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RESEARCH ARTICLE

Efficacy of plant and animal origin bioproducts against lesser grain borer, rhyzopertha *dominica* (fab.) in stored wheat

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ABSTRACT

The laboratory experiments have been conducted to study the efficacy of plant ans animal origin bioproducts against *Rhyzopertha dominica* (Fab.) on stored wheat by undertaking various parameters *viz.* percent adult mortality, percent adult emergence, percent seed damage, per cent weight loss , per cent germination, vigour index and significance of viability after six months of storage. Among different bio products evaluated, neem leaf powder, jatropha seed powder, mustard oil, cow dung powder and cow dung ash powder and cow urine @ 2% were found superior with less adult emergence, seed damage and weight loss with higher adult mortality, seed germination, vigour index and significance of viability in comparison to other treatments and untreated control. It has been clearly observed that only mustard oil reduced the seed germination with adverse effect on quality parameters after six months of storage. The studies clearly demonstrated that eco friendly indigenous bio products could be used to manage the storage insect pests in wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the important cereal crop which ranks first among world food crops (Jagshoran *et al*., 2004). The average food grains loss in storage condition due to biotic and abiotic factors accounts for 10 per cent per year, out of which insects are contributing about 2.5 to 5.0 per cent (Girish *et al.,* 1985). Lesser grain borer, *Rhyzopertha dominica* (Fabricius) (Coleoptera :Bostrichidae) is the predominant pest causing considerable grain loss during storage (Champ and Dyte, 1977).

The control of this pest is dependent upon applications of organophosphorus and pyrethroid insecticide and fumigants (Tewary *et al*., 2003) which lead to problems such as disturbance in environment, increasing application cost, pest resurgence, pest resistance to pesticide and toxic residues in food grains (Subramanyam and Hagstrum, 1995). Because of these drawbacks of insecticides, efforts are needed to develop some alternate methods of their management such as plant based bioactive compounds and animal origin products as a substitute of chemical pesticides. It is less hazardous to use plant materials with antifeedant , repellant or insecticidal action than to use synthetic insecticides (Sharma & Bhargava, 2001) However, it was a novel approach to use animal waste products i.e. cow urine, cow dung cake powder and cow dung ash powder as a grain protectants against *R. dominica* on wheat hence keeping these points in mind a novel approach was undertaken to assess the effect of different indigenous bio products on different parameters of *R. dominica* in stored wheat under six months storage period .

MATERIALS AND METHODS

The experiments were conducted in the Department of Entomology, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar during the year 2011-2012. The culture of *R. dominica* was obtained from the stock culture prepared on wheat. Plastic containers of 1.5 kg capacity were used for insect rearing. About 500 gm of grains were kept in each container and about 600 adults were released separately. They were allowed to lay eggs for 3 to 5 days and removed after 7 days, when the eggs laying was over. These containers were kept at room temperature for the adult emergence.

Extraction of bioactive compounds

The test plants *i.e.* neem leaves (*Azadirachta indica* (Juss.), mehandi leaves (*Lawsonia inermis* (L.), kari leaves (*Murraya koenigii*), seeds and leaves of jatropha (*Jatropha cuaracus* (L.), and rice husk were collected from the University Campus and nearby areas of Pant nagar, whereas, mustard oil was purchased from the market and animal waste *i.e* cow urine and cow dung were collected from the nearby houses domesticating cows . The leaves of different plants were first washed with water, shade dried and were grinded in an electrical grinder to make a fine powder. The cow dung cake was powdered in pestle and mortar and cow dung cake was burned to get ash. To prepare the required quantity of 2% concentration of the treatments 20 gram of each powder and 20 ml of mustard oil and cow urine was added separately to 1kg of wheat seeds.

