Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319– 1554

Short Communication

Evaluation of some indigenous plant extract for the management of *Sitophilus oryzae* L. Coleoptera: Curculionidae

Authors:
Shahbaz Ahmad[1] M, Usman Haider[1], Samreen Gul[1], Nagina Hanif[1], Aqsa Azeem[1], Shahid Nadeem[2], Said Salman[3], Ali Bakhsh[3] and Qurban Ali[4,]

Institution:
1. Institute of Agricultural Sciences, University of the Punjab, Lahore, 54590, Pakistan.

2. Horticulture Research Institute, National Agricultural Research Centre, Islamabad, Pakistan.

3. Department of Plant Breeding and Genetics, Ghazi University, Dera Ghazi Khan, Pakistan.

4. Institute of Molecular Biology and Biotechnology, University of Lahore, Lahore, Pakistan .

Corresponding author:
Qurban Ali

Email ID:
saim1692@gmail.com

ABSTRACT:

Store products are badly hampered by some notorious stored grain pests, *Sitophilus oryzae L.* (Coleoptera: Curculionidae) is one of the devastating pests of stored products. It is a primary pest which causes brutal qualitative and quantitative losses. Present study was performed to check the repellent effect of different ethanolic plant extracts against *S. oryzae* under lab conditions. For this purpose, common plants like Bukain (*Melia Azedarach*), Guava (*Psidium guajava)*, Eucalyptus (*Eucalyptus camaldulensis)*, Jaman (*Eugenia jambulana*) and Citrus (*Citrus reticulata*) were investigated. Three concentrations *viz*, 25%, 50% and 75% were used with three replications for each treatment. Data was taken after 1, 2 and 3 hours after application. Filter paper bioassay method was used to check the repellency. Results revealed that repellent effect was totally dose dependent, higher the concentration greater was the repellency. Results indicated that Guava was the most repellent while Bukain was least repellent to *S. oryzae* at all concentrations and time intervals. Moderate repellency was also observed in other examined plant extracts. The findings of this study were that all these botanicals were proved effective in repelling pest; it was due to presence of some bioactive chemicals in them. It is concluded that for a secure, cheap, reliable, ecofriendly and sustainable control program these plant extracts should be accommodated and compensated.

Keywords:
Extract, Indigenous plant, Management, *Sitophilus oryzae*.

Article Citation:
Shahbaz Ahmad M, Usman Haider, Samreen Gul, Nagina Hanif, Aqsa Azeem, Shahid Nadeem, Said Salman, Ali Bakhsh and Qurban Ali
Evaluation of some indigenous plant extract for the management of *Sitophilus oryzae* L. Coleoptera: Curculionidae
Journal of Research in Ecology (2017) 5(2): 1291-1297

Dates:
Received: 17 Oct 2017 **Accepted:** 02 Nov 2017 **Published:** 05 Dec 2017

Web Address:
http://ecologyresearch.info/documents/EC0502.pdf

INTRODUCTION

Cereals are the healthy and main food source of energy but their storage is not safe due to attack of the pests. Postharvest losses are very common during the storage of these food products. Postharvest losses are about 9% in under developing countries and 20% or more in developing countries (Philips *et al.,* 2010). Qualitative and quantitative losses in stored products are caused by more than 600 species belonging to beetle pests. Brutal losses are associated by 70 species of moths and 355 species of mites (Rajendran, 2002). This damage differs in different zones, about 5 to 10% in temperate zone and 20-30% in tropical zone (Haque *et al.,* 2000). The major pests of the store grains are red flour beetle, khapra beetle and rice weevil but the most destructive pest is *Sitophilus oryzae L.* (Coleoptrra: Curculionidae). Adult rice weevils feed on rice and lay their eggs within rice kernels, where larva can develop to the adult stage (Lucas and Riudavets, 2002).

