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REPELLENT ACTIVITY OF *ABROMA AUGUSTA* EXTRACTS AGAINST *TRIBOLIUM CASTANEUM* (HERBST) ADULTS

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Abstract

Context: Repellency test can play an important role in special environmental conditions.

Objectives: The main objective of this study was to make a standard protocol to control the pest by screening the test materials using adult beetles by repellency test to see whether or not the extracts contain any potential to repel the stored grain pest.

Materials and Methods: The experiment was conducted in choice chamber, which was divided by half filter paper discs (Whatman No. 40, diameter 9 cm). One half of the filter paper was loaded with untreated (control) and the other half was loaded with the extract of *A. augusta*. All the $CHCl_3$ extracts were separately applied onto each of the half-discs and allowed to dry out in the air for 10 mins. Each treated half-disc was then attached lengthwise, edge-to-edge, to a control half-disc with adhesive tape and placed in petri dishes. The orientation of the same was changed in the replicates to avoid the effects of any external directional stimulus affecting the distribution of the test insects *Tribolium castaneum* (Herbst). Ten adult insects were released in the middle of each of the filter-paper circles and each test was replicated five times.

Results: All the test extracts of seed, leaves, root wood, stem bark and stem wood of *A. augusta* collected in chloroform showed repellent activity against adult beetles of *T. castaneum* at dose levels of 314.540, 157.270, 78.635, 39.318, 19.659 and, 9.831 µg/cm^2 on filter paper. According to the intensity of repellency the results could be arranged in the order: stem bark >seed> root wood > leaf > stem wood and in all the cases significant differences were obtained.

Conclusion: The present results revealed that *A. augusta* extracts can be used as a reduced risk repellent compound in the grain and cereal stores to manage the population of *T. castaneum.* The results also seen to be encouraging when there is a greater need for environment-friendly pesticides then ever before.

Key words: *Abroma augusta*, repellent activity, *Tribolium castaneum*.

Introduction

Natural products derived from plants, as an alternative to conventional insecticides for insect control, is now-a-days very popular among the pest control experts. Botanical pesticides are more readily biodegradable and therefore, are less likely to contaminate the environment. Moreover, the plant-derived compounds break down readily in soil and are not stored in plant or animal tissues. However, they might have a certain extent of toxicity to kill insects, thus affect the food chain or food web and create an imbalance in the ecosystem as an ultimate consequence. Repellents in that case could be a better solution for the management of the stored product pests, among others. Plant-derived pesticides are being subjected to produce insect repellents or insect antifeedants for safer protection of field crops and stored grains with eco-friendly means of sustainable development.

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Abroma augusta L., locally known as Ulatkombal, is a shrub and small tree, attaining a height of 3-5 meters with horizontal and velvety branches. The branches and branchlets are downy. The leaves are alternate. The dry roots have 0.5-1.0 mm thick, highly fibrous, brown barks; the thickness of the bark varies according to the age and girth of the root. When freshly cut the root produces a thick gummy substance. The outer surface of the bark is dull brown and longitudinally wrinkled with small warty markings; the outer surface is whitish yellow and finely longitudinally striate. The root bark is test less, slimy, odourless, and tough, but not brittle. When soaked in cold water for 3-4 days, the bark produces slimy mucilage which can be extracted (Anonymous 2006, Nandkarni 2002).

Being a medicinal plant, *A. augusta* contains antipathogenic properties. Almost all the parts of the plant are used in the treatment of diseases. The root wood and root bark are reputed remedies as an emmenagogue and uterine tonic, used in ammenorrhoea for congestive and nervous dysmenorrhoea and prescribed during irregular menses. The utility of *A. augusta* in uterine hemorrhage might be due to the presence of the magnesium salts (Nandkarni 2002).The leaves are reported to be useful in treating uterine disorders, diabetes, rheumatic pains of joints, and headache with sinusitis. The cold aqueous infusion of the fresh leaves and twigs have been reported to be demulcent and very efficacious in gonorrhea. The leaves are used as aphrodisiac as a sex stimulant. *A. augusta* is also used in stomachache, diabetes, dermatitis, and in whitish discharge in urine in men (Rahamtullah *et al.* 2010).

