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EFFICACY OF SOME BOTANICAL EXTRACTS ON AMARANTH LEAF BORER AND PHYTOCHEMICAL INVESTIGATION OF THE POTENT EXTRACT

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ABSTRACT

This research was conducted in experimental field at University of Rajshahi during March 15, 2019 to June 14, 2019 to investigate the efficacy of aquous extracts of tweleve botanicals for insect pest management in amaranth (*Amaranthus viridis L.*) field and phytochemicals of the potent extracts. Green Callaloo amaranth (locally called Kathua danta) was used as a test crop for the experiment. During this study, a less number of insect pest attack on amaranth leaves was observed in Jackfruit (*Artocarpus heterophyllus*) leaves extract treatment, whereas a higher number of insect pests were found in the Eucalyptus (*Eucalyptus obliqua)* leaves extract treatment. Jackfruit (*Artocarpus heterophyllus*) treatment promoted about 1.37 times better performance than that of control treatment. The extract of Jackfruit leaves showed the best performance against amaranth leaves perforation caused by insect pests, whereas a high number of amaranth leaves perforation by pests were found in the control treatment. Jackfruit leaves treatment showed the best performance on plant height of amaranth and the lowest height of amaranth plant was found in Turmeric (*Curcuma longa)* leaves. Jackfruit leaves treatment induced about 1.42 times better plant growth than that of control treatment. The treatment of jackfruit (*Artocarpus heterophyllus*) also produced the highest yield of Amaranth, whereas the lowest amaranth yield was found in turmeric (*Curcuma longa)* leaves. The yield of amaranth in jackfruit treatment was 138.79% higher over the control treatment. Therefore, Jackfruit (*Artocarpus heterophyllus*) leaves extract can be used as bio-pesticide for the control treatment of insect pests in amaranth field.The presence of phyto-chemicals like alkaloids, tannin, anthraquinone, saponin and terpenoids in jackfruit leaves might be responsible for the pest control in amaranth field .

Keywords: Amaranth, pest, botanicals, efficacy, jackfruit leaves

Introduction

Amaranthus are important leafy vegetable crops cultivated in Bangladesh and other parts of the world. Unfortunately,insect pests are major setback for commercial production of this crop . Amaranth leaves are an excellent source of carotene, iron, calcium, protein, vitamin C and trace elements (Sarker *et al*. 2020). Amaranth leaves are nutritionally similar to beets, Swiss chard and spinach, but are much superior than spinach leaves and amaranth leaves contain three times more calcium and three times more niacin (vitamin B_3) (http://www.daydreamfarms.com/farm-newsblogs/amaranth-bitekuteku).

Several insects however can inflict substantial damage to amaranth crop. Amaranth can succumb to caterpillars, webworms, blister beetles, lygus bugs and leaf borers. The management of these insect pests has been practiced through the use of insecticides.Schmutterer (2002) reported that the World Health Organization (WHO) reported the poisoning of at least 3 million agricultural workers from which 20,000 deaths are recorded annually due to pesticide usage. Awasthi (2001) also noted that consumers of vegetables may be at risk from pesticide residues. Thus, research has been geared towards identifying non-chemical methods of pest control, which are safe, cheap, easy to apply and accessible to farmers (Jilani and Su 1983). In this regard botanicals from neem have shown considerable potential (Okunlola *et al*. 2008).

It is widely recognized that chemical pesticides are very harmful to our environment as well as for living beings. But bio-pesticides are plant extracts, which are less hazardous to environment. On the other hand, one kind of botanical may be effective against only one kind of insect or pest, combination of two or more botanicals may help to control all kinds of insect in crop field. Chemical

pesticides are costly in the market but bio-pesticides from plant extract is cheaper and even farmers may be able to make it at their home (Azad *et al.* 2012).

Botanicals are traditional and non-synthetic protectants derived from plants. Traditionally, different types of plant parts are used for the protection of agricultural produce; these plants are available in many developing countries and contain several active ingredients and act in different ways under different circumstances (Isman 2006). Botanicals break down rapidly to harmless metabolites and appear less likely to build up genetic resistance to targeted species. They are also less harmful to mammals and other beneficial organisms (Rahman 2009).

Therefore, the present study was conducted to assess the efficacy of some botanicals for the management of borer insect pest of amaranth and to identify the effect of botanical extracts on plant growth and yield of Amaranth.

Materials and Methods

This experiment was conducted in Kharif-I season during March 15, 2019 to June 14, 2019 at Botanical Pesticides Research Field of the Institute of Environmental Science of University of Rajshahi.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications and 12 botanicals as treatments. The plot size was 14 m x 5 m, line spacing and replication to replication distances were 1.0 m. Twenty five days old amaranthus seedlings variety Green Callaloo Amaranth was collected from Katakhali, Rajshahi and transplanted to field on 15th March, 2019 and the crop was harvested on 14th June, 2019. Standard agronomic practices like ploughing, weeeding, fertilization and irrigation were followed during this experiment at appropriate time.