Larvae are without legs and remain in the grain kernel for their entire duration. The estimate losses due to the rice weevil are about 75% (Bello *et al*., 2001). The nutritional and aesthetic value of grains is also reduced due to the activity of these stored pests. The husked rice weight losses reported by Bhuiya *et al.,* (1992) are about 11-16% during four months of storage in the laboratory. Therefore, it is very important to combat these pests in storages to avoid these losses. Methyl bromide (MeBr) and phosphine tablets (PH3) are widely used in the control program of these pests (Negahban *et al.,* 2006). Ozone layer depletion resulting in long term irreversible damages to the environment are drawbacks induced by Methyl bromide (Cassanova, 2002). Phosphine is efficient in use but it is slow in activity and resistance is developed in insects. Chemicals have also some environment risks and some residual effects. Resistances against conventional insecticide are also reported (Benhalima *et al.,* 2004). There is a need for a control program which should be cheap, reliable, environmental friendly, and having less residual effects (Talukder and Howse, 1995).

Now a day's trend is shifted towards plant extracts having some insecticidal properties. There are certain plants that can be utilized for their medicinal properties as their extracts could be beneficial for human beings (Nawaz, 1999). Plant family Maliacae is well known for its secretions that may help to cop against certain insect infestations by interrupting the feeding and growth mechanism of these insects. Additionally, these secretions do not pose much risk towards human beings (Butterworth and Morgan, 1968; Arnason *et al.,* 1985; Schmutterer, 1990; Isman *et al.,* 1997). Plants belonging to various families e.g Meliaceae, Rutaceae, Asteraceae, Labiateae, Piperaceae, Verbenaceae and Annonaceae were the well-known sources of botanicals and these were effective too (Jacobson, 1989; Isman, 1995). In recent study extracts from five plants (Bukain (*Melia Azedarach)*, Guava (*Psidium guajava)*, Eucalyptus (*Eucalyptus camaldulensis)*, Jaman (*Eugenia jambulana*) and Citrus (*Citrus reticulata*)] were evaluated for their repellency against *S. oryzae.*

MATERIALS AND METHODS

The experiment methodology performed was the same as adopted by Saljoqi *et al*. (2006).

Collection of untreated wheat grains for experiment

Untreated wheat grains were procured for ac-

Table 1. Means representing repellency of all treatments

S. No	Treatments	Guava	Eucaplatus	Jaman	Citrus	Bukain
1	T_1 25%	15.222 B	13 C	12.889 C	13.667 B	10.667 B
2	T_2 50%	17.556 AB	16.444 B	14.333 B	15.444 AB	13.333 A
3	T_3 75%	17.889 A	18.778 A	17.444 A	17.667 A	14.889 A
4	T_4 Control	0 C	0 D	0 D	0 C	0 C

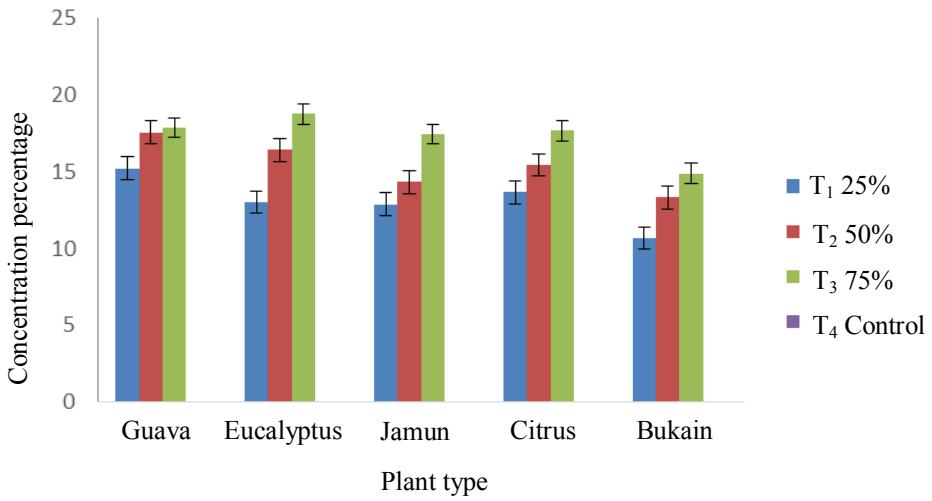

Figure 1. Graph showing comparison efficacy and repellency among all applied treatments

