



## Efficacy of Some Botanical Extracts on Plant Growth, Yield and Pest Management in Eggplant Field

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### Abstract

An experiment was conducted to evaluate the efficacy of nine botanical extracts on plant growth, yield and pest management in eggplant field. Aqueous extracts of dried leaves of *Nicotiana tabacum*, *Aegle marmelos*, *Ficus hispida*, *Lawsonia inermis*, *Vitex negundo* and seeds of *Carum roxburghianum*, *Corchorus capsularis* and *Swietenia macrophylla* and bulb of *Allium sativum* were prepared and sprayed in experimental eggplant field at University of Rajshahi during January 1, 2014 to May 5, 2014. Out of these nine botanicals, *Nicotiana tabacum* extract showed best performance against pest attack in eggplant field. The leaf extract of *Ficus hispida* also showed good efficacy in the protection of eggplant from pest attack. The highest plant length and fruit yield were recorded in the treatment of *Nicotiana tabacum*, whereas second and third highest productions were observed in *Aegle marmelos* and *Ficus hispida* treatments, respectively. Both *Allium sativum* and *Carum roxburghianum* extracts were found to show phyto-toxicity to eggplant and hampered the plant growth and yield.

**Key words:** Botanical extracts, Efficacy, Eggplant, Growth and Yield

### Introduction

Eggplant (*Solanum melongena* L.) belongs to the family of Solanaceae, is one of the most popular and nutritious vegetables worldwide. Adaptability to wide range of soil and climate is the main reason for its worldwide extensive cultivation. China is the first in cultivating and consuming eggplant. It is a cheap source of carbohydrate and vitamins. In a sub-tropical country like Bangladesh, eggplant is grown all over the country on medium high land to high land in both Rabi and Kharif seasons. Its position is 2<sup>nd</sup> next to potato as per cultivation area, production, yield and consumption. Eggplant is attacked by a number of pests, nematodes and disease causing fungi at various stages. Among them, eggplant shoot and fruit borers, stem borer, leaf sucker, leaf hoppers and epilachna beetles cause serious damage to the crop (BARI, 1995). One of the major factors of low yield of eggplant is pest attack. The eggplant leaf sucker has been found to be a serious pest of brinjal in Bangladesh. Both the nymphs and adults of hopper cause serious damage to leaves by sucking the cell sap. The small nymphs suck sap from the lower surface of the leaves. The entire plant turns brown and show burn symptom and ultimately the leaves droop off.

The use of conventional insecticides has raised some concern about their threat to the environment (Huang *et al.*, 1998). Therefore, there is an imperative need for the development of safer, alternative crop protectants such as botanical insecticides. Current pest control technology is based largely on imported synthetic insecticides, which are frequently priced beyond the small farmers, who constitute a very large proportion of the farming population in Bangladesh.

Moreover, many insects been reported to be resistance to chemical insecticides (Halliday *et al.*, 1988). This problem has increased the need for effective and biodegradable pesticides with greater selectivity. Bangladesh and many other Asian countries are rich in plant products and traditionally used by the rural inhabitants for medicinal purpose and in some instance as preparations for insect control (Talukdar and Howse,

1993). Botanical insecticides tend to have broad spectrum activity, are relatively specific in their mode of action, and easy to process and use in farm-levels. They are also safe for higher animals and the environment (Anonymous, 1991). Botanical insecticides can often be easily produced by farmers and small-scale industries with indigenous plant materials. These are cheaper and hazard free in comparison to chemical insecticides (Saxena *et al.*, 1980). Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect control (Sadek, 2003). Crude plant extracts often consist of complex mixtures of active compounds, they many show greater overall bioactivity compared to the individual constituents (Berenbaum *et al.*, 1991; Chen *et al.*, 1995). The deleterious effects of crude plant extracts on insects were manifested in several ways, including toxicity (Hiremath *et al.*, 1997) and feeding inhibition (Klepzig and Schlyter, 1999; Wheeler and Isman, 2001). Certain plant families, particularly Meliaceae, Rutaceae, Asteraceae, Labiateae, Piperaceae and Annonaceae were viewed as exceptionally promising sources of plant-based insecticides (Jacobson, 1989; Schmutter, 1990; Isman, 1995).

Bangladesh is rich in plant biodiversity. Therefore, research on botanical pesticides has a good scope of study to find out the suitable combinations and formulations of different indigenous botanicals to produce an eco-friendly plant based pesticide for sustainable pest management. This study was carried out to find out the efficacy of nine botanicals on plant growth, yield and eco-friendly pest management in eggplant field without hampering the nature.

