J. Environ. Sci. & Natural Resources, 7(2): 151-154, 2014 ISSN 1999-7361

The Repellent Effect of Some Indigenous Plant Extracts Against Pulse Beetle (*Callosobruchus chinensis)*

M. T. Ahmed, M. Begum and M. W. Zaman

Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh

Abstract

An Experiment was conducted in the laboratory of the Division of Entomology, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh to evaluate the efficacy of four indigenous plants parts such as leaves of raintree (*Albizia saman*), riot lata (*Mikania micrantha*), pithraj (*Aphanamixis polystachya*) and seeds of mahogani (*Swietenia macrophylla*) with methanol extracts at the rates of 10.0, 7.5, 5.0 and 2.5% for their direct toxicity against the pulse beetle, *Callosobruchus chinensis* (L.). Among the four plants extracts tested, pithraj leaf showed the highest (52.28%) mean repellency effect followed by riot lata (Mikania) leaf extract (46.07%), mahogani seed extract (38.79%) and raintree leaf extract (25.13%). On the basis of mean repellency rate, it was found that mahogany seed, pithraj leaf and riot lata (Mikania) leaf extracts were in the same repellency class i.e. Class Ill and except raintree leaf (Class II).

Key words: Plant extracts, Pulse beetle, Repellency

Introduction

Pulse is one of the best sources of plant protein and plays an important role in the diet of common people ofdeveloping countries like Bangladesh (Darmadi-Blackberry *et al.,* 2004). It has been reported that cultivatedarea under pulse crops in Bangladesh coverage 3113603.24 ha (769000 acres) with annual production of 259000tons (BBS, 2007). In Bangladesh 50 species of insect are consideredinjurious to food grains and their products (Ahad, 2003). But in India there are about 200 species of pest insectswhich cause damage to stored grains and grain products in storage (Maniruzzaman, 1981). Among these, the pulse beetles *Callosobruchus spp*. are the major pests in stored pulse (Ahad, 2003; Bhalla *et al*., 2008). Mostof the cereals and pulses have to be stored by the producer in their home and by the traders and the Governmental agencies in go-downs for one year or more for future use. So, insects pests are the major problemfor storing cereals and pulses. It has been reported that pulse beetle, *Callosobruchus chinensis* is a major economically importance pest of all pulses and causes 40-50% in losses of pulses storage (Gosh and Durbey, 2003). Generally management of stored product pest is done through fumigation (Page and Lubatti, 1963; and Lemon, 1967) and also is controlled by synthetic insecticides (Atwal and Dharial, 2005), which have many limitations and undesirable side effects. Insecticides have been used for a long time with serious drawbacks. Indiscriminate use of insecticides to protect pulse beetle in storage may cause serious health hazard as well asdestruction of beneficial insect and increasing costs of application (Kavadia *et al.,* 1984; Desmarchelier, 1985; Fishwich, 1988; Singh *et al*., 2001). Global warning has cautioned us and the adverse consequences ofinsecticide use are always alarming and also inducing pest out break because of pest resistance. In thiscondition, alternative methods of insect control utilizing botanical products are being used in many countries.Botanical insecticides are biodegradable, relatively specific in the mode of action and easy to use (Das, 1986);and are environmentally safe, less hazardous, less expensive and readily available (Ahmed *et al.,*1993). Manyworkers at home and abroad studied on the insecticidal properties of plant materials (Ahad *et al.,* 1994; Kestenholzetal *et al.,* 2006; Fokunang *et al.,* 2007; Kiruba1 *et al.,* 2008). Considering the above problem of synthetic insecticides and benefit of botanical insecticides the presentresearch work was undertaken by four indigenous plants extracts in solvent methanol. These plants are well distributed in Bangladesh and their leaves and fruits exhibit toxicity, antifeedants, repellent and growthinhibition activity to insects. So, the four indigenous plants extracts were evaluated on pulse beetle. Scientific research works have been done in Bangladesh to explore our locally available plant materials for the control of harmful insect pests in storage and field level. Considering problems of synthetic insecticides and benefits of botanical insecticides, the present research work was undertaken by four indigenous plants extracts with the followihg objective: To determine the repellent effect of the plant extractsainst pulse beetle.