complishing the experiment from local market of Lahore city, located in Punjab province of Pakistan. The grains were cleaned through common sieves and kept in glass jars. *S. oryzae* were reared by releasing 100 insects in each glass jar with same number of male and females (1:1). Jars were covered with black nylon mesh, held with a rubber band and these jars were kept under uniform conditions (28±2°C and 70-80% relative humidity) in IPM lab.

Raw materials for natural Insecticides

In present study five traditional and commonly known plants with effective bio-toxicity were used. Fresh leaves from plants of Bukain (*Melia Azedarach*), Guava (*Psidium guajava*), Citrus (*Citrus reticulata*), Jaman (*Eugenia jambulana*) and Eucalyptus (*Eucalyptus camaldulensis*) were collected from different localities of University of the Punjab Lahore, Pakistan to obtain extracts of respective plant materials.

Preparation of ethanol extracts

Leaves were kept on shade to dry for three days. After this, dried leaves were grounded in a processor to fine powder. Powder of each plant leaves weighing 40g was soaked in 200 ml of 70 % ethanol and put for three days in an obituary shaking rotary shaker at 140 rpm (revolutions per minute) at room temperature. From that point, it was separated by utilizing Oklahoma filter screen through Whatman no.1 filter paper. Suction was finished by embedding the screen in a conical flask until the point that all filtrate was separated from residue. Crude ethanol extract was obtained by keeping filtrates in a rotary evaporator under reduced pressure at 50° C. 10 ml of crude ethanol extract served as stock solutions

