Efficacy of different plant powder against lesser grain borer, *Rhizopertha dominica* (Fabricius) on the stored rice grain under laboratory condition

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ABSTRACT

The present study was undertaken to investigate the insecticidal properties of different plant extracts *viz. Melia azadarach, Perthenium hysterophorus, Phlogocanthus thyrsiflorus, Vitex trifolia, Zanthoxylum acanthopodium* and *Azadirachta indica* against lesser grain borer, *Rhizopertha dominica* under the laboratory condition. Adult insects were exposed to the 1.5 g and 2.5 g plant powder extract treated rice and mortality was assessed after 1,3,5,7 and 10 days. There was an increase in beetle mortality with days of exposure in all concentration. The result indicated that 2.5% *P. hysterophorus* and *Z. acanthopodium* extracts were more effective out of these six plant extracts. They have shown high mortality (i.e. 75-80%) were found to be dose dependent. It was concluded that both *P. hysterophorus* and *Z. acanthopodium* can be used for the protection of stored rice grain from infestation of *R. dominica.*

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INTRODUCTION

The lesser grain borer, *Rhyzopertha dominica* (Fabricius) (Coleoptera: Bostrichidae) is one of the most important pests of stored rice *Oryza sativa* L. In addition it is destructive to wheat, maize, barley, dry fruit and other grains. The beetle has been reported to be highly polyphagous and cosmopolitan in tropical and sub tropical region of the world. Both adults and grubs attack the food grain at embryo point and proceed inside to eat the entire content of the grain and leave the shell behind. Adult beetles are more harmful which destroy healthy grains leaving it as mere husk. This insect generally has five generations in a year and causes more than 40% damage in food grain in store house. The maximum damage by this pest occurs during July to October. The world wide overall damage caused by this insect is estimated to be 10-40% annually (Matthews, 1993). From the research, it has been suggested to use of fumigants and other chemicals to combat with the population of *R. dominica* in stored grains (Yadav and Singh, 1994 and Athur, 1995), however, chemicals evidently pose several problems, *viz.* Chronic and acute toxicity, development of insect resistance, environmental pollution, etc. Recently, there is a steady increase in the use of medicinal plant products as a cheaper and ecologically safer means of protecting stored products against infestation by insects (Adedire and Lajide, 2003; Ashamo and Odeyremi, 2001; Ileke *et al.,* 2012). Use of naturally occurring plant materials to protect agricultural products against insect pests is an age-old practice in many parts of the world (Dales, 1996; Belmain, 1999). Extract qualities of botanicals that give optimum insecticidal effects are unknown. It is thus desirable to quantify the amount of plant derived materials that provide adequate protection against insect pest and to determine how to affect insect pests and to determine how these affect insect behaviour, growth and reproduction (Jilani, 1992). Equally, plant species that are found to be effective and popular locally with the farmers need to be subjected to safety testing, at least involving basic toxicological studies (Jilani, 1992). The principal advantage of botanicals is that farmers are able to provide their own protectant (Isman, 2008). Considering the uses of various plant materials by indigenous farmers in controlling the pest of stored rice grains, their scientific evaluation is of utmost importance. Thus, it is essential to screen locally available important plant materials with desired insecticidal properties that are biodegradable and inexpensive for poor farmers. Therefore, the present study was conducted to find out possibly the most

effective plant powder against *Rhizopertha dominica* in stored rice grain.

MATERIALS AND METHODS

The experiment was carried out at the Laboratory of Entomology, D.M. College of Science, Imphal during November to January 2012-2013. Material used and the technique employed during the course of investigation for conducting the experiments are presented here.

Test insects culture and maintenance

The experimental insect, *R. dominica* was obtained from Entomology laboratory stock. They were reared and bred under laboratory condition (28±2 ^{O}C and relative humidity of 67±3%) on diet of the rice grains with 12 per cent moisture content, kept in a plastic jar of 3 kg capacity. Initially 50 pairs of 1-5 day-old adults were placed in a plastic jar containing rice grain. The jars were sealed and a maximum of 10 days were allowed for mating and oviposition. Then parent stocks were removed and the breeding jars were covered with pieces of cloth fastened with rubber bands to prevent the contamination and escape of insects. After 35 to 40 days, emerged adults from the culture were utilized for the maintenance of subcultures. The subsequent progenies of the beetles were used for all experiments.

Preparation of native botanical powders

Fresh leaves of *M. azadarach, P. hysterophorus, P. thyrsiflorus, V. trifolia, Z. acanthopodium* and *A. indica* were collected from the surrounding of D.M College campus. Afterward they were washed in running water. The plant materials were kept in shade for air- drying and then dried in the oven at 60^{o}C to gain constant weight. The powdered samples were prepared by pulverizing the dried leaves and seed with the help of a grinder. The ground samples were passed through a 25-mesh sieve to obtain fine and uniform dust. The extracts were preserved in airtight jar and stored in a refrigerator until their use for insect bioassay.

Plant extracts on *R. dominica* mortality

The toxic effect of plant on adult *R.domonica* was accomplished in petri-dishes (9 cm diameter) containing 20g of rice grains with doses of 1.5g and 2.5g plant powder extracts. The extracts were thoroughly mixed for about two minutes with rice grains with the aid of a glass rod after which 10 newly emerged adult *R. domonica* were introduced into the dishes and mortality was observed after one day interval up to 10 days. The grains that were not treated were served as the control experiment. Adults were considered dead where no response was observed after probing them with forceps. Three replications were maintained for each concentration of the individual plant extract. Observations were recorded on 1,3,5,7 and 10 days after the treatment.

