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Effects of Six Botanical Plant Powder Extracts on the Control of Rice Weevil, *Sitophilus Oryzae* L. in Stored Rice Grains

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Abstract* – In the present study, powder prepared from parts of six indigenous botanical plants in Manipur, India (*Melia azadarach, Perthenium hysterophorus, Phlogocanthus thyrsiflorus, Vitex trifolia, Zanthoxylum acanthopodium* and *Azadirachta indica*) were tested for their efficacy on mortality, rate of adult emergence, grain damage effect against rice weevil, *Sitophilus oryzae* on rice grain. Adult insects were exposed to 5 g powder extracts treated rice grain 20 g and mortality was assessed after 7, 14, 21, 28 and 35 days. The result obtained showed that plant powder *M. azadarach* recorded the highest mean mortality of 80.54% at 35 days after treatment (DAT) when compared with other treatments, followed by *Z. acanthopodium* and *A. indica* showed 70.74% mortality whereas *P. hysterophorus* and *P. thyrsiflorus* was found less effective 56.11 % mortality followed by *Vitex trifolia* (36.66%) mortality. The plant powder A. *indica* was found highly effective in prohibiting the adult emergence and reduction in grain damage per cent over other treatment. It was concluded that *M. azadarach, A. indica* and *Z. acanthopodium* could be used for the protection of stored rice from infestations of *S. oryzae.

Keyword* – Plant Powder Extracts, Mortality, Emergence, Grain Damage, Rice Grain, *Sitophilus Oryzae.

I. INTRODUCTION

The rice weevil, *Sitophilus oryzae* is one of the major pests of stored rice in India. It is the most widespread and destructive major insect pest of stored cereals throughout the world. Especially such types of insects are very active in warm and humid area. It is well known to all that both the adults and grubs are serious pests of stored grains and stored products namely rice, wheat, maize, sorghum, barley, lentil,

Biscuits, dried potatoes, corn flower, beans, pumpkin seeds, tamarind seeds, millets etc. In some cases they cause severe infestation i.e. a considerable amount of loss and spoiled more than what they eat. A larva of the *Sitophilus oryzae* consumes 14 mg grain/d and adult stage consumes 0.4 mg grain/d [Giolebiowska, 1969] .Use of synthetic chemical insecticides for grain protection is a common practice, but it may have drawbacks including toxicity, attendant resistance problems and environmental pollution [Georghious and Lagunes –Tejeda, 1991;Yusof and Ho, 1992]. In fact, management of stored product pests, using materials of natural origin, is nowadays the subject which received much research to overcome their problems because of their little environmental hazards and low mammalian toxicity [Isman, 1994]. The use of plant products as grain protectants has been a traditional method in Indian villagers and this revived a great interest in the recent past. The plant materials possessing insecticidal as well as repellent properties with little or no mammalian toxicity are much in use. Previous research indicated that some plant powder and extracts have strong effect on stored grain insects such as toxicity and the inhibition of reproduction [Regnault-Roger and Hamraoui, 1993; Talukder and Howse, 1995]. The plant products may prove superior to synthetic chemicals as they are ecologically safe and easily degradable besides easy availability at law cost. There has also been some degree of success and achievements in the use of such botanical. It is hoped that these concentred efforts shall eventually bring forth botanicals that can be used as alternate bioinsecticides. This study reports on the effect of six botanical plant powder extract in the control of rice weevil in stored rice.

II. MATERIALS AND METHODS

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

Insect culture

Parent stock of *S. oryzae* was obtained from infested raw white rice brought from the local market of Implal-west. The adult rice weevil, *S. oryzae* were maintained on uninfected rice grain. 50 pairs of adult rice weevils were introduced into plastic jars containing 400g of rice. These plastic jars were then covered with muslin cloth to prevent insects escaping and to allow ventilation. After two weeks the adult were removed and left the rice medium until new adult emerged. These cultures were done under laboratory conditions at 20.6^{o}c min, 29.3^{o}c max temperature and 80.75% relative humidity .The cultures so maintained were used throughout the period of investigation.

