**International Journal of Zoology Studies**
**ISSN: 2455-7269**
**Impact Factor: RJIF 5.14**
**www.zoologyjournals.com**
**Volume 2; Issue 6; November 2017; Page No. 282-285**

# Evaluation of repellency and antifeedant activities of *Saraca asoca* and *Terminalia arjuna* Bark extracts against *Sitophilus oryzae*

**S Gomathi, * KM Subbu Rathinam**
PG & Research Department of Zoology, Rajah Serfoji Govt. College, Autonomous "A" Grade, Thanjavur, Tamil Nadu, India

**Abstract**
The rice weevil *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), is one of the most important stored grain pest in India and has been spread worldwide by commerce. Plants have developed subtile chemical defense mechanisms against insects and other organisms; these defense mechanisms do not generally produce immediate death but do affect common biochemical and physiological functions. In this study, we evaluated the repellency and antifeedant activities of *Saraca asoca* and *Terminalia arjuna* bark extracts to control *Sitophilus oryzae*. The repellent activity against *S. oryzae* adults was more pronounced in methanol extract of *Terminalia arjuna* bark as compared with *Saraca asoca* bark extract. The antifeedant activity against *S. oryzae* adults was greater in methanol extract of *Terminalia arjuna* bark as compared with *Saraca asoca* bark extract. The potential insecticidal, repellent and antifeedant activity of *Saraca asoca* and *Terminalia arjuna* bark extracts might be present in bioactive compounds. Therefore, *Saraca asoca* and *Terminalia arjuna* could be considered an ideal grain (Rice) protectant from the point of view of seed viability and safety to mammals.

**Keywords:** *Sitophilus oryzae, Saraca asoca, Terminalia arjuna*, repellency and antifeedant activities

## Introduction

The rice weevil Sitophilus oryzae (L.) (Coleoptera: Curculionidae), is one of the most important stored grain pest in India and has been spread worldwide by commerce. Both, the adults and larvae feed on whole grains. They attack wheat, corn, oats, rye, barley, sorghum, dried beans and cereal products. Some plants of worldwide distribution in the province of Córdoba had shown, in previous observations, antifeedant an repellent effects on insects. Plants have developed for 400 million years and have acquired effective defense mechanisms that ensure survival under rough environmental conditions and in the presence of natural enemies. Besides a number of morphological protective mechanisms, plants have developed subtile chemical defense mechanisms against insects and other organisms; these defense mechanisms do not generally produce immediate death but do affect common biochemical and physiological functions (Prakash and Rao 1997) [15]. The repellents are desirable chemicals as they offer protection with minimal impact on the ecosystem, as they drive away the insect pest from the treated materials by stimulating olfactory or other receptors. Repellents from plant origins are considered safe in pest control; minimise pesticide residue; ensure safety of the people, food and environment (Talukder *et al*., 2004; Talukder, 2006; Maia and Moore, 2011) [17, 18, 10]. The plant extracts, powders and essential oil from the different bioactive plants were reported as repellent against stored grain insect pests (Talukder *et al.*, 2004; Owusu, 2001; Xie *et al*., 1995; Koul *et al*., 2008; Boeke *et al*., 2004) [17, 14, 22, 7, 2]. For example, the essential oil of *Artemisia annua* was found as repellent against *Tribolium castaneum* and *Callosobruchus maculates* (Tripathi *et al*., 2004) [21].

Antifeedants, sometimes referred to as "feeding deterrents" are defined as chemicals that inhibit feeding or disrupt insect feeding by rendering the treated materials unattractive or unpalatable (Munakata, 1997; Saxena *et al*., 1988) [12, 16]. Some naturally occurring antifeedants, which have been characterized, include glycosides of steroidal alkaloids, aromatic steroids, hydroxylated steroid meliantriol, triterpene hemiacetal and others (Jacobson, 1982) [5]. Essential oil constituents such as thymol, citronellal and α-terpineol are effective as feeding deterrent against tobacco cutworm, *Spodoptera litura* synergism, or additive effects of combination of monoterpenoids from essential oils have been reported against *Spodoptera litura* larvae (Hummelbrunner and Isman, 2001) [3]. The screening of several medicinal herbs showed that root bark of *Dictamnus dasycarpus* possessed significant feeding deterrence against two stored-product insects (Liu *et al*., 2002) [8]. Recent chemical ecology studies have shown that many of these secondary compounds play an important role in plant-insect relations. Some compounds, either separately or synergically, make up a chemical defense barrier in the plant against certain pests and diseases. In this study, we evaluated the repellency and antifeedant activities of *Saraca asoca* and *Terminalia arjuna* bark extracts to control *Sitophilus oryzae*.