Powdered roots are used as abortifacient and anti-fertility agent. Leaves are useful in treating uterine disorders, diabetes, rheumatic pain of joints, and headache with sinusitis (Prajapati *et al*., 2003). Leaves and stem are demulcent and an infusion of fresh leaves and stem in cold water is very efficacious in gonorrhea(Nandkarni 2002).The root-bark is used as an emmenagogue and uterine tonic. The action of dried roots as well as the sap of the fresh root has been studied (Kirtikar and Basu 1999). The leaves and stems of *A. augusta* were used by the traditional healers of Bogra district, but the bark of roots were used by the traditional healers of Jessore district (Hanif *et al*. 2010). A combination of aqueous extract of dried powder of root and leaves of *A. augusta* and *Azadirachta indica* lowered blood sugar in alloxan diabetic rats when administered orally (Halim and Hossain 2002). A number of researchers reported the repellent activities of different plants on storage pests Mc Donald *et al*.1970, Talukder and Howse1995, Pramanik *et al*. 2009, Abdullah Jilani *et al*. 1988, Huang *et al.*1997. No published information was available on the repellent activities of the extractives of *A. augusta*. The following investigation reports the repellent effects of the chloroform extracts of various parts of *A. augusta* on a major storage pest, *Tribolium castaneum* (Herbst).

Materials and Methods

Preparation of plant materials for extraction: The fresh leaves, root wood, seeds, stem bark, and stem wood of *A. augusta* were collected from the campus of the University of Rajshahi, Bangladesh. After drying under shade the plant materials were powdered in a grinder separately avoiding excess heat during grinding.

Chemical extraction of the collected materials: Chloroform was selected as a solvent to extract different parts of *A. augusta* separately. The ground dried materials, *viz.* leaves, root wood, seeds, stem bark, and stem-wood were extracted with sufficient amounts of chloroform (500g × 1500ml × 3 times) for each of the items. Separate extracts were collected by the cool method after 72 hrs of plunging for each of the materials. Extracts, thus obtained, were subjected to filtration and evaporation of the solvent. The residue was left and kept in a refrigerator after proper labeling.

Preparation of doses with the crude extracts: A general concentration for each of the extracts was selected as stock dose to make other successive doses by serial dilution to give 314.540, 157.270, 78.635, 39.318, 19.659 and, 9.831 µg/cm^2 for all the extracts.

Application of doses: The repellency test used in this experiment was adopted from McDonald *et al*. (1970) with some modifications by Talukder and Howse (1993, 1994). Half filter paper discs (Whatman No. 40, diameter 9 cm) were prepared and selected doses of all the $CHCl_3$ extracts were separately applied onto each of the half-discs and allowed to dry out in the air for 10 mins. Each treated half-disc was then attached lengthwise, edge-to-edge, to a control half-disc with adhesive tape and placed in petri dishes. The orientation of the same was changed in the replica to avoid the effects of any external directional stimulus affecting the distribution of the test insects. Ten adult insects were released in the middle of each of the filter-paper circles and each test was replicated five times.

Observation and analysis of repellency data: Insects that settled on the non-treated half of the filter paper discs were counted after 1 h and then at hourly intervals for 5 hrs. The average of the counts was converted to percent repellency (*PR*) using the formula of Talukder and Howse (1993, 1995):

$PR = 2(C - 50)$,

Where, C is the percentage of insects on the untreated half of the disc. Positive values expressed repellency and negative values for attractant activity. The data obtained as percent repellency was developed by arcsin transformation for the calculation of ANOVA. The experiment was conducted at room temperature of 30± ^{o}C..