Materials and Methods

Preparation of crude extract and mass culture of C. chinensis

Experiments were conducted in the laboratory of the Division of Entomology, Bangladesh Institute of Nuclear Agriculture (BINA), All insect cultures were maintained in the laboratory at room temperature (30 ± 2° Cand with 70 ± 5 % RH) during the experiments. Leaves of the test plant were washed in running water and then air dried. Finally, the dried plant materials were powdered by the Mortar. The leaf powder of 100g of each desired plant were taken in 1.5 liter separated funnel and 130 ml methanol were added in separated funnel and were kept for 72 hours with interval of shaking. After 72 hours it was then filtered by Whatman paper No.1 (diameter 40). The filtrates liquid were aqueous extract. The aqueous extract was collected in a beaker. The solvent was evaporated by using thin film rotary evaporator under reduced pressure. Obtaining crude extracts were stored in refrigerator at 0ęC for further investigation. Rearing of and maintenance of the pulse beetle, *Callosobruchus chinensis* were done according to Ahad *et al*, (2012).

Repellency test

The repellency test was conducted according to the method of Talukder and Howse (1993). For repellency test (Plate no. 3.03-C) plant extracts were diluted with respective solvents to prepare (2.5, 5.0, 7.5 & 10%) solutions. Petridishes were divided into two parts, treated and fresh grain portion (untreated). With the help of a pipette, 1.0 ml solution of each plant extract was applied to one half of the grains. The treated half was then air dried. Ten insects (5 male and 5 female) were released at the centre of each petridish and a cover was placed on the petridish. There were replications for each plant extract and each dose. Then the insects present on each portion were counted at hourly intervals up to fifth hour. The data were expressed as percentage repulsion (PR %) by the following formula**:** PR (%) = (Nc-50) × 2

Where,

N= the percentage of insects present in the control half.

Positive (+) values expressed repressed repellency and negative (-) values attractancy. Data (PR %) was analyzed using analysis of variance (ANOVA) after transforming them into arcsine percentages values. The average values were then categorized according to the following classes Table 1:

Table 1. Categorized values

Class	Repellency rate (%)
0	>0.0 1 to 0.1
I	0.1 to 20.0
II	20.1 to 40.0
III	40.1 to 60 .0
IV	60.1 to 80.0
V	80.1 to 100.0

Results and Discussions

The repellency rate of different plant extracts at different hours after treatment (HAT)have been presented in Table 2. The mean repellency rate of different plants extracts was found statistically significant. Among the four plants extracts tested, pithraj leaf showed the highest (52.28%) mean repellency effect followed by riot lata (Mikania) leaf extract (46.07%), mahogani seed extract (38.79%) and raintree leaf extract (25.13%). On the basis of mean repellency rate, it was found that mahogany seed, pithraj leaf and riot lata (Mikania) leaf extracts were in the same repellency class i.e. Class Ill and except raintree leaf (Class II). The repellency rate of different plant extracts at level of concentrations on pulse beetle have been presented in Table 3. The repellency rate increased with the increase of doses. The mean repellency rate among different doses was found to be significant statistically. The comprison effects of plant, dose and time were shown in Table 4. The highest mean repellency rate was found with 10% pithraj leaf extract (61.99 %) and the lowest rate was found with 2.5% raintree extract (15.73%). The repellent action of all the four plant extracts on the pulse beetle was statistically significant except 5 HAT .

Table 2. Repellent effect of different plant extracts at different HAT

Plant extract	Repellency rate (%)					Mean Repellency (%)	Repellency Class
	1 HAT	2 HAT	3 HAT	4 HAT	5 HAT		
Riot lata leaf	45.66b	45.66b	43.77b	47.36b	47.93b	46.07 b	III
Mahogani seed	37.30c	40.20c	36.30c	38.77c	41.39c	38.79 c	II
Pithraj leaf	40.26a	52.SSa	59.88 a	53.97a	54.69a	52.28 a	III
Rain tree leaf	23.10 d	25.25 d	22.99d	26.45d	27.90d	25.13 d	II
$S\bar{x}$	0.92	0.98	1.09	0.87	0.88	0.76	-
Probability Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	-

HAT= Hours After Treatment

Within column, values followed by different letter(s) are significantly different by DMRT.