## Materials and Methods

**Plant materials:** The chosen herbal plants as *Saraca asoca* and *Terminalia arjuna* barks were collected in January 2015 from Karaikudi surroundings, Sivagangai District Tamil Nadu, India.

**Preparation of powder:** The plant leaves were collected and dried under shade. These dried leaves were mechanically powdered and stored in an airtight container. These powdered materials were used for further analysis.

**Preparation of extracts**

The collected *Saraca asoca* and *Terminalia arjuna* barks were washed several times with distilled water to remove the traces of impurities from the barks. The barks were dried at room temperature and coarsely powdered. The powder was extracted with aqueous and methanol for 24 hours. A semi solid extract was obtained after complete elimination of water and alcohol under reduced pressure. The extract was stored in desiccator until used. The extract contained both polar and non-polar phytocomponents of the plant material used.

**Evaluation repellency activity**

The area preference test described by McDonald *et al.* (1970) [11] was used to evaluate repellent action of *Sitophilus oryzae*. Test areas consisted of 6 cm Whatman No. 1 filter papers that were cut two parts. In first part one ml (1, 2, 4, 8, 16 and 32%) of methanol extract of *Saraca asoca* and *Terminalia arjuna* bark. The other part (control) was only treated with 1 ml of methanol. Both the treated part and the control part were air dried to evaporate the solvent completely. A full disc was carefully remade by attaching the treated part to the control part with adhesive paper tape. Each filter paper was placed in a petri dish and 10 adult of *Sitophilus oryzae* were released in the center of each filter paper disc and covered. Each treatment was replicated five times. The number of insects present on control (NC) and treated (NT) strips were recorded after 1, 2, 4, 8 12 and 24 h. Percent repellency (PR) values for test was computed as PR= [(NC-NT) / (NC+NT)] ×100 (Obeng-Ofori and Reichmuth, 1997) [13].

**Evaluation antifeedant activity**

Antifeedant activity was study as the methods of Keita *et al.* (2001) [6] and Mahdi and Rahman (2008) [9] with some modifications. The *Saraca asoca* and *Terminalia arjuna* bark extracts were applied (spiked) to 10g grain, by mixing to give 10, 25, 50, 75 and 100 milligram per kilogram. Controls for each set of treatments consisted of grain treated with water only. Both the treated part and the control part were air dried to evaporate the solvent completely. 10 adult *Sitophilus oryzae* was introduced into the glass jars containing the treated or untreated grains. The glass jars were covered with cotton cloths held with rubber bands and allowed to feed for 7 days. After the feeding period, grains were weighed, and weight loss was measured. The percentage of antifeedant index was calculated by this formula: %WL = (IW-FW) × 100/IW, where the IW is the initial weight and FW is the final weight.

**Results and Discussion**

Evaluation repellency activity of *Saraca asoca* and *Terminalia arjuna* bark extracts

Plants as alternative source of repellent agent, reported in numerous ethnobotanical evaluations. The summary of recent informations on claiming and efficacy of plant-based repellents as well as promising new developments in the field. Plant-derived repellents usually do not pose hazards of toxicity to humans and domestic animals and are easily biodegraded. Compared to synthetic compounds, natural products are presumed to be safer for human. In general, the extracts of *Saraca asoca* and *Terminalia arjuna* bark had a moderate repellency effect on *S. oryzae*. These results agree with those obtained by Talukder and Howse (1993, 1994) [19, 20] with extracts of *A. polystachya* on *S. oryzae* and *T. castaneum*, although the latter species showed a higher repellency effect; the authors also found a higher repellency effect of extracts on *S. oryzae*, mainly extracts of methanol (67%), acetone (67%), and ethanol (57%). In the present study was to examine the *Saraca asoca* and *Terminalia arjuna* bark extracts were repelled adults of *S. oryzae*. Where, the repellency activities were dependent to the extractions dosage. A highest concentration of methanol extracts of *Saraca asoca* and *Terminalia arjuna* bark showed 80 and 100% repellency, after 24 h against adult of *S. oryzae*, respectively. In overall, the repellent activities were more pronounced for methanol extract of *Terminalia arjuna* bark compared with *Saraca asoca* bark extract. (Table 1 and Fig 1).

