigants, methyl bromide andphosphine are widely used against stored product insect pests. Furthermore, phosphine resistance is becoming more common (Tyler *et al*., 1983) [2] and is a matter of considerable concern. Thus, there is an urgent need to develop safe alternatives of conventional insecticides and fumigants to protect stored grains from insect pest infestations which are more effective, economical safer and easier to adopt.

Research methodology

The study was entitled "Management of lesser grain borer, *Rhyzopertha dominica* Fab. (Coleoptera: Bostrichidae) on stored wheat" was conducted in the laboratory of Department of Entomology, College of Agriculture, Gwalior, Madhya Pradesh during the year 2019-2020. This was selected purposively. Seeds of 10 wheat varieties were collected from Department of Genetics and Plant Breeding, RVSKVV, Gwalior. Sound and healthy grains of each variety were stored in the same manner as those of stock culture grains were stored. The study is done by taking 100g of grains of each variety in plastic containers of 250g capacity for each replication to evaluate resistance/susceptibility against lesser grain borer. Five days old adults collected from stock culture are taken into pairs and ten pairs are released in each plastic jar and they are covered with muslin cloth and tightly fixed with rubber band to avoid escape of insects and are conditioned in laboratory. The observations were recorded at 30, 60, 90 and 120 days after storage to evaluate the per cent weight loss, per cent grain damage and progeny development (no. of adults emerged). The observation on per cent weight loss was recorded by counting number of un-infested grains and number of infested grains. This is even called count and weight method (Gwinner and Mack, 1996). Weight loss was worked out by using the formula (Agarwal *et al*., 1984).

Results and Discussions

1.0 The effectiveness of inert dusts against lesser grain borer, *R. dominica* Fab.

The wheat grains are treated with three types of inert dusts with two different concentrations to assess their efficacy against lesser grain borer, *Rhyzopertha dominica*. The observations regarding per cent weight loss in grains, per cent grain damage and population build-up at 30, 60, 90 and 120 days after storage post treatment.

The results delved are explained below.

1.1 Per cent grain damage

(a.) 30DAS: All the inert dusts were found effective in reducing grain damage as compared to control (16.67%). The grain damage ranged from 0.00% to 5.80% per cent in different inert dusts. The grains treated with rice husk ash at 1.0 per cent, silica at 0.5 and 1.0 per cent did not observe any grain damage. While, maximum grain damage was recorded in grains treated with fly ash at 0.5 per cent (5.80%), cow dung ash at 0.5 per cent (4.73%), cow dung ash 1 per cent (4.67%) and fly ash at 1.0 per cent (4.53%) were all at par with each other.

(b.) 60DAS: The grain damage ranged from 0.00 to 16.67 per cent in different inert dusts. No grain damage was recorded in the grains treated with rice husk ash at 1.0 per cent, silica at 0.5 and 1.0 per cent followed by rice husk ash at 0.5% (2.67). While, significantly maximum (5.80%) grain damage was observed in grains treated with fly ash at 0.5 per cent which was at par with cow dung ash at 1.0 per cent (4.73%), cow dung ash at 0.5 per cent (4.63%) and fly ash at 1 per cent (4.53) when compared to control (16.67).

(c.) 90DAS: The grain damage ranged from 0.00 to 18.67 per cent in different inert dusts. No grain damage was recorded in the grains treated with rice husk ash at 1.0 per cent, silica at 0.5 and 1.0 per cent followed by rice husk ash at 0.5% (2.67). While, significantly maximum (7.07%) grain damage was observed in grains treated with fly ash at 0.5 per cent which is par with cow dung ash at 1.0 per cent (5.67%) when compared to control (18.67).

(d.) 120DAS: The grain damage ranged from 0 to 26 per cent in different inert dusts. There was no grain damage was recorded in the grains treated with silica 1.0, 0.5 per cent and rice husk ash 1 per cent. While, significantly maximum (11.67%) grain damage was observed in grains treated with fly ash at 0.5 per cent when compared to control (26).

(e.) Overall mean per cent grain damage

The grain damage ranged from 0 to 20.75% in different inert dusts. There was no grain damage was recorded in the grains treated with silica 1.0, 0.5 per cent and rice husk ash 1 per cent followed by rice husk ash at 0.5% (5.17). While, significantly maximum (8.18%) grain damage was observed in fly ash 0.5 per cent which was at par with all the remaining treatments viz., fly ash 1.0 per cent (6.43%), cow dung ash 0.5 per cent (6.32%) and cow dung ash 1.0 per cent (6.83%) when compared to control (20.75).

