Journal of Medicinal Plants Research Vol. 6(33), pp. 4811-4814, 29 August, 2012
Available online at http://www.academicjournals.org/JMPR
DOI: 10.5897/JMPR12.604
ISSN 1996-0875 ©2012 Academic Journals

Full Length Research Paper

Effect of some plant products on the control of rice weevil *Sitophilus oryzae* (L.) Coleoptera: Curculionidae

E. F. Asawalam*, U. E. Ebere and K. C. Emeasor

Department of Plant Health Management, Michael Okpara University of Agriculture, Umudike, P. M. B. 7267 Umuahia, Abia State, Nigeria.

Accepted 2 August 2012

Powders prepared from parts of four indigenous botanical plants in Nigeria (*Curcuma longa* L. rhizomes, *Dennettia tripetala* Baker F. fruits*, Piper guineense*, Schum and Thonn, seeds and *Zingiber officinale* Rosc. rhizomes*)* were evaluated for insecticidal activity against rice weevil *Sitophilus oryzae* (L.) in the laboratory. The experiment was carried out in a completely randomized design (CRD) with four replications. A control treatment was set up. The result obtained showed that the use of powders from the selected indigenous botanical plants increased adult mortality and suppressed the adult emergence of the rice weevils. *P. guineense* and *D. tripetala* recorded the highest mean mortality of 18.8 and 16.5 respectively at 35 days after treatment (DAT) when compared with other treatments. Applying *P. guineense* seed powder, the number of adults that emerged (3.25) was significantly (P<0.05) lower in the rice seed treated and also performed best in terms of percentage weight loss when compared with the control. These results suggest that the plants are suitable for possible exploitation in protecting stored rice from damage by storage insects.

Key words: *Sitophilus oryzae*, rice, plant products, control.

INTRODUCTION

The rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) is a serious pest of stored rice in Africa. The efficient control of stored grain pests has long been the aim of entomologists throughout the world. Synthetic chemical pesticides have been used for many years to control stored grain pests (Salem et al., 2007). However, the potential hazards on mammals from synthetic insecticides increased concern by consumers over insecticide residues in processed cereal products, the occurrence of insecticide-resistant insect strains, the ecological consequences, increasing cost of application and the precautions necessary to work with traditional chemical insecticides all call for new approaches to control stored-product insect pests (Aslam et al., 2002; Fields, 2006; Mahdiand and Rahman, 2008; Salem et al., 2007; Udo, 2005). Therefore, there is a need to look for alternative organic sources that are readily available, cheap, affordable, relatively less poisonous and less detrimental to the environment (Udo, 2005). For these reasons, attention has been directed towards the development of alternative chemicals such as botanical pesticides (Ivbijaro, 1984; Niber, 1994). The objective of this study was to assess the efficacy of some medicinal plant powders as protectants of rice grains against infestation by *Sitophilus oryzae*.

*Corresponding author. E-mail: elechiasw@yahoo.com.

MATERIALS AND METHODS

S. oryzae culture

Adult *S. oryzae* was reared in the laboratory at 27 ± 2°C, 60 to 65% relative humidity and 12 h: 12 h light: dark regime. *S. oryzae* was obtained from stocks maintained at Crop Science Laboratory, Michael Okpara University of Agriculture, Umudike. The food media used was whole rice grains. Fifty pairs of *S. oryzae* were introduced into 1 L glass jar containing 400 g weevil susceptible rice grains following the methods of Halstead (1963) and Stenley and Wilbur (1966). The jar was covered with nylon mesh held in place with rubber bands. Freshly emerged adults of *S. oryzae* were then used

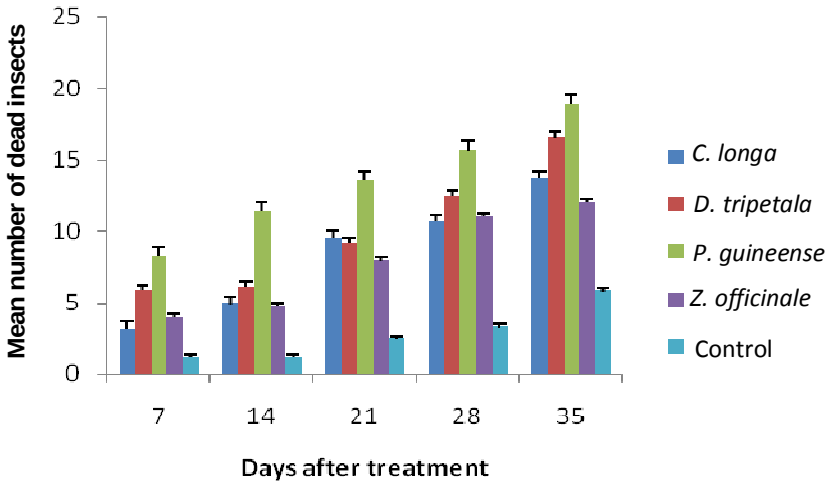

Figure 1. Mortality of freshly emerged adults of *S. oryzae* after introduction onto rice grains treated with different botanicals.

for the experiments. Rice grains used for the study were purchased from weevil susceptible rice grains in Umuahia main market, Abia State Nigeria. Prior to the experiments, the grains were disinfested in the oven at 40℃ for 4 h (Asawalam et al., 2006) a nd kept in the laboratory before use.