**Table 1:** Mean percent repellency values for different concentrations of *Saraca asoca* and *Terminalia arjuna* bark extracts against *S. oryzae*

| Doses (%) | % of Repellency | | | | | | Mean Repellency |
|---|---|---|---|---|---|---|---|
| | 1 hr | 2 hr | 4hr | 8 hr | 12 hr | 24 hr | |
| *Saraca asoca bark extract treated* | | | | | | | |
| 1 | 20±0.14 | 30±0.21 | 60±0.42 | 70±0.49 | 70±0.49 | 80±0.56 | 55±0.36 [a] |
| 2 | 30±0.21 | 80±0.56 | 50±0.35 | 80±0.56 | 60±0.42 | 70±0.49 | 61.66±0.45 [a] |
| 4 | 50±0.35 | 80±0.56 | 40±0.28 | 60±0.42 | 70±0.49 | 60±0.42 | 60±0.42 [a] |
| 12 | 40±0.28 | 70±0.79 | 60±0.42 | 90±0.56 | 70±0.49 | 70±0.56 | 66.66±0.48 [a] |
| 24 | 60±0.42 | 50±0.35 | 40±0.28 | 100±0.70 | 70±0.49 | 90±0.56 | 68.33±0.49 [a] |
| *Terminalia arjuna* bark treated | | | | | | | |
| 1 | 60±0.42 | 40±0.28 | 80±0.56 | 90±0.56 | 80±0.58 | 90±0.63* | 58.33±0.35 [b] |
| 2 | 40±0.28 | 50±0.36 | 60±0.42 | 80±0.56 | 70±0.49 | 80±0.56* | 63.33±0.45 [b] |
| 4 | 80±0.56 | 70±0.19 | 60±0.42 | 70±0.49 | 80±0.56 | 90±0.63* | 70±0.50 [b] |
| 12 | 70±0.49 | 60±0.42 | 70±0.50 | 80±0.55 | 90±0.62 | 80±0.56* | 75±0.52 [b] |
| 24 | 70±0.49 | 80±0.56 | 80±0.56 | 100 ±0.71 | 80±0.56 | 100±0.71* | 85±0.58 [b] |

Values are expressed as Mean± SD for six triplicates

Mean values within a column followed by different letters are significantly different from each other at $P$ <0.05 level comparison by Duncan's multiple range test (DMRT).

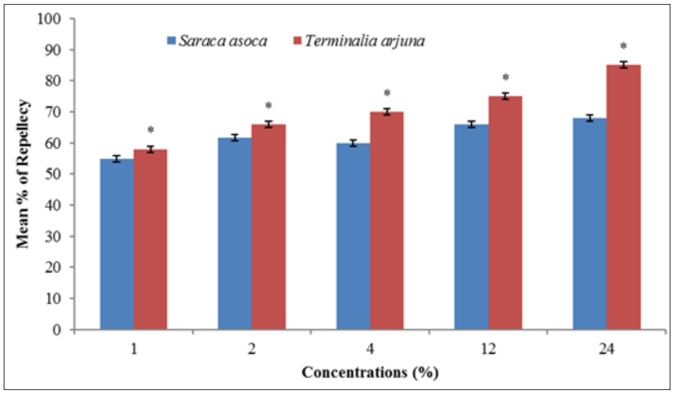


**Fig 1:** Mean percent repellency values for different concentrations of *Saraca asoca* and *Terminalia arjuna* bark extracts against *S. oryzae*

### Evaluation antifeedant activity of *Saraca asoca* and *Terminalia arjuna* bark extracts

Antifeedant is defined as a chemical that inhibits feeding without killing the insect directly, while the insect remains near the treated foliage and dies through starvation. (Isman, 2002) [4]. This definition excludes chemicals that suppress feeding by acting on the central nervous system (following ingestion and absorption) or a substance that has sub-lethal toxicity to the insect. Many well documented insect anti-feedants are triterpenoids. Based on a 30-carbon skeleton, these substances often occur as glycosides (conjugated with sugars) and are often highly oxygenated. Especially well studied in this regard are the limonoids from the neem (*A. indica*) and chinaberry (*Melia azedarach*) trees, exemplified by *azadirachtin*, *toosendanin* and limonin from Citrus species (Adeyemi *et al*., 2009) [19].