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Bioassay- About 10 kg seeds of UP-2338 variety of wheat was collected from Department of Genetics and Plant Breeding, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, india.. The moisture content of seeds was less than 12 per cent. The required quantity of plant powders, mustard oil and animal waste products at the rate of (2%) 2g/100g were mixed with 250g sterilized and conditioned wheat seeds separately. The seeds were taken in the polythene bags and shaken with hands horizontally and vertically so that every grain can have a thin coating of bio products. The treated grains were stored in the plastic boxes having lids and considered as a grain lot for taking out requisite amount of grains for further studies.

After six months, an aliquot of 20 g grain for each treatment was drawn and kept in each plastic vials (10X2.5cm), and replicated thrice for each candidate bio product for the tested insect. Five pairs of freshly emerged adults of weevils were released in each glass vial. The vials were covered with perforated lids. The per cent adult mortality was recorded at 14 days after their release and all the remaining adults were removed. Forty days after their release, total number of adults (F1 adult emergence) emerged in each treatment was counted. The observations were recorded on per cent grain damage and weight loss. The grain damage by one generation of the pest was recorded on the basis of the visual count. Weight loss was recorded by the exclusion of frass from the grain and was compared with the grain damage in control.

To observe the adverse effect of different bio products on wheat seeds, germination test of the treated seeds was carried out separately at 60 days and 180 days interval of seed treatment by taking 50 wheat seeds. The seed germination tests was carried out employing rolled paper towel test according to International Rules of Seed Testing (Anonymous, 1976) .The germinated seeds was counted after 4-6 days. Seedling vigour index was calculated by formula given by Abdul Baki and Anderson (1973)

Vigour Index (VI) = percent germination x length of hypocotyls in mm and + length of radical in mm

$$\text{Significance of viability (SV)} = \frac{\text{Percent germination in treated grain}}{\text{Per cent germination in control}}$$

Data subjected to Complete Radomazied Design (CRD) after suitable transformations using programme STPR3

RESULTS AND DISCUSSION

Effect of different bioproducts on the management of R. dominica in stored wheat

The observations regarding the efficacy of plant and animal origin bio products against *R. dominica* with respect to different parameters *viz.*, adult mortality, adult emergence, seed damage, weight loss, seed germination, vigour index and significance of viability after six months (180 days) is presented in Table 1. Among all indigenous bio products evaluated for their efficacy over 180 days of treated wheat storage, the best treatments with significantly high mean mortality of released *R. dominica* adults were observed in mustard oil (94.52%) followed by, cow dung ash powder (90.98%), neem leaf powder (86.37%), cow dung powder (86.01%), jatropha leaf powder (85.72%) cow urine (79.20%) and jatropha seed powder (79.12%) and while least effective treatments were observed to be mehandi powder with adult mortality (76.71%), kari leaf powder (62.82%) and rice husk powder (58.07%) in comparison to adult mortality recorded in untreated wheat grains (5.45%).

There was no adult emergence observed in mustard oil treated grains with very less adult emergence in neem leaf powder (3.85%) followed by cow dung ash powder (2.75%) , jatropha leaf powder (5.02%) , jatropha seed powder (6.85%) and cow dung powder (6.07%) however,, among the other treatments significantly less adult emergence was observed as mehandi powder (11.80%), cow urine (13.36%) and rice husk powder (22.80%) in comparison to untreated control (32.62%).

Over 180 days of storage of wheat seeds treated with different indigenous bio products significantly maximum seed damage was observed in untreated check (72.50%) whereas, no seed damage was observed in mustard oil treated wheat seeds followed by very less seed damage in neem leaf powder (1.25%), cow dung ash powder (1.95%), jatropha seed powder (10.05%), cow dung powder (11.08%), jatropha leaf powder (13.67%) whereas among the other bioproducts treated grains the seed damage was ranged from (21.25% 25.85%) which was significantly very less than seed damage recorded in untreated control Similarly no weight loss of seed was recorded in mustard oil treated grains with very less weight loss observed in neem leaf powder (0.80%), cow dung ash powder (1.10%),jatropha seed powder (2.13%), cow dung powder (5.37%), jatropha leaf powder (5.40%) treated wheat seeds as they retained their residual toxicity but significantly less weight loss was observed in, mehandi powder (8.06%) followed by cow urine (8.77%), kari leaf powder (8.98%), and rice husk powder (9.24%) with significantly maximum weight loss was recorded in untreated check (31.67%)