Preparation of native botanical powders

Fresh leaves of *Melia azadarach, Perthenium hysterophorus, Phlogocanthus thyrsiflorus, Vitex trifolia, Zanthoxylum acanthopodium* and *Azadirachta 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 they were 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.

Experiment: Effect of the plant powders on mortality of rice weevil on rice grain.

For this experiment, the grains were sterilized in an incubator, about 24 hour at 60°C to disinfect them. About 20 g of the fresh and un-infested rice grain was measured in electronic balance and transferred into translucent plastic bottle of 8×8 cm size. Thereafter 5 g doses of each plant power were thoroughly mixed with 20 g of rice grain in each plastic bottle. Freshly emerged adult were starved for 4 hour and 20 pairs of adult weevil were released in the treated grain plastic bottle .The plastic bottles were covered with piece of cloth sized of plastic bottle with rubber band. For control no extract was applied on grains. Mortality was recorded at 7 days interval in one month. Three replications were maintained in each treatment. The experiment was conducted at 27°C and 73% relative humidity under laboratory condition.

Mortality, progeny and damage assessment assays

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 was assessed as

Number of dead insect/Total number of insects x 100

Data on percentage adult weevil were corrected using Abbott's [1925] formula

Percentage of corrected mortality =

$$\frac{(\text{Observed mortality} - \text{Control mortality})}{100 - \text{Control mortality}} \times 100$$

Insects subsequently emerging were counted to estimate F1 progeny production. Counting was stopped after 35 days to avoid overlapping of generation .Weight loss was calculated as the difference between the final and initial weights of treated or untreated grain, corrected for changes in moisture content, and expressed as a percentage of initial weight of grains. The following equation was used:

% WL= (IW-FW) X 100 / IW

Where, WL: Weight loss index.

IW: Initial weight and FW is the final weight.

Mean of all determination (+SEM) were recorded.

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.

III. Results and Discussion

Mortality

The result of the experiment (table 1) showed that most of the treatment revealed significantly ($p<0.05$) higher mortality at 35 days of exposure when compared to the control. The data on mortality of adult after 7, 14, 21, 28 and 35 days of the treatment were recorded. Result revealed that among all the grain protectants, *M. azadarach* had given maximum protection to the seed by causing 27.60 per cent mortality of the pest followed by *A.indica* and *P. hysterophorus* with 17.90 per cent mortality at 7 days after treatments. Similarly, Saljoqi et al, 2006 also reported that *M. azadarach* was proved to be most effective against *Sitophilus oryzae* in the stored wheat grain. Similar trend was observed at 14 days after treatment, *M. azadirach* was recorded the highest mortality with 51.44 per cent among all the tested treatments. This was followed by *P. thyrsiflorus* with 31.91 per cent mortality. Whereas *A. indica*, *P. hysterophorus, V. trifolia and Z. acathopodium* gave the average mortality with 27.11%, 17.34 % and 12.53% respectively. [Valladares *et al*. 2003] examined the antifeedent activity of an extract of senescent leaves of *M. azedarach* on nine insect species, including *S.oryzae*.

At 21 days after treatment *M. azadarach* @ 5 g continue to be most effective with 56.26% mortality among all the tested treatments followed by P.thyrsiflorus, *Z. acanthopodium* and *A. indica* with 36.88% mortality. However, at 28 and 35 DAT, overall *M. azadarach* tested was found superior among the other treatment with 80.54% followed by *A. indica* and *Z. acanthopodium* showed 70.74% mortality whereas *P. hysterophorus and P. thyrsiflorus* was found less effective 56.11 % mortality followed by *Vitex trifolia* 36.66% respectively. The present results support the finding of [Khan and Marwat, 2004] who reported that the leaves bark and seeds of bakain (*Melia azadarach*) and Ak (*Calotropis procera*) powder against lesser grain borer (*R. dominnica*). They tested that insect (*R. dominica*) was repellent from bakain's bark powder with 98.25% repellency followed by powder of Ak (*Calotropis procera*).