Antifeedant is defined as a chemical that inhibits feeding without killing the insect directly, while the insect remains near the treated foliage and dies through starvation. Antifeedant activity of methanol extracts of *Saraca asoca* and *Terminalia arjuna* bark were assessed based on antifeedant index. Higher antifeedant index normally indicates decreased rate of feeding. In the present study, irrespective of concentration used for extraction the antifeedant activity varied significantly. The antifeedant activity of the extract of barks were tested at different concentrations. The rate of feeding significantly varied depending on the concentration of the methanol extracts of *Saraca asoca* and *Terminalia arjuna* bark. Data pertaining to the above experiment clearly revealed that maximum antifeedant activity was recorded in *Terminalia arjuna* bark as compared to *Saraca asoca* extract. This indicates that the active principles present in the plants inhibit larval feeding behaviour or make the food unpalatable or the substances directly act on the chemosensilla of the larva resulting in feeding deterrence. This study demonstrated that the plant extraction is effective as antifeedant against *S. oryzae* adults (Table 2 and Fig 2).

**Table 2:** Evaluation antifeedant activity of *Saraca asoca* and *Terminalia arjuna* bark extracts

| S. No. | Doses (mg/kg) | Weight loss (gm) | |
|---|---|---|---|
| | | ***Saraca asoca* bark extract treated** | ***Terminalia arjuna* bark treated** |
| 1 | Control | 9.65 | 9.65 |
| 2 | 10 | 2.85±0.20 a | 2.08±0.14 b |
| 3 | 25 | 2.12±0.15 a | 1.45±0.10 b |
| 4 | 50 | 1.56±0.11 a | 1.02±0.09 b |
| 5 | 75 | 1.07±0.07 a | 0.92±0.06 b |
| 6 | 100 | 0.65±0.05 a | 0.24±0.03 b |

Values are expressed as Mean± SD for six triplicates
Mean values within a row followed by different letters are significantly different from each other at $P < 0.05$ level comparison by Duncan's multiple range test (DMRT).

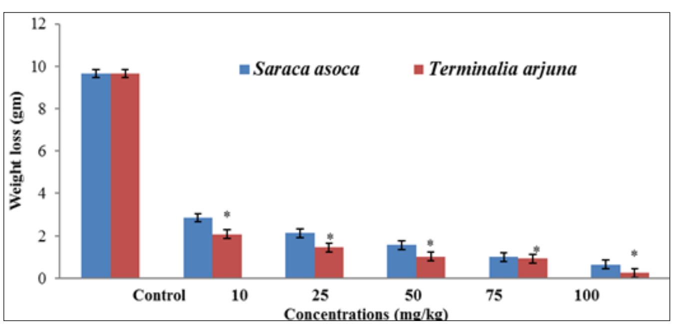


**Fig 2:** Evaluation antifeedant activity of *Saraca asoca* and *Terminalia arjuna* bark extracts

### Conclusion

The repellent activity against *S. oryzae* adults was more pronounced in methanol extract of *Terminalia arjuna* bark as compared with *Saraca asoca* bark extract. The antifeedant activity against *S. oryzae* adults was greater in methanol extract of *Terminalia arjuna* bark as compared with *Saraca asoca* bark extract. The potential insecticidal, repellent and antifeedant activity of *Saraca asoca* and *Terminalia arjuna* bark extracts might be present in bioactive compounds. Therefore, *Saraca asoca* and *Terminalia arjuna* could be considered an ideal grain (Rice) protectant from the point of view of seed viability and safety to mammals.

### References

1. Adeyemi O, Ajayi JO, Olajuyin AM, Oloyede OB, Oladiji AT, Oluba OM, *et al*. Toxicological evaluation of the effect of water contaminated with lead, phenol and benzene on liver. Kidney and colon of albino rats. Food Chem Toxicol. 2009; 47(4):885-7.
2. Boeke SJ, Baumgart IR, Van Loon JJA, Van Huis A, Dicke M, Kossou DK. Toxicity and repellence of African plants traditionally used for the protection of stored cowpea against Callosobruchus maculatus, Journal of Stored Products Research. 2004; 40(4):423-438.
3. Hummelbrunner LA, Isman MB. Acute, sublethal,