1.2 Per cent weight loss

(a.) 30DAS: All the inert dusts were found effective in reducing grain damage as compared to control (9.32%). The weight loss ranged from 0.00% to 5.45% per cent in different inert dusts. The grains treated with silica at 0.5 and 1.0 per cent and rice husk ash 1 per cent did not observe any loss in grain weight. While, maximum weight loss was recorded in grains treated with fly ash at 0.5 per cent (5.45%) which was found at par to cow dung ash at 0.5 per cent (3.97%) when compared to control (9.32).

(b.) 60DAS: The weight loss ranged from 0.00 to 16.58% in different inert dusts. No weight loss in grain treated with silica at 0.5 and 1.0 per cent and rice husk ash 1 per cent did not observe any loss in grain weight. While, significantly maximum (8.23%) was observed in grains treated with fly ash 0.5 per cent which was found at par to cow dung ash at 1 per cent (4%) and fly ash at 1.0 per cent (6.52%) were all at par with each other.

(c.) 90DAS: The weight loss ranged from 0% to 19% per cent in different inert dusts. The grains treated with silica at 0.5 and 1.0 per cent and rice husk ash 1 per cent did not observe any loss in grain weight While, significantly maximum (11%) loss of weight was observed in grains treated with fly ash at 0.5 per cent

(d.) 120DAS: The weight loss ranged from 0% to 22% in different inert dusts. The grains treated with silica at 0.5 and 1.0 per cent and rice husk ash 1 per cent did not observe any loss in grain weight. Whereas, significantly maximum (15.67%) weight loss was observed in grains treated with fly ash 0.5 per cent.

(e.) Overall mean percent weight loss: The weight loss ranged from 0% to 11.63% in different inert dusts. The grains treated with silica at 0.5 and 1.0 per cent and rice husk ash 1 per cent did not observe any loss in grain weight. Whereas, all the remaining treatments were at par with each other.

1.3 Population build-up

(a.) 30DAS: All the inert dusts were found effective in disrupting population build up as compared to control. The grain population build up ranged from 0.00 to 31.33 in different inert dusts. The grains treated with silica at 0.5 and 1.0 per cent and rice husk ash1.0 per cent did not observe any population buildup of lesser grain borer. While, maximum population build up was recorded in grains treated with fly ash at 0.5 per cent (14.33) followed by cow dung ash at 0.5 per cent (10.33) when compared to control (31.33)

(b.) 60DAS: The population build up ranged from 0.00 to 44.33 in different inert dusts. No population build up was recorded in the grains treated with silica at 0.5 and 1.0 per cent and rice husk ash at 1.0 per cent. While, significantly maximum population was observed in fly ash at 0.5 per cent (17.33) which is par with cow dung ash at 0.5 per cent (18.33) when compared to control (44.33).

(c.) 90DAS: The population build up ranged from 0.00 to 54.33 per cent in different inert dusts. No new progeny or No population build up was recorded in the grains treated with silica at 0.5 and 1.0 per cent and rice husk ash at 1.0 per cent following which, least population build up was recorded in rice husk ash at 0.5 per cent (5.33). While, significantly maximum population build up was observed when compared to control (54.33) in grains treated with fly ash at 0.5 per cent (21) which is par with cow dung ash at 0.5 per cent (20.33).

(d.) 120DAS: The population build up ranged from 0 to 67.33 in different inert dusts. There was no population recorded in silica at 0.5 per cent, 1 per cent and rice husk ash at 1 per cent. While, significantly maximum (24.33) population was observed in grains treated with fly ash at 0.5 per cent which is at par with cow dung ash at 0.5 per cent (22.33) when compared to control (67.33).

(e.) Overall mean population build up

The population build up ranged from 0 to 55.33 in different inert dusts. No population was recorded in the entire experiment in the treatments of silica with 0.5 per cent, 1 per cent and rice husk ash with 1 per cent. While, all the treatments were at par with each other when compared to control (55.33).