Adult emergence

The mean number of *S.oryzae* adults that emerged after 35 days of treatment is presented in Table 2. The result revealed that significantly higher mean number of adults emerged that significantly higher mean number of adult emerged in the control 54% mean when compared with the other treatments *P. thyrsiflorus* was the highest among the six treatments with 30 % mean followed by *Vitex trifolia* with 27% mean number of adult emerged while *P. hysterophorus Z. acanthopodium ,M.azadarach* and *A. indica* recorded respectively as 26%, 4%, 3% and 2% mean number of adult emergence of *S.oryzae* in rice grain protected with different plant powders

(Table 2) when compared with the other treatments during the infestation at 35 days after treatment.

Effect of grain weight

The mean percentage weight loss of rice grain treated with the plant powder at 35 days after treatment (DAT) followed a similar trend with the mean adult emergence. The mean weight loss of rice grains treated with *A. indica* dried leave powder was significantly lower than the other treatment. The loss in weight of rice grains due to infestation by *S.oryzae* varied from 1.13% (*A. indica* leave powder) to 29% (untreated control).

The treatment with *M. azadarach, Z. acanthopodium*, *P. hysterophorus, P.thyrsiflorus, V. trifolia,* leave powder snt.were also found to be significantly superior to the

untreated control (Table 2).These finding supported the finding of [Achiano *et al*,1999] who showed the effectiveness of neem leaf powder and ash from various sources against different stored grain pest.

Table 1: Effect of plant powder extract against Rice weevil on Rice grain

Treatment (g)	Mean mortality (7 – 35) days post treatment				
	7	14	21	28	35
T1-*Melia azadarach* 5	27.60	51.44	56.26	66.03	80.54
T2-*P. hysterophorus* 5	17.90	17.34	27.11	41.69	56.11
T3- *P.thyrsiflorus* 5	8.35	31.91	36.88	46.51	56.11
T4-*Vitex trifolia* 5	13.12	17.34	31.91	36.88	36.66
T5-*Z.acanthopodium 5*	3.42	12.53	36.88	61.07	70.74
T6-*Azadirachta indica* 5	17.90	27.11	36.88	46.69	70.74
T7-Control	1.33	2.00	2.00	2.00	2.33
F value	0.797 P>0.05	0.820 P>0.05	0.382 P>0.05	0.516 P>0.05	0.550 P>0.05
C.D.	1.83	2.99	3.33	3.91	3.99

Table 2: Effect of plant extracts on Sitophilus oryzae emergence and Grain weight loss on rice.

Treatment	Doses	Adult emergence (mean±Sm)	Grain weight loss% (mean±Sm)
T1-*Melia azadarach*	5g	3±88	1.31±0.47
T2-*P. hysterophorus*	5g	26±0.47	10.71±4.05
T3- *P.thyrsiflorus*	5g	30±0.47	11.45±3.27
T4-*Vitex trifolia*	5g	27.66±1.18	8.81±3.08
T5-*Z.acanthopodium*	5g	4±0.80	2.11±0.37
T6-*Azadirachta indica*	5g	2.33±0.94	1.13±0.47
T7-Control		54±6.96	29.03±9.92

IV. Conclusion

The present result finding show that among the botanical plant powder treatments *M. azadarach* , *A.indica* and *Z. acanthopodium* powder was found as effective grain protectants, suppressed the adult emergence and reduced percentage weight loss on rice grain.[Luo *et al,* 1995] reported that these plants have a range of chemicals which isolated and used for pest control. The test plants being medicinal would yield environmentally sound chemicals having no harmful effects on the non target organisms.

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