antifeedant, and synergistic effects of monoterpenoid essential oil compounds on the tobacco cutworm, *Spodoptera litura* (Lep, Noctuidae), Journal of Agricultural and Food Chemistry. 2001; 49(2):715-720.
4. Isman M. Insect Antifeedants: In Pesticide Outlook. Royal Soc. Chem, 2002, 152-157.
5. Jacobson M. Plants, insects, and man-their interrelationships, Economic Botany. 1982; 36(3):346-354.
6. Keita S, Vincent C, Schmit J, Arnason J, Bélanger A. Efficacy of essential oil of Ocimum basilicum L. and O. gratissimum L. applied as an insecticidal fumigant and powder to control Callosobruchus maculatus (Fab.)[Coleoptera: Bruchidae]. J Stored Prod. Res. 2001; 37:339-349.
7. Koul O, Walia S, Dhaliwal GS. Essential oils as green pesticides: potential and constraints, Biopesticide International. 2008; 4(1):63-88.
8. Liu ZL, Xu YJ, Wu J, Goh SH, Ho SH. Feeding deterrents from *Dictamnus dasycarpus* Turcz against two stored-product insects, Journal of Agricultural and Food Chemistry. 2002; 50(6):1447-1450.
9. Mahdi S, Rahman M. Insecticidal effect of some spices on Callosobruchus maculatus (Fabricius) in black gram seeds. Univ. J Zool., Rajshahi University. 2008; 27:47-50.
10. Maia MF, Moore SJ. Plant-based insect repellents: a review of their efficacy, development and testing, Malaria Journal. 2011; 1(11):1-15.
11. McDonald L, Guy R, Speirs R. Preliminary evaluation of new candidate materials as toxicants, repellents and attractants against stored product insects. Marketing research report, 1970, 882.
12. Munakata K. Insect antifeedants of *Spodoptera litura* in plants, in Host Plant Resistance to Pests, P. A. Hedin, Ed., vol. 62 of ACS Symposium Series, American Chemical Society, Washington, DC, USA, 1997, 185-196.
13. Obeng-Ofori D, Reichmuth C. Bioactivity of eugenol, a major component of essential oil of *Ocimum suave* (Wild.) against four species of stored-product Coleopteran, International Journal of Pest Management. 1997; 43(1):89-94.
14. Owusu EO. Effect of some Ghanaian plant components on control of two stored-product insect pests of cereals, Journal of Stored Products Research. 2001; 37(1): 85-91.
15. Pakash A, Rao J. Botanical pesticides in agriculture. CRC Press Inc, 1997, 461.
16. Saxena RC, Jillani G, Kareem AA. Effects of neem on stored grain insects, in Focus on Phytochemical Pesticides, The Neem Tree, M. Jacobson, Ed., CRC Press, Boca Raton, Fla, USA. 1988; 1:97-111.
17. Talukder FA, Islam MS, Hossain MS, Rahman MA, Alam MN. Toxicity effects of botanicals and synthetic insecticides on *Tribolium castaneum* (Herbst) and *Rhyzopertha dominica* (F.), Bangladesh Journal of Environment Science. 2004; 10(2):365-371.
18. Talukder FA. Plant products as potential stored product insect management agents–a mini review, Emirates Journal of Agricultural Science. 2006; 18:17-32.
19. Talukder FA, Howse PE. Deterrent and insecticidal effects of extracts of pithraj, *Aphanamixis polystachya* (Meliaceae) against Tribolium castaneum. J Chem. Ecol. 1993; 19:2463-2471.
20. Talukder FA, Howse PE. Laboratory evaluation of toxic repellent properties of the pithraj tree, *Aphanamixis polystachya* Wall & Parker, against *Sitophilus oryzae* (L.). Int J Pest Man. 1994; 40:274-279.
21. Tripathi AK, Prajapati V, Ahmad A, Aggarwal KK, Khanuja SPS. Piperitenone oxide as toxic, repellent, and reproduction retardant toward malarial vector *Anopheles stephensi* (Diptera: Anophelinae), Journal of Medical Entomology. 2004; 41(4):691-698.
22. Xie YS, Fields PG, Isman MB. Repellency and toxicity of azadirachtin and neem concentrates to three stored-product beetles, Journal of Economic Entomology. 1995; 88(4):1024-1031.