Preparation and application of plant materials

The *Dennettia tripetala* fruits (pepper fruit)*, Piper guineense* (black pepper) seeds *and Zingiber officinale* (ginger) rhizomes were locally purchased from Umuahia main market, while *Cucurma longa* (turmeric) rhizomes were obtained from National Root Crops Research, Institute Umudike. The plant materials were air-dried for two weeks in a well ventilated place. The powders were prepared by milling the plant materials using Thomas (model ED-5) milling machine at Soil Science Laboratory, National Root Crops Research Institute, Umudike. Twenty grams (20 g) of clean and uninfested weevil susceptible rice variety, used for the study, were weighed into four sterilized plastic vials. To each plastic vial, 1 g of each powder was added and mixed thoroughly by manual agitation of the vials. The powder weight corresponded to 5% of the seed weight. A control experiment containing no plant powder was set up. Five pairs of *S. oryzae* adults were introduced into treated and untreated rice grains. The lids of the plastic vials were perforated. Muslin cloths were used to secure the opening of the plastic vials to ensure aeration and avoid entry or exit of insects. The contents of the plastic vials were then shaken gently for proper admixture. Each treatment was replicated four times. The experiment was arranged in Completely Randomized Design on a laboratory table.

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 insects/Total number of insects × 100

Data on percentage adult weevil mortality were corrected using Abbott's (1925) formula thus:

$$P_T = \frac{P_o - P_c}{100 - P_c}$$

where P_T = corrected mortality (%); P_O = observed mortality (%); P_C = control mortality (%).

Insects subsequently emerging were counted to estimate F_1 Progeny production. Counting was stopped after 35 days to avoid overlapping of generation. Weight loss was assessed by re-weighing the grains to determine percentage weight loss. Percentage weight loss was calculated following the method of FAO (1985) as:

$$\% \text{ Weight loss} = \frac{[UaN - (U + D)]}{UaN} \times 100$$

where U = weight of undamaged fraction in the sample; N = Total number of grains in the sample; Ua = Average weight of undamaged grains; D = Weight of damaged fraction in the sample

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) and significant difference (P>0.05), means were separated by using Fishers protected least significant difference (LSD) test.

RESULTS AND DISCUSSION

Mortality

The result of the experiment (Figure 1) showed that the powder of the plant materials, *P. guineense* seed powder had significant mortality effects on *S. oryzae*. Plant powders have been used to suppress the population of storage insect pests (Rajapakse, 2006; Parugrug and Roxas, 2008; Asawalam and Emosairue, 2006). It has

Table 1. Effect of different plant powders on adult emergence of *S. oryzae* and percentage weight loss of rice grains at 35 Days after treatment (DAT).

Treatments	Adult emergence	Weight loss (%)
C. longa	6.25	7.35
D. tripetala	5.00	5.86
P. guineense	3.25	3.30
Z. officinale	5.50	6.33
Control	27.25	30.49
LSD (0.05)	2.22	1.92

been reported that powders of plant materials are capable of blocking the spiracle of insects (Lale, 2002) and this can lead to suffocation and death. The high mortality rate observed in the treatment with *P. guineense* seed powder could also be as a result of direct feeding of the insects on the various resins particularly, chavicine and a yellow alkaloid, piperine, which is contained in the seeds. The pungency of *P. guineense* seed has been attributed to the presence of these various resins and piperine (Asawalam and Emosairue, 2006). Turmeric powder was found to be insecticidal against S. *oryzae* (Chander et al., 1991) and the biologically active constituent of *Curcuma* rhizome was characterized as the sesquiterpene ketone ar-tumerone by spectroscopic analysis (Lee et al., 2001).

Adult emergence

The mean number of *S. oryzae'* adults that emerged after 35 days of treatment is presented in Table 1. The result revealed that significantly higher mean number of adults emerged in the control (27.25) when compared with the other treatments*. C. longa* was highest among the four treatments (botanicals) with a mean of 6. 25 followed by *Z. officinale* with 5.50 mean numbers of adults that emerged while, *D. tripetala* and *P. guineense* recorded 5.00 and 3.23 respectively as mean number of adults that emerged. There were significant differences in adult emergence of *S. oryzae* in rice grain protected with different plant powders (Table 1) when compared with the other treatments during the infestation at 35 days after treatment.

Effect on grain weight

The mean percentage weight loss of rice grains 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 *P. guineense* seed powder was significantly lower than the other treatments. The loss in weight of rice grains due to infestation by *S. oryzae* varied from 3.3% (*P. guineense* seed powder) to 30.49% (untreated control). The treatments with *D. tripetala, C. longa and Z. officinale* seed powders were also found to be significantly superior to the untreated control (Table 1). This was similar to the findings of Saroukolai et al. (2010) who demonstrated that *Thymus persicae* essential oil recorded increased fumigant toxicity against *S. oryzae*.