Statistical analysis

The experiment was carried out by adopting analysis of variance one way classification and the data thus collected were statistically analysed by using SPSS software in a microcomputer. The F-values and Critical Difference was calculated from the ANOVA table of analysis of variance. Mean values were adjusted by for mortality tests, original data were corrected by Abbott's (1925) formula.

Table 1. Plant evaluated for insecticidal activities against store grain pest.

Scientific Name	Local Name	Part used	Active Compounds	Mode of action
Melia azadarach	Seizrak	Leave	Melianone, Melianol	Ovicidal, Antifeedant, Repellent
P. hysterophorus	Congress grass	Leave	Perthenin	Ovicidal, Antifeedant, Insecticidal
Phlogocanthus thyrsiflorus	Nongmangkha	Leave	Adhatodene	Ovicidal, Antifeedant, Insecticidal
Vitex trifolia	Urikshibi	Leave	Vitricin	Antifeedant, Insecticidal & Repellent
Zanthoxylum acanthopodium	Mukthrubi	Leave	Zanthophylline	Feeding deterrent ,repellent
Azadirachta indica	Neem	Leave	Azadirachtin, Meliantriol, Nimbin & nimbidin	Antifeedant, Insecticidal, Repellent, Ovicidal & Insect growth regulator

Table 2. Effect of chosen plant extracts on adult mortality of *Rhizopertha dominica* after 1 – 10 days after treatment.

Treatment (g)	Doses	Mean mortality				
		1DAT	3DAT	5DAT	7DAT	10DAT
T1-*Melia azadarach*	1.5	3.3	3.3	6.29	29.53	62.92
	2.5	3.3	20.0	33.07	42.72	69.59
T2-*P. hysterophorus*	1.5	0.0	6.6	16.32	52.97	69.69
	2.5	3.3	3.3	33.07	52.82	79.73
T3- *Phlogocanthus thyrsiflorus*	1.5	3.3	6.6	29.76	42.92	59.59
	2.5	3.3	10.0	36.39	52.82	76.28
T4-*Vitex trifolia*	1.5	3.3	6.6	16.32	19.46	42.72
	2.5	0.0	16.6	26.35	29.29	56.01
T5-*Zanthoxylum acanthopodium*	1.5	3.3	6.6	26.35	46.24	76.36
	2.5	6.6	10.0	39.80	49.49	79.73
T6-*Azadirachta indica*	1.5	0.0	3.3	19.73	39.60	59.59
	2.5	3.3	6.6	19.73	49.49	76.28
T7-Control	0.0	0.0	0.0	3.3	6.6	10.0
		0.0	0.0	3.3	10.0	20.0

RESULTS AND DISCUSSION

The data with respect to per cent mortality of *R. dominica* observed on different interval days are presented in table 2. The data shows that the tested plant extracts had profound effect on suppression of the pest's population. Most of the treatment revealed significantly higher mortality at 10 days of exposure when compared to the control. Maximum mortality was caused by 2.5 g *P. hysterophorus* and *Z. acanthopodium* rather than by *Phlogocanthus thyrsiflorus* and *A. indica*. In general mortality rate was increased with increasing the concentration of plant extract and exposure time. Among different plant extracts, the grains treated with *V. trifolia* extract product showed low mortality (table 2). Furthermore, both 2.5g of *P. hysterophorus* and *Phlogocanthus thyrsiflorus* caused high mortality of 52.82% followed by *Z. acanthopodium and A. indica* with mortality of 49.49% after 7 days of treatment. Minimum mortality 19.46% was recorded in grain treated with 1.5 g *V. trifolia* after 7 days. All the powders caused significantly ($P<0.05$) higher mortality to *R. dominica* starting from 1 day after treatment. It was observed that toxicity of the powder increased with increase in dosage and exposure time.

The overall present mortality data in table 2 indicated that 2.5 g powder of *P. hysterophorus* and *Z. acanthopodium* gave significantly better control of *R. dominica* than other extracts used in the experiment. Likewise, different workers reported that parthenin inhibited a dose-dependent toxicity effects on a range of test species (Patil and Hedge, 1988 cited in Paudel *et al.,* 2009; Panday 1994). Different studies have demonstrated that sesquiterpene lactones derivative of parthenin obtained from *Parthenium hysterophorous* were proved for their antifeedant action against six instar larvae of *Spodoptera litura* and *Tribolium castneum* and for insecticidal activity against the adults of stored grain pest *Callosobruchus maculatus* and cabbage leaf webber, *Crocidolomia binotalis* Z.. Furthermore, Wabale and Kharde (2010) noticed that an extract of *Parthenium* has a tendancy of 81.87% in damaging the life cycle of sugarcane wooly aphid, *Ceratovacuna lanigera* Z.. *Parthenium hysterophorous* leave possess pesticidal potential which has been established in terms of ovicidal and antifeedant effects (Datta and Saxena 2001).

Santosh and Chhetry (2012) reported that the use of dry leave of *Z. acanthopodium* in seasoning of dry chillies avoided pest and pathogen. These leaves possessed a strong pungent smell which act as pest repellent. The insecticidal effect of plant powder might be attributed to one or more of the following properties including repellent, antifeedant, stomach poisoning effect where insects fed on admixed grains

and picked up lethal doses of treatment particles and these powders might reduce insect movement and also cause death through occlusion of their spiracles, thereby preventing respiration via trachea (Shaheen and Khaliq, 2005). Hence the present finding suggested that the leaves of these plants possessed certain bioactive components which required further investigation to determine the exact mode of action of these active components and their effect on non-target organism. Thus the use of *P. hysterophorus* and *Z. acanthopodium* powders need to be encouraged for use at household level.

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