Botanical extract preparation and spray: Twelve botanicals such as Neem (*Azadirachta indica*) leaves, Custard apple (*Annona squamosa*) leaves,Turmeric (*Curcuma longa*) leaves, Lemon (*Citrus limon*) peel, Garden croton (*Codiaeum variegatum*) leaves, Pandan (*Pandanus amaryllifolius*) leaves, Lemon grass (*Cymbopogon citratus*) leaves, Amla (*Phyllanthus emblica*) leaves, Horitoki (*Terminalia chebula*) leaves, Eucalyptus (*Eucalyptus obliqua*) leaves, Jackfruit (*Eucalyptus obliqua*) leaves and Watergourd (*Lagenaria siceraria*) leaves were collected from Rajshahi University Campus and local markets. Leaves of plants were dried at room temperature for 21 days before grinding. About 100 gm of grinding leaves and peel of fruits were soaked in one liter of water. These samples were kept in water for 03 days. Then solutions were filtered with plastic water-filter. The filtrated water extract were kept in plastic bottles. Botanical extracts were sprayed on experiemntal amaranth field twice a week with the help of sprayer.

Plant growth and pest monitoring: Total leaves, plant height and yield were measured to monitor the amaranth plant growth. Pest attack in leaves and number of leaves perforation of amaranth plant were also recorded during this experiment. The pest infestation were observed regularly in experimental field.

Phyto-chemical screening: Out of twelve botanicals, phyto-chemical analysis of the extract of potent botanical like jackfruit leaves was done following the standard proceudres described by Harborne (1973), Sofowara (1993) and Edeoga *et al.* (2005).

Alkaloids: About 1.2 ml of plant extract was taken in a test tube. Then 0.2 ml of dilute HCl and 0.1 ml of Mayer›s reagent were added. Formation of yellowlish puff coloured precipitate indicates the presence of alkaloid.

Tanin: About 0.5 g of dried powder of leaves/fruits was dissolved in 20 ml of water in test tube. Then it was boiled and filtered. In filtrate, a few drops of 0.1% ferric chloride was added. A brownish-green or a blue-black coloration indicates presence of tanin.

Saponin: About 2 g of powder sample was boiled in 20 ml distilled water in a water bath and filtered. In 10 ml filtrate, 5 ml of distilled water was added and shaken vigorously for a stable persistent froth. The frothing was mixed with 3-drops of olive oil and shaken vigorously. A formation of emulsion indicates the presence of saponin.

Flavonoids: About 5 ml aquous extract was taken in a test tube and a few drops of 1% aluminium solution was added. A yellow coloration was observed indicating the presence of flavonoids.

Steroids: About 0.5 g ethanolic extract was taken in a test tube and then 2 ml acetic anhydride and 2 ml H_2SO_4 were added. The violet color was changed to blue or green indicating the presence of steroids.

Terpenoids: Two ml of chloroform was added in 5 ml of aqueous extract in a test tube and mixed in a vortex mixer.

Then 3 ml of concentrated was H_2SO_4 added very slowly and carefully to form a layer. A reddish brown coloration of the inter-face was formed, which indicates the positive results for the presence of terpenoids.

Anthraquinones: About 5 ml of chloroform was added to 2 ml of extract in a test tube. The mixture was shaken for 5 minutes and then 7 ml of 10% ammonia solution was added and shaken again vigorously. The presence of a bright pink color in the aqueous layer indicated the presence of alkaloid.

Data analysis:. The recorded data were first put in the EXCEL programme and the mean values were adjusted by one way ANOVA. The significant differences among the treatments were tested by Duncan's Multiple Range Test (Duncan, 1951) ($P < 0.05$) using standard software.

Results and Discussion

It is seen from the Table 1 that the effect of botanicals on total leaves and plant height of amaranth plant was very clear. There was significant effect of botanicals against leaves attack and leaves perforation of Amaranth (Table 1). The Jackfruit leaves treatment showed best performance against infected Amaranth leaves (24.2± 1.3c) caused by pests. The extract of turmeric leaves treatments showed good protection against infected leaves of Amaranth. Whereas a high number of Amaranth leaves (54.5±3.8a) attacked by insect were found in Garden Croton leaves treatment.

