REPELLENT EFFECT OF SOME INDIGENOUS PLANT EXTRACTS AGAINST SAW-TOOTHED GRAIN BEETLE, *Oryzaephilus surinamensis* (L.)

M. M. R. SHAH[1], M. D. H. PRODHAN[2], M. N. A. SIDDQUIE[3], M. A. A. MAMUN[3] AND M. SHAHJAHAN[4]

[1]Scientific Officer, Entomology Division, Regional Wheat Research Center, BARI, Shyampur, Rajshahi, [2]Scientific Officer, Entomology Division, Bangladesh Agricultural Research Institute, Gazipur, [3]Scientific Officer, On-Farm Research Division, Region-1, Bangladesh Agricultural Research Institute, Shyampur, Rajshahi, [4]Professor, Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh

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ABSTRACT

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The study was conducted in the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh. Leaves of six indigenous plants viz., *Typhonium trilobatum*, *Cleome viscosa*, *Cassia occidentalis*, *Pongamia pinnata*, *Mesua ferrea*, and *Trewia nudiflora* were extracted using acetone, ethanol and water solvents. These extracts were evaluated for their repellent effect against *Oryzaephilus surinamensis* (L.) at 2.5, 5.0, 7.5, and 10.0% concentrations. Three replications were used for each dose of all the plant extracts and examined in petridishes. Extracts of water solvent showed higher repellent effect than that of others except ethanol extract of *M. ferrea*. Considering mean repellency rate, extracts of three solvents of all six plants were in the same repellency class i.e. class II except water extract of *P. pinnata* (class III). It was found that the rate of repellency increased with the increase of dose level. At 10.0% dose level all plant extracts showed the highest repellency rate and were in repellency class III.

Keywords: Indigenous plant extract, solvent, repellent, *Oryzaephilus surinamensis*

INTRODUCTION

Oryzaephilus surinamensis (L.) is one of the most serious and destructive insect pest of grains stored in bulk condition. This insect feeds on a variety of products including almost all grains and grain products, dried fruits, fast foods, nuts, seeds, yeast, sugar, candy, tobacco, snuff, dried meats, and in fact, almost all plant products used as human food (Metcalf and Flint 1979). Control of this pest population around the world primarily depends upon continued applications of organophosphorus and pyrethroid insecticides and fumigants, e.g., methyl bromide and phosphine, which are still the most effective means for the protection of stored food, feedstuffs and other agricultural commodities from insect infestation (Kim *et al*. 2003a, Park *et al*. 2003b). But synthetic insecticide causes several problems like, environmental pollutions, health hazards, pest and pesticide resistance, disrupt biological control and ecosystem etc. Not only that the insecticides have been detected in excessive amounts in almost all the food materials including food grains, vegetables, fruits, meat, fish, eggs, milk and milk products, and even in human milk (Das *et al*. 1999). Thus, to combat these problems, there is an urgent need for safe but effective, biodegradable pesticides with no toxic effects on non-target organisms. This has created a world-wide interest in research particularly the use of plant extracts as alternative to synthetic chemicals. Many plant extracts may be used for protection of stored product pests as they constitute a rich source of bioactive chemicals. Many of them are free from undesirable effect on non-target organisms, often active against specific target insects, biodegradable, and are potentially sound for use in integrated pest management (Kim *et al.* 2003b). In view of the aforesaid perspective, the present research work was undertaken to evaluate the possible repellent effect of six indigenous plant viz., Ghet-kachu (*Typhonium trilobatum*), Hurhuri (*Cleome viscosa*), Kalkasunda (*Cassia occidentalis*), Karanja (*Pongamia pinnata*), Nagchampa (*Mesua ferrea*), and Pitali (*Trewia nudiflora*) extracts against Saw-toothed grain beetle (*Oryzaephilus surinamensis*).

MATERIALS AND METHODS

A study conducted in the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh during June to August 2002. The methodology is discussed below with the following sub-headings:

Rearing Technique: *Oryzaephilus surinamensis*(L.) was reared in round plastic jars (14x10.5x30 cm) at 27-30 ^{0}C and 70-75% RH. Wheat grains were sterilized at 60 ^{0}C for 30 m and then used as food for rearing insects. Each jar was set up with 100 pairs of adult beetles. The mouths of the jars were covered with pieces of cloth fastened with rubber bands to prevent insect escape. The insects were allowed 7 days in the jars for mating and oviposition and were removed from the jar. Then the jars were placed in a growth chamber maintained at 27 ^{0}C and 70% RH for completing the life cycle of insects after emergence from the eggs in the food.