Effect of different bioproducts on the quality of wheat seeds

To observe the adverse effect of different bio products on the quality of wheat seeds, germination test of the treated seeds was carried out separately at 60 and 180 days interval in which after 60 days of seed treatments (Table-1), the germination was maximum (96.70%) in neem leaf powder and cow dung powder followed by rice husk powder (96.09%), mehandi powder, kari leaf powder and cow dung powder all have 95.39 % germination, with the least germination mustard oil treated seeds (82.00%) in comparison to germination in untreated wheat seeds (90.70%). Similarly, less Vigour Index (VI) and Significance of Viability (SV) was calculated in mustard treated seeds (11532.2 and 0.99) and jatropha seed powder treated seeds (
12773.5 and 1.00) in comparison to the other treatments in which VI was ranged from (13228.2 to 15653.7)and SV was ranged from (1.09-1.12) in comparison to untreated control (13120.2).

After 180 days of seed treatments, the highest germination was recorded in kari leaf powder (96.70%) followed by mehandi powder (96.00%) and rice husk powder (96.00%), neem leaf powder (92.13%) and cow urine and cow dung powder (91.70 %) followed by jatropha seed powder and cow dung ash powder (90.80%). The percent germination was drastically reduced to 56.30% in mustard oil treated wheat grains with less VI 8215.3 and SV 0.62 followed by jatropha

Table 1 Effect of plant and animal origin bio products on *R. dominica* and quality parameters of wheat under storage conditions

Treatments	Conc. (%)	After 180 days				After 60 days			After 180 days		
		Mean adult mortality	Mean adult emergence	Seed damage (%)	Weight loss (%)	Germination (%)	Vigour index	Sig. of viability	Germination (%)	Vigour index	Sig. of viability
Neem leaf powder	2%	96.19 (78.75)*	00.00 (00.00)	0.00 (0.00)	0.00 (0.00)	96.70 (78.69)	14328.2	1.12	92.13 (73.71)	13163.7	1.02
Jatropha leaf powder	2%	84.80 (67.05)	7.30 (15.67)	14.22 (21.99)	6.50 (14.77)	95.39 (77.23)	13883.7	1.09	90.80 (72.34)	13025.3	0.99
Jatropha seed Powder	2%	88.80 (70.44)	1.70 (7.48)	0.00 (0.00)	2.13 (8.39)	86.70 (68.61)	12773.5	1.00	83.00 (66.05)	12156.0	0.91
Mehandi powder	2%	77.40 (61.61)	14.60 (22.46)	23.77 (28.85)	7.60 (16.00)	96.00 (78.62)	14553.2	1.11	96.00 (77.34)	15237.2	1.07
Kari leaf powder	2%	62.70 (52.35)	15.30 (23.02)	27.67 (31.44)	8.80 (17.65)	95.39 (77.23)	15125.7	1.09	96.70 (77.65)	15783.2	1.07
Mustard oil	2%	93.40 (75.11)	00.00 (00.00)	0.00 (0.00)	0.00 (00.0)	82.00 (65.62)	11532.2	0.99	56.30 (50.16)	8215.3	0.62
Rice husk powder	2%	56.33 (48.63)	16.20 (23.73)	29.79 (32.69)	9.70 (18.14)	96.09 (78.43)	15653.7	1.11	96.00 (77.34)	15382.0	1.06
Cow dung powder	2%	80.80 (64.01)	7.40 (15.78)	14.07 (21.82)	4.80 (12.65)	96.70 (78.69)	14825.3	1.12	91.70 (73.34)	14336.3	1.01
Cow dung ash powder	2%	90.80 (72.34)	2.30 (8.72)	0.00 (0.00)	0.00 (0.00)	95.39 (77.23)	14328.2	1.09	90.80 72.34	13862.7	1.00
Cow urine	2%	80.50 (63.79)	12.10 (20.35)	24.77 (29.28)	9.20 (17.65)	92.00 (74.64)	13228.3	1.06	91.70 (73.46)	12768.3	0.98
Control	–	36.30 (48.61)	33.60 (35.42)	87.50 (69.30)	34.80 (36.15)	90.70 (72.32)	13120.2	-	90.30 (72.24)	12843.7	-
SEM	–	0.589 (0.053)	0.052 (0.065)	0.047 (0.037)	0.053 (0.711)	0.602 (0.045)	-	-	0.602 (0.045)	-	-
CD (5%)	–	0.234 (0.212)	0.207 (0.259)	0.133 (0.090)	0.212 (0.283)	0.176 (0.132)	-	-	0.176 (0.132)	-	-
CV		0.129 (0.144)	0.899 (0.717)	0.313 (0.216)	1.214 (0.960)	0.128 (0.121)	-	-	0.156 (0.124)	-	-