Conclusion

The result of this study revealed that application of *C. longa.* rhizomes, *D. tripetala* fruits*, P. guineense* seeds *and Z. officinale* rhizomes increased adult mortality, suppressed the adult emergence and reduced percentage weight loss. The *P. guineense* seed powder performed best. These insecticidal effects of the botanicals and potential for their local availability make them attractive candidates in upgrading traditional post-harvest protection practices. Since the result obtained from this study showed that the powders from the botanicals have potential insecticidal activities, further research efforts are suggested towards the screening and integration with other effective botanicals in order to formulate them for commercial purposes and wide scale usage.

REFERENCES

Abbott WS (1925). A Method of Computing the effectiveness of an Insecticide. J. Econ. Entomol. 18:265-267.

Asawalam EF, Emosairue SO (2006). Comparative efficacy of *Piper guineense* Schum and Thonn and Pirimiphos methyl on [*Sitophilus zeamais* (Motschulsky)]. Trop. Subtrop. Agroecosyst. 6:143-148.

Asawalam EF, Emosairue SO, Hassanali A (2006). Bioactivity of *Xylopia aetiopica* (Dunal) A. Rich essential oil constituents on maize weevil *Sitophilus zeamais* (Motschulsky). Elect. J. Environ. Agric. Food Chem. 5(1):1195-1204.

Aslam M, Ali Khan KH, Bajwa MZH (2002). Potency of some spices against *Callosobruchus chinensis* L. Online J. Biol. Sci. 2(7):449-452.

Chander H, Kulkarni SG, Berry SK (1991). Effectiveness of turmeric powder and mustard oil as protectants in stored milled rice against the rice weevil *Sitophilus oryzae.* Int. Pest Control 33:94-97.

FAO (1985). Prevention of Post harvest food losses. Training series No.10. Italy, Rome. pp. 122.

Fields PG (2006). Effect of *Pisum sativum* fractions on the mortality and progeny production of nine stored-grain beetles. J. Stored Products Res. 42:86-96.

Halstead DGH (1963). External sex difference in stored products coleoptera. Bull. Entomol. Res. 54:119–134.

Ivbijaro MF (1984). Toxicity effects of groundnut oil on the rice weevil, *Sitophilus oryzae* L. Insect Sci. and its Application 5(4):251–252

Lale NES (2002). Stored product entomology and acarology in Tropical Africa. 1st edition. Mole Publication, Maiduguri, Nigeria. pp. 204.

Lee HS, Wook-Kyun S, Cheol S, Kwang-Yun C, Young-Joon A (2001). Insecticidal Activities of *ar-Turmerone* Identified in *Curcuma longa* Rhizome against *Nilaparvata lugens* (Homoptera: Delphacidae) and *Plutella xylostella* (Lepidoptera: Yponomeutidae) Asia-Pacific Entomol. J. 4(2):181-185.

Mahdian SHA, Rahman MK (2008). Insecticidal effect of some spices on *Callosobruchus maculatus* (Fabricius) in black gram seeds. Rajshahi Univ. Zool. Soc. 27: 47-50. Available from: http://journals.sfu.ca/bd/index.php/UJZRU.

Niber TB (1994). The ability of powders and slurries from ten plant species to protect stored grain from attack by *Prostephanus truncatus* Horn *Coleoptera:Bostrichidae* and *Sitophilus oryzae* L. (Coleoptera :Curculionidae) J. Stored Products Res. 30(4):297-301.

Parugrug ML, Roxas AC (2008). Insecticidal action of five plants against Maize weevil, *Sitophilus zeamais* Motsch. Coleoptera: Curculionidae. KMITL Sci. Technol. J. 8(1):21-38.

Rajapakse RHS (2006). The potential of plants and plant products in stored insect pest management. J. Agric. Sci. 2(1):11-21.

Salem SA, Abou-Ela RG, Matter MM, El-Kholy MY **(**2007). Entomocidal Effect of *Brassica napus* Extracts on Two Store Pests, *Sitophilus oryzae* (L.) and *Rhizopertha dominica* (Fab.) (Coleoptera). J. Appl. Sci. Res. 3(4):317-322.

Saroukolai AT, Moharramipour S, Meshkatalsadat MH (2010). Insecticidal properties of *Thymus persicus* essential oil against *Tribolium castaneum* and *Sitophilus oryzae.* J. Pest Sci. 83:3-8.

Stenley PG, Wilbur DA (1966). Colour characteristics for sexing live adults of lesser grain borer. J. Econ. Entomol. 59:760–761.

Udo IO (2005). Evaluation of the potential of some local spices as stored grain protectants against the maize weevil *Sitophilus zeamais* Motsch (Coleoptera: Curculionidae). J. Appl. Sci. Environ. Manage. 9(1): 165-168. Available from: www.bioline.org.br/ja.