Dust preparation: Fresh leaves of *T. trilobatum*, *C. viscosa*, *C. occidetalis*, *P. pinnata*, *M. ferrea*, and *T. nudiflora* were collected kept in the shade for air-drying and then dried in the oven at 60 ^{0}C. Dusts of dried leaves were prepared by using a grinder machine. Then the dusts were passed through a 25-mesh diameter sieve to obtain fine and uniform dust.

***Extraction procedure*:** The extracts were prepared according to Chitra *et al*. (1993). Ten grams of each category of dust were taken in a 600 ml beaker separately and mixed with 100 ml of different solvents (acetone, ethanol and distilled water). Then the mixture was stirred for 30 m by a magnetic stirrer (at 6000 rpm) and left stand for next 24 hours. The mixture was then filtered through a fine cloth and again through filter paper (Whatman No. 1). The filtered materials were collected in round bottom flasks and then condensed by evaporation of solvent in a water bath at 80 ^{0}C, 55 ^{0}C, and 45 ^{0}C for water, ethanol and acetone extracts, respectively. Evaporation was done to make the volume of 10 ml and stored in a refrigerator.

***Preparation of different concentration*:** By diluting the condensed extracts with acetone, ethanol, and distilled water, the stock solutions of plant extracts were prepared. Four different concentrations viz., 2.5, 5.0, 7.5, and 10.0% of each category of plant extracts were prepared by dissolving the stock solution in the respective solvent.

***Repellency test*:** The stock extract was diluted with respective solvents to prepare 2.5, 5.0, 7.5, and 10.0% solutions. Repellency test was conducted according to the method of Talukder and Howse (1994). Petridishes were divided into two parts, treated and fresh grain portion (untreated). With the help of a pipette, 1 ml solution of each plant extract was applied to one half of the grains. The treated half was then air-dried. Ten *O. surinamensis* adults were released at the centre of each petridish and covered. For each plant extract and each dose, three replications were used. Then the numbers of insect pest present on each portion of the petridishes were counted at hourly intervals. The data were expressed as percentage repulsion (PR %) by the following formula: PR (%) = (N_C-50) x 2. Where, N_C= Percentage of insects present in the control half. Positive (+) values expressed repellency and negative (-) values attractency. Data (PR%) were analysed using analysis of variance (ANOVA). The average values were then categorized according to the classes of 0, I, II, III, IV and V having per cent repellency rate of >0.01 to 0.1, 0.1 to 20, 20.1 to 40, 40.1 to 60, 60.1 to 80 and 80.1 to 100, respectively (McDonald *et al.* 1970).

RESULTS AND DISCUSSION

The results and statistical analysis of the repellency rate of tested plant extracts at different hours after treatment (HAT) are presented in Table 1 to 2. The repellency rate of acetone, ethanol and water solvents extract of six plants showed insignificant at different hours after treatment (Table 1). But numerically the repellency rate of all the extracts was higher at one hour after treatment than two or three hours after treatment except few. Considering solvents used in this study, extracts of water solvent showed higher repellency rate than other extract of acetone and ethanol except *M. ferrea* plant where extract of ethanol showed higher repellency rate. The highest mean repellency rate was observed in water extract of *P. pinnata* (41.67%) and the lowest in acetone extract of *T. trilobatum* (21.11%). On the basis of mean repellency rate, it was found that extracts of acetone, ethanol, and water of all six plants were in the same repellency class i.e. class II except *P. pinnata* extract of water (class III). The repellency rate of different plant extracts at different dose level on *O. surinamensis* is presented in Table 2. Findings revealed that the rate of repellency increased with increase of dose level. At 10.0% dose level all plants showed the highest repellency rate and were in repellency class III, but at 7.5% dose level also *C. occidentalis*, *P. pinnata*, and *M. ferrea* remained same repellency class. The highest mean repellency rate was found with 10.0% dose level of *P. pinnata* extract (55.56%) and the lowest rate was found with 2.5% dose level of *T. trilobatum* extract (8.15%). Published information regarding repellency of these six plant extracts against *O. surinamensis* is not available. Deka *et al.* (1998) evaluated the repellent properties of chloroform, petroleum ether, methanol solvent extracts of *P. pinnata* and *Lantana camara* against *Helopeltis theivora* in the laboratory. Extracts of both plants showed a repellent effect to 1st instar larvae of *H. theivora*. Dwivedi and Kumar (1999) observed the possible repellent action of *Cassia occidentalis* and other aboriginal plant species against a stored product pest insect under laboratory conditions and they obtained good result. Sighamony *et al.* (1984) carried out an experiment with acetone extracts of *Piper nigrum*, oils of *Syzygium aromaticum*, *Juniperus virginiana* and *P. pinnata* in India by a choice test method to determine their repellent effects on adults of *Tribolium castanium*. They observed that *P. pinnata* oil was found to show more repellent effect.