The Jackfruit leaves treatment had about 1.37 times better performance than that of control treatment. The study also showed significant effect of other botanicals against infested leaves of Amaranth. The benefits botanicals remarked as less toxic to mammals, may be more selective in action and may retard the development of resistance (Elhag 2000). The insecticidal property of botanical extract has long been known and well documents against various insect pests (Pedigo 2002). Saikia *et al*. (2000) reported that leaf (10-50%) and seed kernel (5%) extracts of neem caused effect of Amaranth insects pests.

The jackfruit leaves treatment showed best performance against Amaranth leaves perforation (39.0±9.5e) caused by insect pests. The extract of Turmeric leaves treatment showed moderate Amaranth leaves perforation (64.3±10.6ce). Whereas a high number of Amaranth leaves perforation (152.3±58.2a) caused by insect were found in Ata leaves treatment. The Jackfruit leaves treatment kept about 2.99 times better performance against perforation of leaves than that of control treatment (Table 1). The study also observed significant effect of other botanical treatments against leaves perforation of Amaranth plant compare to the control treatment.

Four kinds of leaf borer insect pests were observed in the experimental plots of amaranth which were leaf webber *(Psara basalis*), leaf borer (*Eretmocera impactella*), amaranthus caterpillar (*Hymenia recurvalis*) and grasshopper (*Atractomorpha crenulata*). However, a

Table 1. Efficacy of botanical extracts against leaves attack, leaves perforations and leaf borer species

Treatments	Leaves attack	Leaves perforations	Observed leaf borer species
Control (Water only)	33.1±2.4bc	116.6±15.2ad	*Psara basalis*, *Eretmocera impactella*, *Hymenia recurvalis*
Neem leaves	34.0±4.1bc	131.8±4.8ab	*Psara basalis*, *Eretmocera impactella*
Ata leaves	41.3±8.9ab	152.3±58.2a	*Psara basalis*, *Eretmocera impactella*, *Hymenia recurvalis*
Turmeric leaves	32.8±2.7bc	64.3±10.6ce	*Psara basalis*, *Eretmocera impactella*, *Hymenia recurvalis*
Lemon peel	38.5±4.9ac	128.3±8.6ac	*Psara basalis* and *Eretmocera impactella*
Garden Croton leaves	54.5±3.8a	132.3±5.9ab	*Psara basalis*, *Eretmocera impactella*, *Hymenia recurvalis*
Polau leaves	29.0±6.1bc	103.5±6.8ae	*Psara basalis*, *Eretmocera impactella*, *Hymenia recurvalis*
Lemon grass	32.3±2.7bc	77.5±3.9be	*Psara basalis*, *Eretmocera impactella*
Amloki Leaves	33.0±4.9bc	75.5±6.1be	*Psara basalis*, *Eretmocera impactella*
Horitoki leaves	31.5±3.7bc	87.0±4.7be	*Psara basalis*, *Eretmocera impactella*
Eucalyptus leaves	42.5±2.9c	83.3±6.0de	*Psara basalis*, *Eretmocera impactella*
Jackfruit leaves	24.3±1.3c	39.0±9.5e	*Eretmocera impactella*
Watergourd	36.3±2.3bc	84.5±8.2be	*Psara basalis*, *Eretmocera impactella*, *Atractomorpha crenulata*

Column having the same or common letter does not differ significantly

less number of insect pest, only leaf borer *(Eretmocera impactella)* was found in the treatment of jackfruit leaves treatment (Table 1).

The different botanical extracts had notable effects on the reduction of insect numbers in Amaranthus (Bahar *et al.* 2007). Botanical products can also be easily and cheaply collected in rural Bangladesh, have been found promising and useful for pest control (Roy *et al*. 2005). Serious problems of genetic resistance by insect species, residual toxicity, photo toxicity, vertebrate toxicity, widespread environmental hazards and increasing costs of application of the presently used synthetic pesticides have diverted the need for effective, biodegradable pesticides (Zettler and Cuperus 1990, Talukder and Howse 2000). This awareness has created worldwide interest in the development of alternative strategies such as use of plant-derived materials, which are more readily biodegradable. This demand of interest encouraged to conduct the present botanicals controls of different insect pests to minimize the losses of Amaranth.

Table 2 shows the effect of botanicals on plant growth (total leaves and plant height) of amaranth plant. The Jackfruit leaves treatment showed best performance on total leaves (925.5±20.9a) of Amaranth.The extract of Amloki leaves treatment showed moderate total leaves (845.2±35.8a) of Amaranth.Whereas the lowest number of Amaranth leaves (290.0±22.3d) were found in Polau leaves treatment.The Jackfruit leaves treatment kept about 2.49 times better performance in respect to total leaves than that of control treatment (Table 2).