Results and Discussion

All the test extracts of seed, leaves, root wood, stem bark and stem wood of *A. augusta* collected in chloroform showed repellent activity against adult beetles of *T. castaneum* at dose levels of 314.540, 157.270, 78.635, 39.318, 19.659 and, 9.831 µg/cm^2 on filter paper (Table 1). The statistical analyses of the data are given in Table 2. According to the intensity of repellency the results could be arranged in the order: stem bark >seed> root wood > leaf > stem wood and in all the cases significant differences were obtained.

Table 1. Repellency of *T. castaneum* adults by $CHCl_3$ extracts of different parts of *A. augusta*

Material extracted	Dose (µg/cm^2)	Repellency percentage (arcsin) at intervals				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
Leaf	314.540	66.67 (54.70)	80.00 (63.44)	40.00 (39.23)	60.00 (50.77)	73.32 (58.89)
	157.270	80.00 (63.44)	46.67 (43.05)	33.32 (35.24)	40.00 (39.23)	66.67 (54.70)
	78.635	53.32 (46.89)	60.00 (50.77)	40.00 (39.23)	33.32 (35.24)	40.00 (39.23)
	39.318	53.32 (46.89)	20.00 (26.56)	26.67 (31.05)	13.32 (21.39)	6.67 (14.89)
	19.659	6.67 (14.89)	20.00 (26.56)	6.67 (14.89)	6.67 (14.89)	20.00 (26.56)
	9.830	6.67 (14.89)	20.00 (26.56)	20.00 (26.56)	13.32 (21.39)	20.00 (26.56)

Contd. Table 1. Repellency of *T. castaneum* adults by $CHCl_3$ extracts of different parts of *A. augusta*

Material extracted	Dose (μg/cm²)	Repellency percentage (arcsin) at intervals				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
Root wood	314.540	80.00 (63.44)	66.67 (54.70)	66.67 (54.70)	40.00 (39.23)	60.00 (50.77)
	157.270	60.00 (50.77)	40.00 (39.23)	60.00 (50.77)	46.67 (43.05)	53.32 (46.89)
	78.635	46.67 (43.05)	40.00 (39.23)	20.00 (26.56)	40.00 (39.23)	33.32 (35.24)
	39.318	26.67 (31.05)	6.67 (14.89)	13.32 (21.39)	20.00 (26.56)	26.67 (31.05)
	19.659	6.67 (14.89)	6.67 (14.89)	13.32 (21.39)	33.32 (35.24)	6.67 (14.89)
	9.830	20.00 (26.56)	13.32 (21.39)	13.32 (21.39)	13.32 (21.39)	6.67 (14.89)
Stem bark	314.540	80.00 (63.44)	80.00 (63.44)	60.00 (50.77)	80.00 (63.44)	73.32 (58.89)
	157.270	66.67 (54.70)	60.00 (50.77)	66.67 (54.70)	66.67 (54.70)	66.67 (54.70)
	78.635	40.00 (39.23)	40.00 (39.23)	40.00 (39.23)	60.00 (50.77)	40.00 (39.23)
	39.318	40.00 (39.23)	33.32 (35.24)	26.67 (31.05)	26.67 (31.05)	20.00 (26.56)
	19.659	26.67 (31.05)	26.67 (31.05)	20.00 (26.56)	26.67 (31.05)	6.67 (14.89)
	9.830	6.67 (14.89)	13.32 (21.39)	26.67 (31.05)	6.67 (14.89)	13.32 (21.39)
Stem wood	314.540	60.00 (50.77)	40.00 (39.23)	66.67 (54.70)	46.67 (43.05)	46.67 (43.05)
	157.270	60.00 (50.77)	60.00 (50.77)	33.32 (35.24)	33.32 (35.24)	46.67 (43.05)
	78.635	33.32 (35.24)	26.67 (31.05)	26.67 (31.05)	6.67 (14.89)	26.67 (31.05)
	39.318	26.67 (31.05)	20.00 (26.56)	13.32 (21.39)	6.67 (14.89)	40.00 (39.23)
	19.659	6.67 (14.89)	13.32 (21.39)	13.32 (21.39)	26.67 (31.05)	20.00 (26.56)
	9.830	6.67 (14.89)	6.67 (14.89)	6.67 (14.89)	13.32 (21.39)	6.67 (14.89)
Seed	314.540	93.34 (75.00)	73.34 (58.89)	80.00 (63.44)	86.67 (68.53)	86.67 (68.53)
	157.270	60.00 (50.77)	80.00 (63.44)	73.34 (58.89)	60.00 (50.77)	53.34 (46.89)
	78.635	60.00 (50.77)	60.00 (50.77)	66.67 (54.70)	53.34 (46.89)	60.00 (50.77)
	39.318	53.34 (46.89)	40.00 (39.23)	53.34 (46.89)	40.00 (39.23)	53.34 (46.89)
	19.659	40.00 (39.23)	46.67 (43.05)	40.00 (39.23)	33.34 (35.24)	33.34 (35.24)
	9.830	26.67 (31.05)	26.67 (31.05)	20.00 (26.56)	33.34 (35.24)	33.34 (35.24)