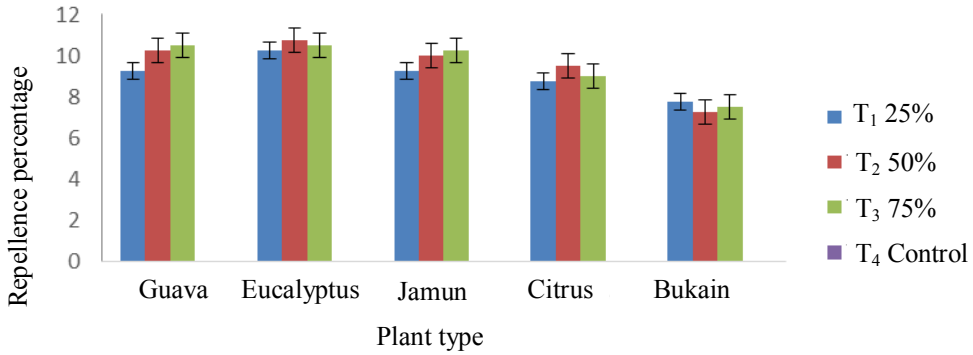

Figure 2. Repellency after one hour

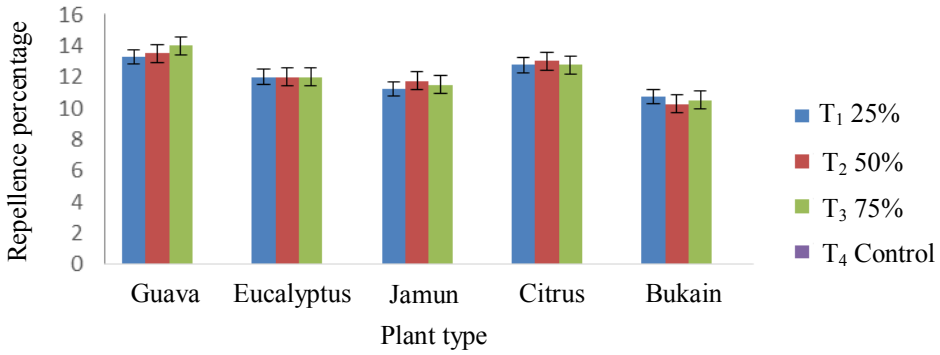

Figure 3. Repellency after two hour

for each treatment. They were then tightly packed and checked for quality loss followed by refrigeration. At the time of application, stock solutions of each plant material were then fractionated into 100 ml ethanol to get three concentrations i.e. 25%, 50% and 75% concentrates for each treatment (Saljoqi et al., 2006).

Repellency test bioassay

Repellency of different plant extracts against *S. oryzea* was evaluated by using filter paper bioassay method. Filter paper was divided into two halves; on one half different concentrations of extracts were applied while ethanol was applied on the remaining half. Total amount of 1ml of each treatment was applied on one half and same amount of ethanol was applied on the remaining half. Concentrations used were 25%, 50% and 75% of extracts with three replicates for each treatment including control. After application both halves of filter paper were kept to dry at room temperature. During rejoining the filter paper a prominent gap was kept between treated and non-treated portion of the filter paper to avoid any error. After they get dried, twenty (20) rice weevils were placed in the center of the petri dish. Data was taken after 1 h, 2 h and 3 h of their exposure.

RESULTS

In this study the efficiency of ethanolic extracts from five different plants species (Citrus, Jaman, Eucalyptus, Guava and Bukain) were evaluated against rice weevil. Repellency was the parameter of efficacy for these applied treatments. Three replicates for each individual treated at (25%, 50%, 75% concentrations and Control) were given under Complete Randomized Design (CRD). The experiment was performed in Integrated Pest Management (IPM) lab and all lab conditions were fulfilled as per requirements. Results showed that all the treatments were effective in noticeable repelling the rice weevil and no repellency was ob-

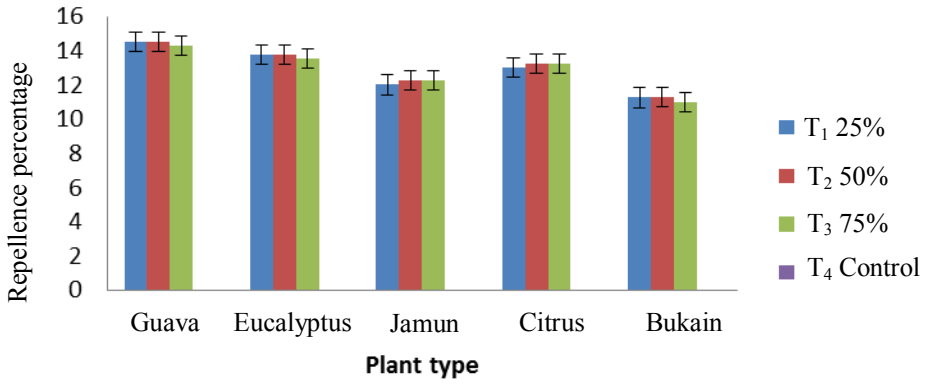

Figure 4. Repellency after three hours

served in control treatment. Means representing repellency of all treatments are shown in Table 1.

The graph (Figure 1) shows that at 75% concentration all the treatments showed maximum repellency as compared to other concentrations (50% and 25%). Among these treatments it was observed that Eucalyptus was more significant in repelling 18.77% the pest at 75% concentration while Guava gave maximum repellency (17.556% and 15.222%) at other applied concentrations 50% and 25% respectively. This repellency in Guava is due to the presence of some aromatic compounds in Guava (Isman, 2000). The overall results showed that all treatments at all applied concentrations were able to repel *S. oryzae* which showed the effectiveness of these plant extracts in a sustainable control program against economical important pests.