### Materials and Methods

#### Field Preparation and Experimental Period

The experiment was conducted at IES Research Field of University of Rajshahi during January 01, 2014 to May 05, 2014. The land of the experimental plot was ploughed with power tiller and was pulverized by 4 times ploughing followed by laddering. The weeds and stubbles were removed from the field. The soil was

properly leveled for planting. After opening the land, well decomposed cowdung was applied and thoroughly mixed up with soil. Before final land preparation, inorganic fertilizers were applied as per Fertilizer Recommendation Guideline of BARC. Several holes were made every 50 cm interval and line to line 1 meter. About 30-35 days old eggplant seedling (local variety Kanta Begun) were purchased from local Katakali bazar, Rajshahi and planted in each hole. Watering and other intercultural operations were done as and when necessary.

**Preparation of Botanical Extracts**

Plant materials of *Ficus hispida*, *Aegle marmelos*, *Nicotiana tabacum*, *Lawsonia inermis*, *Vitex negundo*, *Allium sativum*, *Carum roxburghianum*, *Corchorus capsularis* and *Swietenia macrophylla* were collected from Rajshahi area (Table 1).

three replications. Nine botanical treatments and one control (tap water) were used in this experiment.

All data were analyzed by ANOVA and means are separated using Duncun’s Multiple Range Tests (p=0.05).

**Results and Discussion**

In this study, efficacy of nine botanical extracts was tested in experimental eggplant field. Out of nine botanicals, *Nicotiana tabacum* leaves extract showed excellent performance against the pest attack of eggplant leaves (3.63±0.96) compare to control (8.80±0.50). *Ficus hispida* leaf extract was also found to show good performance against the leaves attack

**Table 1.** Plant parts used for botanical extract preparation

Names of plants	Scientific name	Plant parts used
Mehidi	<i>Lawsonia inermis</i>	Leaves
Nishinda	<i>Vitex negundo</i>	Leaves
Tobacco	<i>Nicotiana tabacum</i>	Leaves
Garlic	<i>Allium sativum</i>	Bulb
Soj	<i>Carum roxburghianum</i>	Seeds
Bell	<i>Aegle marmelos</i>	Leaves
Khoksha	<i>Ficus hispida</i>	Leaves
Jute	<i>Corchorus capsularis</i>	Seeds
Mahogani	<i>Swietenia macrophylla</i>	Seeds

Before grinding or cutting, plant parts were dried in lab for 20-25 days. About 100 gm of leaf dusts or grinding seeds were dissolved in one litre of tap water in a plastic bucket and kept for three days and filtered through white markin cloth and preserved in refrigerator until use.

**Spray of Botanical Extracts and Pest Attack Monitoring**

The botanical extract was sprayed on eggplant experimental plot twice a week with the help of a sprayer. The pest attack and damages were monitored every 3- days in a week. The numbers of infested leaves were also recorded.

**Experimental Plot Design**

The experimental plot was arranged as per CRD with

(6.80±0.34). Whereas the efficacy of *Vitex negundo*, *Carum roxburghianum*, *Corchorus capsularis* and *Swietenia macrophylla* extract was more or less same to control. Two botanicals like *Allium sativum* and *Lawsonia inermis* were found to enhance pest attack in eggplant (Table 2). The extract of *Aegle marmelos* showed moderate protection against the pest attack. All these results are highly significant (p<0.05). Cork *et al.* (2005)<sup>a</sup> reported the efficacy of botanicals on the eggplant shoot and fruit borer. They found that extracts from neem, cinnamon (*Cinnamomum cassia*), anise (*Illicium verum*) and fennel (*Foeniculum vulgare*) as well as cinnamon oil, horseradish oil and mustard oil acted rapidly against pest and caused over 80% mortality to eggplant shoot and fruit borer.

**Table 2.** Effect of plant extract against pest attack on eggplant leaves

Sl. No.	Treatments	Total number of leaves	Number of infected leaves
1	<i>Lawsonia inermis</i>	17.66± 3.28ab	9.03 ±.95ab
2	<i>Vitex negundo</i>	13.33 ±6.17b	8.40 ±.75abc
3	<i>Nicotiana tabacum</i>	40.33 ±14.26ab	3.63 ±.96d
4	<i>Allium sativum</i>	12.33± 2.60b	9.26± .46a
5	<i>Carum roxburghianum</i>	11.33± 3.33b	7.46 ±.78abc
6	<i>Aegle marmelos</i>	21.33± 9.20ab	6.96 ±.29bc
7	<i>Ficus hispida</i>	27.66 ±8.11ab	6.80 ±.34c
8	<i>Corchorus capsularis</i>	23.00± 10.69ab	8.56± .32abc
9	<i>Swietenia macrophylla</i>	25.33± 5.81ab	7.90 ±.20abc
10	Control (tap-water)	13.00± 6.11b	8.80 ±.50abc

Values in a column having same letter did not differ significantly (P=0.05) by DMRT