Table 2. ANOVA results of repellency by *A. augusta* extracts against *T. castaneum* adults.

Test material	*Source of Variation*	SS	df	MS	F-ratio	P-value
Seed	Between dose levels	3861.734	5	772.3468	31.06174***	8.99E-09
	Between time intervals	30.21025	4	7.552562	0.303744	0.872006
	Error	497.2978	20	24.86489		
	Total	4389.242	29			
Leaf	Between dose levels	4806.357	5	961.2714	13.87454***	6.35E-06
	Between time intervals	513.2012	4	128.3003	1.851827	0.158545
	Error	1385.662	20	69.28311		
	Total	6705.22	29			
Root wood	Between dose levels	4671.159	5	934.2319	19.87131***	3.86E-07
	Between time intervals	198.6403	4	49.66007	1.05628	0.403684
	Error	940.282	20	47.0141		
	Total	5810.082	29			
Stem wood	Between dose levels	3401.835	5	680.3671	13.35112***	8.45E-06
	Between time intervals	159.3931	4	39.84828	0.781959	0.550127
	Error	1019.191	20	50.95954		
	Total	4580.419	29			
Stem bark	Between dose levels	5949.248	5	1189.85	39.22012***	1.15E-09
	Between time intervals	97.87965	4	24.46991	0.806583	0.535457
	Error	606.7547	20	30.33773		
	Total	6653.883	29			

** = P<0.01; * = P<0.05

Our results are in agreement with similar works of McDonald *et al*. (1970), Khan (1981), Talukder and Howse (1995), Hebbalkar *et al.* (1992) and Pugazhvendan *et al*. (2012). Abdullah *et al*. (2011) assessed the mortality and repellency of the chloroform extracts of different parts of *Urena sinuata* on *T. castaneum* adults. The root and stem extracts showed significant repellent effects on the beetles but the fruit and leaf extracts produced no repellency at all. The repellency record triggers a hope for the use of *A. augusta* extracts as repellents since most of the extracts repelled the beetles significantly. Singh *et al.* (2001) carried out antifeedant activity tests of some (of bioactive potentials) plants that help understanding repellent potentiality of some medicinal plant extracts. Mondal *et al*. (2011) assessed the repellent activity of *Derris indica* extracts against *T. castaneum* adults. The fruit shell, leaves, seed and stem bark extracts showed repellent activity but the stem wood, root bark and root wood extracts produced no repellency at all.

Conclusion

The present results revealed that *A. augusta* extracts can be used as reduced risk repellent compounds in the grain and cereal stores to manage the population of *T. castaneum.* The results also seem to be encouraging when there is a greater need for environment-friendly pesticides than ever before.

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