Table 1: Effect of inert dusts on per cent grain damage by *R. dominica*

Inert dusts	Per cent grain damage (%)				Mean
	30DAS	60DAS	90DAS	120DAS	
Fly ash (0.5%)	5.80 (13.90)*	7.07 (15.39)*	8.13 (16.54)*	11.67 (19.96)*	8.17 (17.29)*
Fly ash (1%)	4.53 (12.22)*	4.87 (12.69)*	6.67 (14.93)*	9.67 (18.09)*	6.43 (15.24)*
Rice husk ash (0.5%)	2.67 (9.27)*	3.67 (10.96)*	5.67 (13.73)*	8.67 (17.10)*	5.17 (13.93)*
Rice husk ash (1%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
Cow dung ash (0.5%)	4.73 (12.56)*	6.13 (14.32)*	6.47 (14.70)*	7.93 (16.33)*	6.32 (15.11)*
Cow dung ash (1%)	4.67 (12.42)*	5.67 (13.73)*	7.67 (16.05)*	9.33 (17.76)*	6.83 (15.85)*
Silica (0.5%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
Silica (1%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
control	16.67 (24.09)*	18.67 (25.59)*	21.67 (27.74)*	26 (30.65)*	20.75 (27.99)*
SeM±	0.653	0.619	0.586	0.549	1.077
CD@5%	1.954	1.853	1.755	1.642	3.141

()* Figures in parenthesis are angular transformed and DAS – days after storage.

Table 2: Effect of inert dusts on per cent weight loss in grains caused by *R. dominica*

Inert dusts	Per cent weight loss				Mean
	30DAS	60DAS	90DAS	120DAS	
Fly ash (0.5%)	5.45 (13.45)*	8.23 (16.62)*	11.00 (19.33)*	15.67 (23.31)*	11.63 (19.76)*
Fly ash (1%)	3.93 (11.36)*	6.52 (14.75)*	9.85 (18.25)*	10.67 (19.05)*	9.01 (17.35)*
Rice husk ash (0.5%)	3.36 (10.49)*	5.72 (13.80)*	8.67 (17.10)*	10.00 (18.39)*	8.13 (16.43)*
Rice husk ash (1%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
Cow dung ash (0.5%)	3.97 (11.44)*	6.99 (15.26)*	8.64 (17.12)*	12.67 (20.84)*	9.44 (17.74)*
Cow dung ash (1%)	1.33 (6.54)*	4.00 (11.54)*	7.67 (16.05)*	9.67 (18.09)*	7.11 (15.23)*
Silica (0.5%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
Silica (1%)	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
control	9.32 (17.75)*	16.58 (24.02)*	19.00 (25.84)*	22.00 (27.96)*	19.19 (25.94)*
SeM±	0.683	0.635	0.567	0.550	1.696
CD@5%	2.046	1.900	1.697	1.647	4.947

()* Figures in parenthesis are angular transformed and DAS – days after storage.

Table 3: Effect of inert dusts on population buildup of *R. dominica*

Inert dusts	Population build up (Mean)				Mean
	30DAS	60DAS	90DAS	120DAS	
Fly ash (0.5%)	14.33 (3.85)*	17.33 (4.22)*	21.00 (4.64)*	24.33 (4.98)*	20.89 (4.61)*
Fly ash (1%)	9.33 (3.13)*	11.33 (3.44)*	15.33 (3.98)*	21.33 (4.67)*	16.00 (4.03)*
Rice husk ash (0.5%)	2.66 (1.74)*	3.67 (1.97)*	5.33 (2.41)*	10.33 (3.29)*	6.44 (2.56)*
Rice husk ash (1%)	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*
Cow dung ash (0.5%)	10.33 (3.28)*	18.33 (4.34)*	20.33 (4.56)*	22.33 (4.78)*	20.33 (4.56)*
Cow dung ash (1%)	9.66 (3.19)*	11.36 (3.44)*	13.67 (3.76)*	19.66 (4.91)*	14.89 (3.90)*
Silica (0.5%)	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*
Silica (1%)	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*	0.00 (0.71)*
control	31.33 (5.64)*	44.33 (6.70)*	54.33 (7.40)*	67.33 (8.24)*	55.33 (7.45)*
SeM±	0.127	0.148	0.079	0.066	0.245
CD@5%	0.384	0.447	0.240	0.200	0.720

()* Figures in parenthesis are square root transformed and DAS – days after storage.

Conclusion

The study shows that the Most of out the 10 wheat varieties screened, HI-1544 and HI-8498D were found to be resistant to grain damage, weight loss and population buildup by *Rhyzopertha dominica* (Fab.). The three types of inert dusts used, Silica at 1% and 0.5%and Rice husk ash at 1 per cent were most effective in reducing the grain damage, weight loss and population buildup of lesser grain borer. Fly ash at 1% and 0.5% were not much effective in minimizing the damage incurred by lesser grain borer yet it was found far superior to control so all inert dusts were efficient in reducing the damage, weight loss and population buildup.

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