Plant extract was found to have profound effect on the physiology of eggplant. In the treatment of *Nicotiana tabacum*, maximum plant height (42.33±2.40 cm) was monitored compare to control (26.66±3.38 cm). The second tallest eggplant (31.00±4.04 cm) was found in the *Ficus hispida* treatment (Table 3). However, extracts of seeds of *Carum roxburghianum* and *Swietenia macrophylla* showed lower plant growth, 16.33±2.18 cm and 15.33±2.96 cm, respectively. Besides the *Nicotiana tabacum* and *Ficus hispida*, other

extracts were found to have phyto-toxic effect to eggplant and showed negative plant growth compare to control (Table 3). Out of nine plant botanicals, the extract of *Nicotiana tabacum* showed five times higher production (421.28±208.05g) over control (80.25±41.81g) in experimental eggplant field. The second highest yield (91.87± 58.30g) was recorded in *Ficus hispida* treatment. Other seven treatments showed lowest or negative level of yield compare to control (Table 3).

**Table 3.** Effect of plant extracts on plant height and production of eggplant

Treatments	Plant height (cm)	Eggplant fruit production (g)
<i>Lawsonia inermis</i>	25.00±2.08bcde	30.67± 5.81b
<i>Vitex negundo</i>	22.33± 1.45cdef	50.80± 11.72b
<i>Nicotiana tabacum</i>	42.33± 2.40a	421.28± 208.05a
<i>Allium sativum</i>	18.66 ±1.33def	.00± .00b
<i>Carum roxburghianum</i>	16.33 ±2.18f	.00 ±.00b
<i>Aegle marmelos</i>	26.00± 1.52bcd	91.87± 58.30b
<i>Ficus hispida</i>	31.00± 4.04b	68.05 ±41.90b
<i>Corchorus capsularis</i>	17.66 ±1.20ef	55.71± 42.57b
<i>Swietenia macrophylla</i>	15.33 ±2.96f	42.52 ±24.57b
Control (tap-water)	26.66± 3.38bc	80.25± 41.81b

Values in a column having same letter did not differ significantly (P=0.05) by DMRT

Leaves are important for the photo-synthetic process of plant. Plants are green as long it contains the leaves. In this experiment, leaves of some treatments were fallen first and some treatments kept the leaves for long time in eggplant (Table 4). In the treatment of *Nicotiana tabacum*, eggplant was found to alive with leaves for

more than four months (122.33±1.45 days) compare to control (51.00±2.08). Whereas leaves in other treatments were found to fallen first due to phyto-toxic effect of some botanicals (Table 4).

**Table 4.** Leaves retention period in eggplant

Treatments	Leaves retention period (days)
<i>Lawsonia inermis</i>	42.66±1.45f
<i>Vitex negundo</i>	42.33±1.45f
<i>Nicotiana tabacum</i>	122.33± 1.45a
<i>Allium sativum</i>	52.33± 1.45e
<i>Carum roxburghianum</i>	42.66 ± 1.45f
<i>Aegle marmelos</i>	52.33 ±1.45e
<i>Ficus hispida</i>	60.00 ±2.88d
<i>Corchorus capsularis</i>	87.66 ±1.45b
<i>Swietenia macrophylla</i>	70.00 ±2.88c
Control	51.00 ±2.08f

Values in a column having same letter did not differ significantly (P=0.05) by DMRT

During this study, it was observed that both nymphs and adults hopper cause serious damage to the leaves of eggplant by sucking the cell sap. Eventually the entire plant turned brown and caused for the leaves drop off earlier in most of the treatments. In the treatments of *Nicotiana tabacum* and *Corchorus capsularis* were found to keep eggplant green for longer periods with sufficient number of leaves (Table 4).

The main compounds of plant extracts are different kinds of terpenoids and phenolic compounds. Botanicals contain these compounds having anti-insect activity and consider as promising alternatives to chemical insecticides. These compounds may act as effective insecticides against vegetables pests (Cork et

al., 2005<sup>b</sup>; Muyinza et al., 2010), contact insecticides (Kim et al., 2004; Tapondjou et al.,2005), repellents and anti-feedants (Park et al.,2003).

**Conclusions**

Out of nine botanical extracts, *Nicotiana tabacum* leaves extract showed excellent performance against pest attack in leaves of eggplant. Garlic bulb (*Allium sativum*) extract showed a very poor efficacy to protect the eggplant leaves from pest attack. Mahagoni (*Swietenia macrophylla*) and soj (*Carum roxburghianum*) seeds extracts were showed phyto-toxicity and hampered the plant growth of eggplant. Tobacco (*Nicotiana tabacum*) enhanced the plant growth, yield and longevity of eggplant life. On the

other hand, *Allium sativum* and *Carum roxburghianum* were caused total inhibition of eggplant fruit production. Therefore, *Nicotiana tabacum* was identified as a potent botanical insecticide for eggplant cultivation in Bangladesh.

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