Repellency on the basis of hours

The repellency was also observed on the basis of hours. For this purpose data was collected after the intervals of one hour, two hours and three hours. The graph representing repellency after one hour is given in (Figure 2). It was observed that after one hour maximum repellency was observed in Eucaplatus as compared to other applied treatments and minimum repellency was observed in Bukain.

Repellency after two hours

After two hours (Figure 3) it was revealed that this time Guava was most repellent to *S. oryzae* .Among the treated botanicals, minimum repellency was observed in Bukain. The graph also revealed the repellency of plant extracts. After three hours (Figure 4) the maximum repellency was again observed in Guava as compared to the other applied treatments and minimum repellency was observed in Bukain. So, overall results proved that all the botanicals were significant in repelling *S. oryzae*.

DISCUSSION

The research revealed that botanicals are significant for their toxic effects on different insect pests. These botanicals contain some bioactive ingredients which have repellent and anti-feedant activity against some pests. The botanical extracts of Guava, Eucalyptus, Jaman, Citrus and Bukain have natural pest repelling ingredients that commonly gave maximum results. Present study is in line with the study carried by Mishra and Tripathi (2011), they used essential oils of Citrus and some other plants against *S. oryzae* and *T. castaneum* and achieved significant repelling effects against both these pests. Research conducted by Naseem and Khan (2011) on the oils of *P. nigrum* and Eucalyptus against stored pests, both of them were found effective in repelling these pests under lab condition is also in favor of our findings. Different people use the different plants to repel the pest of stored grain. The findings of this research had agreement with those obtain by Talukder and Howse (1994 and 1995), they used extracts of *A. polystachya* a botanical to repel the rice weevil. The results of this finding are related with the Jilani and Su (1983), who reported the repellent effects of extracts of three common plants in Pakistan on three stored-product pests, including rice weevil. The powdered extract of *Curcuma longa* had the strongest repellency effect on stored pests. Oliveira and Vendramim (1999) observed repellent effect of oils and powders on *Zabrotes subfasciatus* in bean seeds. Odeyemi and Ashamo (2005) uses another plant extracts from *Azadirachta indica* which have antifeedant, repelling and in some insects growth regulating properties. It is a botanical so the findings are in strong relation with the findings of our work. However, the fact is that these mixtures have low toxicity and this demands more work to study about those repelling bioactive chemicals present in these extracts. In addition, more researches are required to determine stability, duration of effectiveness, toxicity to human, contact toxicity with treated grain and effect of extract on different species of stored-product insects.

REFERENCES

Arnason JT, Philogene BJR, Donskov N, Hudon M, McDougall C, Fortier G, Morand P, Gardner D, Lambert J, Morris C and Nozzolillo C. (1985). Anti-feed ant and insecticidal properties of azadirachtin to the European corn borer, *Ostrinia nubilalis* Hubner. *Entomologia Experimentalis et Applicata*, 38(1): 29–34.

Benhalima H, Chaudhry M, Mills K and Price N. (2004). Phosphine resistance in stored-product insects collected from various grain storage facilities in Morocco. *Journal of Stored Products Research,* 40(3)**:** 241-249.

Bhuiya MIM, Alam S and Karim ANMR. (1992). Losses to stored rice caused by rice weevil and angoumois grain moth, and their control in Bangladesh. *Journal of Agricultural Science,* 19(1): 13-18.

Butterworth JH and Morgan ED. (1968). Isolation of a substance that suppresses feeding in locusts. *Chemical Communications*, 38(1): 29–34.

Cassanova JL. **(2002).** An overview of the scientific aspect of ozone depletion and their impact on environment. 23-27 p.

Dal Bello G, Padin S, Lopez Lastra C and Fabrizio, M. **(2001).** Laboratory evaluation of Chemical-biological control of the rice weevil (*Sitophilus oryzae* L.) in stored grains. *Journal of Stored Products Research*, 37(1): 77-84.