Table 3. Repellent effects at different concentrations at different HAT

Dose (%)	Repellency rate (%)					Mean Repellency (%)	Repellency Class
	I HAT	2 HAT	3 HAT	4 HAT	5 HAT		
10.0	49.99 a	53.33 a	48.33 a	54.99 a	54.99 a	52.32 a	III
7.5	44.99 b	44.99 b	43.32 b	46.66 b	48.33 b	45.66 b	III
5.0	36.66 c	39.33 c	36.66 c	39.99 c	41.66 c	38.99 c	II
2.5	29.99 d	33.33 d	31.66 d	31.66 d	34.99 d	32.32 d	II
$S\bar{x}$	0.92	0.98	1.09	0.87	0.88	0.76	-
Probability Level	0.01	0.01	0.05	0.01	0.01	0.01	-

HAT= Hours after Treatment
Within column, values followed by different letter(s) are significantly different by DMRT.

Table 4. Repellent effects of different plant extracts at different concentrations at different HAT

Plant Extract	Dose (%)	Repellency rate (%)					Mean Repellency (%)	Repellency Class
		1 HAT	2 HAT	3 HAT	4 HAT	5 HAT		
Riot lata leaf	10.0	58.00a	51.13b	51.13b	58.00b	58.00	45.02b	III
	7.5	44.46b	50.31b	44.66bc	51.23c	51.33	48.34c	III
	5.0	44.40b	38.00d	44.44bc	38.00d	44.44	41.85d	III
	2.5	31.13d	38.00d	31.31d	38.00d	38.00	35.28e	II
Mahogani seed	10.0	44.66b	51.13b	44.44b	51.13c	51.13	48.50c	III
	7.5	44.66b	38.00d	38.66b	38.00d	44.66	40.80d	III
	5.0	31.13d	38.00d	31.13d	38.00d	38.00	38.00e	II
	2.5	24.66e	31.13e	24.66de	31.13e	31.13	28.54f	II
Pithraj leaf	10.0	58.00a	64.66a	58.00a	64.66a	64.66	61.99 a	IV
	7.5	56.00a	39.33b	49.33b	56.006b	56.00	51.33b	III
	5.0	44.46b	51.13b	41.46bc	51.13c	51.13	47.86c	III
	2.5	38.00c	44.46c	44.46bc	38.00d	44.46	41.87d	III
Rain tree leaf	10.0	31.13d	38.00d	31.13d	38.00d	38.00	35.25e	II
	7.5	24.66e	31.13e	24.66de	31.13e	31.13	28.54f	II
	5.0	18.00f	24.66f	18.00e	24.66f	24.66	21.99g	II
	2.5	16.00f	10.34g	16.00c	10.32g	17.00	15.73h	I
$S\bar{x}$		1.85	1.96	2.18	1.74	1.76	1.52	-
Level of significant		0.01	0.01	0.05	0.01	NS	0.01	-

HAT= Hours after Treatment
Within column, values followed by different letter(s) are significantly different by DMRT.
NS = Not significant.

The results presented in forgoing chapter, it was observed that the repellencey effect of extract increased with increase of doses. The order of repellencey effect of the four plant extracts on pulse beetle were Pithraj leaf > Riot lata (Mikania) leaf > Mahogani seed > Raintree leaf. The results supported the findings of Rahman *et al*., (2001). They reported that the highest mean repellency was recorded for 5% pithraj oil (86.69%) and Pithraj oil was the most toxic at 72 (2.63%) and 96 (1.91%) hours after treatment against *A. diaperinus*. Riot lata (Mikania) leaf extract was tested as an insecticide for repellency test for the first time. The results showed that riot lata (Mikania) leaf ranked second in terms of toxic efficacy order against pulse beetle. The repellent action of the four plant extracts on the pulse beetle was statistically significant except 5 hours after treatment (HAT).

Conclusions

Experimental results revealed that these plant extracts had significant repellent effective against the pulse beetle, *Callosobruchus chinensis* (L.). The results shows that the repellencey effect of extract increased with increase of doses. The order of repellencey effect of the four plant extracts on pulse beetle were Pithraj leaf > Riot lata (Mikania) leaf > Mahogani seed > Raintree leaf. In the present research beside pithraj leaf and mahogani seed extracts and raintree leaf extract were used and one naturally grown weed is riot lata (Mikania) that are helpful to reduce the pest attack in stored product. Further research may be conducted to the effect of the plant extract on seed germination and to isolate the active principles that are present in the extract.