*Angular transformed values

seed powder with germination (83.00%) VI 12156.0 and SV 0.91 in comparison to other treatments where VI and SV was more and ranged from (13025.3 to 15783.2 and 1.00 to 1.07) , respectively with seed germination (90.3% and VI 12843.2) in untreated control.

The present studies clearly revealed that that indigenous plant and animal origin bio products have been found significantly effective over untreated control as more insect mortality, les adult emergence, seed damage, weight loss with more per cent seed germination and vigour index was observed on the treated wheat grains after the interval of 60 and 180days of treatments except mustard oil treated wheat seeds where seed germination and vigour index was drastically affected after 180 days of treatment but mustard oil can be used as seed protectant upto 60 days with highest mortality of *R. dominica and* without affecting seed quality. (Amin *et al.,*2000) reported that powdered leaves of neem provided adequate protection of wheat grains. These present studies supported the findings of (Achiano *et al*, 1999) who showed the effectiveness of neem leaf powder and ash from various sources against different stored grain pests. For the control of stored product insects, it is less hazardous to use plant materials with antifeedant , repellant or insecticidal action than to use synthetic insecticides Jadav, (2009). The practice of mixing inert materials such as sand and ash, plant products , with seeds of cereals to save them from stored pests is quite common in rural areas of India. The use of animal origin products such as cow urine, cow dung powder and ash are the emerging traditional approaches in the field of pest management (Yadav and Mahla, 2005) successfully used biogas in the control of stored grain insect pests such as *Rhizopertha dominica, Sitotroga cerealella, Corcyra cephalonica* infesting paddy which was carried out in 100 kg capacity of PVC bins over a period of 8 months. Kumawat, (2009) conducted experiments on the management of lesser grain borer, *R. dominica* infesting wheat grain in laboratory condition by mixing neem products and found that no adult emergence, grain damage and weight loss up to 90 and 270 days of storage with no adverse effect of test compounds on germination was observed up to 270 days.

CONCLUSIONS

Considering the hazardous effects of chemicals used for control of stored insect pests, it is necessitated to use the eco-friendly approaches such as botanicals and animal origin products for their management. However, it is a novel approach to use animal waste products i.e. cow urine , cow dung cake and ash powder and different plant products as a grain protectants against *S. oryzae* and *R. dominica* on wheat. However, It could be concluded that neem leaf powder, cow dung ash powder, cow dung powder, jatropha seed powder, cow urine and mustard oil @ 2% were found highly effective bioproducts for the management of *R. dominica* and as seed protectants. These studies clearly demonstrated the potential and possibilities of using indeginous bio products in overall IPM strategies for the control of storage insect pests in wheat.

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