Table 1. Repellency rate of different solvent extracts of different plants on *O. surinamensis* using treated wheat grains at different hours after treatment (HAT)

Name of the plants	Name of the solvents	Repellency rate (%)			Mean repellency rate (%)	Repellency class
		1 HAT	2 HAT	3 HAT		
T. trilobatum	Acetone	18.33	18.33	26.67	21.11	II
	Ethanol	28.33	23.33	30.00	27.22	II
	Water	30.00	31.67	23.33	28.33	II
C. viscosa	Acetone	31.67	18.33	25.00	25.00	II
	Ethanol	26.67	23.33	21.67	23.89	II
	Water	38.33	28.33	18.33	28.33	II
C. occidentalis	Acetone	46.67	36.67	28.33	37.22	II
	Ethanol	43.33	31.67	23.33	32.78	II
	Water	46.67	40.00	26.67	37.78	II
P. pinnata	Acetone	46.67	36.67	30.00	37.78	II
	Ethanol	36.67	40.00	30.00	35.56	II
	Water	51.67	40.00	33.33	41.67	III
M. ferrea	Acetone	40.00	33.33	30.00	34.44	II
	Ethanol	40.00	36.67	28.33	35.00	II
	Water	35.00	31.67	28.33	31.67	II
T. nudiflora	Acetone	31.67	28.33	25.00	28.33	II
	Ethanol	30.00	26.67	25.00	27.22	II
	Water	40.00	31.67	36.67	36.11	II
Sx			5.0095		2.8922	-
Probability level			NS		NS	-

NS= Not significant

Table 2. Repellency rate of different plant extracts at different doses on *O. surinamensis* using treated wheat grains at different hours after treatment (HAT)

Name of the plants	Doses (%)	Repellency rate (%)			Mean repellency rate (%)	Repellency class
		1 HAT	2 HAT	3 HAT		
T. trilobatum	2.5	8.89	2.22	13.33	8.15	I
	5.0	17.78	20.00	15.56	17.78	I
	7.5	31.11	28.89	33.33	31.11	II
	10.0	44.44	46.67	44.44	45.19	III
C. viscosa	2.5	13.33	6.67	6.67	8.89	I
	5.0	26.67	15.56	17.78	20.00	I
	7.5	40.00	28.89	26.67	31.85	II
	10.0	48.89	42.22	35.56	42.22	III
C. occidentalis	2.5	22.22	20.00	8.89	17.04	II
	5.0	40.00	28.89	20.00	29.63	II
	7.5	53.33	42.22	31.11	42.22	III
	10.0	66.67	53.33	44.44	54.82	III
P. pinnata	2.5	26.67	20.00	17.78	21.48	II
	5.0	40.00	35.56	24.44	33.33	II
	7.5	51.11	44.44	33.33	42.96	III
	10.0	62.22	55.56	48.89	55.56	III
M. ferrea	2.5	20.00	15.56	11.11	15.56	I
	5.0	24.44	26.67	17.78	22.96	II
	7.5	46.67	46.67	40.00	44.44	III
	10.0	62.22	46.67	46.67	51.85	III
T. nudiflora	2.5	20.00	13.33	11.11	14.82	I
	5.0	26.67	22.22	22.22	23.70	II
	7.5	37.78	33.33	35.56	35.56	II
	10.0	51.51	46.67	46.67	48.15	III
Sx			5.7844		3.3397	-
Probability level			NS		NS	-

NS= Not significant

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