References

Ahad, M.A., 1994. Evaluation of edible oils as protectant of pulse beetle *Callosobruchus. Proggressive Agriculture*, 5(1): 1-5

Ahad, M.A., 2003. Pest management in graminicious crops (in Bangla). Bangla Academy, Dhaka, Bangladesh

Ahad, M.A.; Sayed, M.A.; Siddiqui, M.N. and Haque, M.M. 2012. Evaluation of some indigenous plant extracts against pulse beetle, *Callosobruchus chinensis* L. (Bruchidae: Coleoptera) in stored green gram Vigna radiata L.). *Global Journal of Medicinal Plant Research*. 1(1): 33-41.

Ahmed, K.S.; M.A. Haque and B.N. Islam, 1993. Efficacy of edible and non-edible against pulse beetle, Callosobruchus chinensis L. (*Coleoptera: Bruchidae*). Bangladesh Journal of Entomolgy, 3(2): 1-5.

Atwal, A.S. and G.S. Dhalaiwal, 2005. Agricultural Pests of South Asia and Their Management. Kalyani Publishers, India, 265.

BBS, (Bangladesh Bureau of Statistics), 2007.*Statistical Pocket Book of Bangladesh (8th Edn.)* Statistics Division, Ministry of Planning, Govt. of the Peoples Republic of Bangladesh, 452.

Bhalla, Gupta, S.K.; Lal, B.; Kapur, M.L. and Khetarpal, R.K. 2008. *Efficacy of various non-che*mical methods against pulse beetle, *Callosobruchus maculatus.* International Conference of Crop Protection Diversity, La Grande-Motte, France Oral presentations.

Darmadi-Blackberry, I.; Wahlqvist, M.L.; Kouris-Blazos, A.; Steen, B.; Lukito, W.; Horie, Y. and Horie, K. 2004. Legumes: the most important dietary predictor of survival in older people of different ethnicities. *AsiaPacific Journal Clinical Nutre*, 13(2): 217-20.

Fokunang C N, Ikotun T, Dixon AGO, Akem CN, Tembe EA and Nukenine E N, 2007: Efficacy of antimicrobial plant crude extracts on the growth of *Colletotrichum gloeosporioides f. sp. manihotis*. *Pakistan Journal of Biological Science.* 3(6): 928-932.

Gosh, S.K. and Durbey, S.L. 2003. Integrated management of stored grain pests. International book distributioncompay, 263.

Kavadia, V.S.C.; Pareek, B.L. and Sharma, K.P. 1984. Residues of malathion and cabaryl in stored sorghum. *Bulletin of Grain Technology*, 21(3): 247-250.

Kirubal S, Mishra BP, Israel Stalin S, Jeeva S, Manohar and Das S 2008: Traditional pest management practices in Kanyakumari district, southern peninsular India. *Indian Journal of Traditional Knowledge*, 5(1): 71-74.

Kestenholzetal, C.; Stevenson, C.P. and Belmain, S.R. 2007. Comparative study of field and laboratoryevaluations of the ethnobotanical *Cassia sophera* L. (Leguminosae) for bioactivity against the storage pests *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) and *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). *Journal of Stored Products Research,* 43(1): 79-86.

Lemon, R.W. 1967. Laboratory evaluation of malathion bromophos and fenitrothion for use against beetleinfesting stored products. *Journal of Stored Products Research*, 2: 197-210.

Maniruzzaman, F.M. 1981. Plant protection in Bangladesh. National Book house Centre, 67/A, Purana Paltan,Dhaka, pp: 270-276.

Page, A.B.P. and O.F. Lubatti, 1963. Fumigation of insects. Annual Review of Entomology, 8: 239-264.

Rahman, A. Talukder, F.A. 2006: Bioefficacy of some plant derivatives that protect grain against the pulse beetle, *Callosobruchus maculatus*. 10pp. *Journal of Insect Science* 6:03, available online: insectscience.org/6.03

Singh, R.; Singh, B. and Verma, R.A. 2001. Efficacy of some plant products for the control of *Callosobruchus chinensis* (L.). *Indian Journal of Entomology,* 63 (2): Entomology, 8: 239-264.