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

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Abstract

Experiments were 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.). The experiments were set up following Completely Randomized Design (CRD). The results showed that extracts of all the plant parts had very close efficacy in relation to direct toxicity effect and grain protection values. Pithraj leaf extract showed the highest mortality (96.66%) action and raintree leaf extract showed the lowest (80.33%) with 10% extract at 5 DAT. The effectiveness of all the plant extracts were found to increase with the increase of doses and decreased proportionatelly with the increase of time

Key words: Mortality, Plant extracts, Pulse beetle

Introduction

Preservation of reserve food grain stock is necessary to ensure a continuous supply at stable price. About 10,000 years ago, agricultural practices began and that of storing food grain started about 4,500 years ago as a safeguard against poor harvests and famines. Losses due to insect infestations are serious problems in grain storage, particularly in villages and towns of Bangladesh. The losses during growing of crops and postharvest handling, processing, storage and distribution system vary between 20 and 60% in some of the countries of the world. It has been estimated that about 15-20% of the world agricultural production is lost every year. Out of this 8% production is lost every year due to insect infestation alone. In Bangladesh, the annual grain losses cost over taka 120 crores (BBS, 2007). Pulse is one of the best sources of plant protein and plays an important role in the diet of common people of Bangladesh. The cultivated area under pulse crops in Bangladesh coverage 3113603.24 ha (769000 acres) with annual production of 259000 tons (BBS, 2007). Most of the 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. Pulses are more difficult to store than cereals, because pulse grain suffer comparatively more damage during the storage due to insect pest and microorganisms. In Bangladesh, 50 species of insect are considered injurious to food grains and their products. Several species of pulse beetle are reported to attack pulses in storage. These are *Callosobruchus chinensis* (L.), *Callosohruchus maculates* (F.) and *Callosobruchus analis*. Among these, the pulse beetles *Callosobruchus* spp. is the major pests in stored pulse (Bhalla *et al*., 2008). *C. chincnsis* L. is one of the most destructive pests of almost all kind of pulses in storage and to some extent in the field. Pulse beetle, *Callosobruchus chinensis* is a major economically important pest of all pulses and causes 40-50% in losses of pulses storage. The pulse beetle may cause 10-95% loss in seed weight and 45.5-66.3% loss in protein content of the seeds under normal condition and the, severity of damage increases with the duration of storage (Fokunang *et al.*, 2007; Kiruba1 *et al.*, 2008). 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 investigate the direct toxicity of plants extracts against the 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), Mymensingh. 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 werestored 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).

Direct toxicity test

The direct toxicity test was done by exposing pulse beetles in each Petri-dish having mung-bean seeds treated with each plant extracts (2.5, 5, 7.5 & 10%). Residual toxicity effect was evaluated by observing mortality of insects released in the treated mung bean seed at 3 intervals i.e. 5, 7 and 9 days after treatment. Five pair of newly emerged pulse beetles were taken in each petridish for each concentration and covered. Control treatments were performed side by side. The insect mortalities were converted into percentage by the following formula:

$$\text{Mortality} = \frac{\text{Total number of mortality of pulse bettles in each Petri-dish}}{\text{Total number of pulse bettles released in each Petri-dish}} \times 100$$

Results and Discussion

The seeds of mahogani, leaves of raintree, riot lata (mikania) and pithraj leaf extracts were used as protectants for mung-bean stored grains were evaluated by residual toxicity by feeding the treated mung-bean grain at different days after treatment (DAT) and the results were shown in Table.1.When the adults were released at different concentrations of all the plant extracts, the highest mortality (96.66 %) was observed in 10% concentration of pithraj leaf at 5 DAT and the lowest mortality (30%) was observed in 2.5% concentration of raintree leaf extract at 9 DAT (Table 1). The toxicity of different plant extracts were influenced by different concentrations at different DAT. It was observed that the mortality percentage increased gradually following the increase of doses. In all cases the mortality percentage of insects increased with the increase of concentration of the extracts and decreased with increase of time.

Table1. Mean mortality percentage of pulse beetle by different plant extracts at different concentrations at different DAT

Plant extract	Dose (%)	Mortality (%)		
		5 DAT	7 DAT	9 DAT
Riot lata (Mikania) leaf	10.0	93.33 ab	76.66 be	66.66 ab
	7.5	86.66 cd	73.33 cd	63.33 be
	5.0	76.66 ef	63.33 ef	50.00 de
	2.5	73.33 fg	60.00 ef	43.33 fg
	Control	0.00	0.00	0.00
Mahogani seed	10.0	86.66 cd	73.33 cd	63.33 be
	7.5	80.00 de	66.66 de	56.33 cd
	5.0	70.00 fg	56.66 gh	46.66 ef
	2.5	60.00 hi	50.00 hi	56.66 gh
	Control	0.00	0.00	0.00
Pithraj leaf	10.0	96.66 a	83.33 a	70.00 a
	7.5	90.00 be	76.66 be	63.33 be
	5.0	83.33 de	63.33 ef	53.33 de
	2.5	76.66 ef	60.00 ef	43.33 fg
	Control	0.00	0.00	0.00
Rain tree leaf	10.0	S0.33 de	70.00 cd	56.33 cd
	7.5	73.33 fg	54.44 hi	46.66 ef
	5.0	63.33 hi	50.00 hi	56.66 gh
	2.5	53.33 jk	43.33 jk	30.00 hi
	Control	0.00	0.00	0.00
$S\bar{x}$		2.02	1.S0	1.60
Probability level		0.05	0.05	0.01

DAT= Day's After Treatment

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

From Table 1. it was observed that in all cases the mortality percentage of insects increased with the increase of concentration of the extract and decreased with increase of time Table 1. The order of direct toxicity of the four plant extracts on pulse beetle were Pithraj leaf > Riot lata (Mikania) > Mahogani seed > Raintree leaf. Ahad *et al.,* (2012) conducted an experiment on pulse beetle and showed that ethanol solvent extracts of 13 local plants were tested for screening of their insecticidal activity against pulse beetle, *Callosobruchus chinensis* L. 100% mortality achieved in *Annona reticulata* (at 2 and 3%) in 72 hours; *Ziziphus jujube* (at 3%), *Tgetes erecta* (at 2 and 3%) in 96 hours. Riot lata (Mikania) leaf was tested here for the first time as an insecticide for the toxicity effect.

The results showed that riot lata (Mikania) leaf ranked second in terms of toxic efficacy order against pulse beetle, just behind pithraj leaf extract. Singh (2011) tested mahogani wood ash (MWA) and found more effective in causing adult *C. chinensis* mortality, but CLP was significantly ($P< 0.05$) more effective in reducing adult emergence, percentage hatching inhibition rate and percent hold cow pea seed. In the present experiment, mahogani seed was used as botanical pesticide and the effect was significant but not in the highest order.

Conclusions

The output of this research indicated that in all cases the mortality percentage of insects increased with the increase of concentration of the extract and decreased with increase of time.The mortality percentage increased gradually following the increase of doses. 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.

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