The jackfruit leaves treatment also showed best performance on plant height (82.7±4.5a) of Amaranth. The extract of Neem leaves treatment showed moderate effect on Amaranth plant height (75.0± 2.1ab). Whereas the lowest height (58.2±2.7c) of Amaranth plant was found in Turmeric leaves treatment. The Jackfruit leaves treatment kept about 1.42 times better performance than that of control treatment. The study also showed significant effect of other studied treatments on plant height of Amaranth, respectively. AVRDC-The World Vegetable Centre, Taiwan (2003) reported that the vigorous growth in Amaranth which was experienced during the growing period as evidenced in the height and number of leaves produced per plant nutrients from mineral fertilizers and biopesticides enhanced the establishment of crops.

Table 2. Effects of botanical extracts on total leaves and plant height of amaranth

Treatments	Total leaves	Plant height (cm)
Control (Water only)	371.5±22.1cd	67.0±4.5bc
Neem leaves	575.5±34.1b	75.0±2.1ab
Ata leaves	290.5±34.9d	69.0±3.5ac
Turmeric leaves	382.0±27.4cd	58.2±2.6c
Lemon peel	436.2±29.8bcd	67.0±1.8bc
Garden Croton leaves	476.7±106.8bc	71.0±3.1ac
Polau leaves	290.0±22.3d	70.0±3.6ac
Lemon grass	427.0±81.2bcd	73.2±1.7ab
Amloki Leaves	845.2±35.8a	71.2±3.6ac
Horitoki leaves	467.7±36.9bc	63.2±4.8bc
Eucalyptus leaves	441.0±35.3bcd	71.5±4.5ac
Jackfruit leaves	925.5±20.9a	82.7±4.5a
Watergourd	505.2±22.4bc	63.5±5.2bc

Column having the same or common letter does not differ significantly

Amaranthus yield was measured on the day of harvest from experimental field and the average yield (g) is shown in Table 3. The Jackfruit leaves treatment showed best performance on Amaranth production (965.0±96.6a).

The jackfruit leaves treatment kept about 138.8% better performance over control treatment (Table 3). A good yield over control was found in neem leaves (42.4%), ata leaves (37.6%), amloki leaves (35.2%), eucalyptus leaves (39.5%) and watergourd leaves (28.4%). Whereas the lowest yield (292.7±17.1e) was found in Turmeric leaves treatment. The yield loss was 27.5% over control treatment. From the study it was also observed that other botanicals had significant effect on Amaranth production.

Jackfruit leaves were found to be rich in phyto-chemicals. Six out seven tested phyto-chemicals were found to present in jackfruit leaves (Table 4). This huge presence of phyto-chemicals (alkaloids, tannin, anthraquinone, saponin and terpenoids) in jackfruit leaves was responsible for the pest control in Amaranth field.

Amadi *et al.* (2018) found a high amount of alkaloid and flavonoid, and less amount of tannin in jackfruit leaves collected from Nigeria, which are same to the present findings of phyto-chemical analysis of this study.

Table 3. Effect of botanical extracts on Amaranth yield

Treatments	Yield (g)/treatment	Yield over control (%)
Control (Water only)	404.1±17.5ce	
Neem leaves	575.5±31.7b	+ 42.4
Ata leaves	556.2±33.4bc	+ 37.6
Turmeric leaves	292.7±17.0e	- 27.5
Lemon peel	478.7±30.1bd	+ 18.4
Garden Croton leaves	377.5±28.1de	- 6.5
Polau leaves	372.0±22.6de	- 7.9
Lemon grass	482.7±39.6bd	+ 19.4
Amloki leaves	546.2±48.7bc	+ 35.1
Horitoki leaves	390.5±34.3de	- 3.3
Eucalyptus leaves	563.7±16.5b	+ 39.5
Jackfruit leaves	965.0±96.6a	+ 138.8
Watergourd	519.2±27.1bd	+ 28.4

Increase (+) yield over control; Decrease (-) yield over control

Table 4. Phyto-chemical composition of jackfruit leaves extract

Phyto-chemicals	Chemical Reaction	Present(+)/Absent (-)
Alkaloids	Yellowish puff color	++
Tannin	Blue-black color	+
Saponin	Yellow emulsion formation	+
Flavonoids	Deep yellow color	++
Steroids	No reaction	-
Terpenoids	Reddish brown color	++
Anthraquionones	Pink color with aqueous layer	+

High concentration (++) and low concentration (+)

Conclusion

Jackfruit (*Artocarpus heterophyllus*) treatment showed better performance for pest control in amaranth field than other botanicals. Jackfruit leaves treatment also produced the highest production of amaranth. From phyto-chemical analysis, jackfruit leaves were found rich in alkaloids, flavonoids and terpenoids. Therefore, jackfruit leaves extract can be used as eco-friendly bio-pesticides instead of toxic pesticides in amaranth field to protect the human health and environment.

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