Haque MA, Nakakita H, Ikenaga H and Sota N. (2000). Development inhibiting activity of some tropical plants against *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae). *Journal of Stored Products Research*, 36(3): 281-287.

Lucas E and Riudavets J (2002). Biological and mechanical control of *Sitophilus oryzae* (Coleoptera: Curculionidae) in rice. *Journal of Stored Products Research*, 38(3): 293-304.

Isman MB. (2000). Plant essential oils for pest and disease management. *Crop Protection*, 19(8-10): 603- 608.

Isman MB, Matsuura H, MacKinnon S, Durst T, Towers GHN and Arnason JT. **(1997).** Phytochemistry of the *Meliaceae*. *Phytochemical Diversity and Redundancy in Ecological Interactions*, 30: 155–178.

Jacobson M. (1989). Botanical insecticides: Past, present and future. Chapter 1. Washington DC, 1-10 p.

Jilani G and Su HC. (1983). Laboratory studies on several plant materials as insect repellants for protection of cereal grains. *Journal of Economic Entomology,* 76(1): 154-157.

Mishra BB and Tripathi SP. (2011). Repellent activity of plant derived essential oils against *Sitophilous oryzae* (*Linnaeus*) and *Tribolium castenium* (*Herbst*). *Singapore Journal of Scientific Research*, 1(2): 173–178.

Naseem MT and Khan RR. (2011). Comparison of repellency of essential oils against red flour beetle *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae). *Journal of Stored Products and Postharvest Research*, 2(7): 131 – 134.

Nawaz A. (1999). Appraisal of weight losses in stored grains by *Oryzaephilus surinamensis* L. (Coleoptera: Cucujidae) and its mortality by plant extracts. M.Sc. (Hons) Thesis. Department of Entomology, NWFP Agricultural University, Peshawar. 39 p.

Negahban M, Moharramipour S and Sefidkon F. **(2006).** Chemical composition and insecticidal activity of *Artemisia scoparia* essential oil against three coleopteran stored-product insects. *Journal of Asia-Pacific Entomology,* 9(4): 381-388.

Odeyemi O and Ashmao M. (2005). Efficacy of neem

plant (*Azadirachta indica*) extracts in the control of *Trogoderma granarium*, a pest of stored groundnuts. *Journal of Plant Diseases and Protection*, 112(6): 586-593.

Oliviera JV and Vendramim JD. (1999). Repelência de óleos essenciais e pós vegetais sobre adultos de Zabrotes subfasciatus (Boh) (Coleoptera: Bruchidae) em sementes de feijoeiro. *Anais da Sociedade Entomológica do Brasil,* 28(3): 549-555.

Phillips TW, James E and Throne JE. (2010). Biorational approaches to managing stored product insects. *Annual Review of Entomology*, 55: 375 – 397.

Rajendran S. (2002). Postharvest pest losses. In: Pimentel. D. ed. Encyclopedia of pest management. Mareel Cekker. Inc, New York, 654-656 p.

Saljoqi AUR, Afridi MK, Khan SA and Rehman S. (2006). Effects of six plant extracts on rice weevil *Sitophilus oryzae* L. in the stored wheat grains. *Journal of Agricultural and Biological Science*, 1(4): 1–5.

Schmutterer, H. (1990). Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. *Annual Reviews of Entomology*, 35: 271–297.

Talukder F and Howse P. (1994). Laboratory evaluation of toxic and repellent properties of the pithraj tree, *Aphanamixis polystachya* wall and parker, against *Sitophilus oryzae* (L.). *International Journal of Pest Management,* 40(3): 274-279.

Talukder F and Howse P. (1995). Evaluation of *Aphanamixis polystachya* as a source of repellents, antifeedants, toxicants and protectants in storage against *Tribolium castaneum* (Herbst). *Journal of Stored Products Research,* 31(1): 55-61.