



## Screening of Some Botanicals for Eco-friendly Control of Cucurbit Fruit Fly (*Bactrocera cucurbitae*) Infestation in Experimental Cucumber Field

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### Abstract

Cucurbit fruit fly (*Bactrocera cucurbitae*) is the major pest of Cucumber (*Cucumis sativus* L.), which severely damage the cucumber production. This study was carried to evaluate the efficacy of fourteen botanicals such as Chili (*Capsicum frutescens*), Garlic (*Allium sativum*), Onion (*Allium cepa*), Ginger (*Zingiber officinale*), Carrot leaves (*Daucus carota* subsp. *Sativus*), Bitter gourd (*Momordic acharantia*), young Tomato (*Solanum lycopersicum*), Mahogany seed (*Swietenia macrophylla*), Eucalyptus leaves (*Eucalyptus globulus*), Black plum leaves (*Syzygium cumini*), Jackfruit leaves (*Artocarpus heterophyllus*), Neem leaves (*Azadirachta indica*), Black pepper (*Piper nigrum*) and Garden croton leaves (*Codiaeum variegatum*) to control the cucurbit fruit fly infestation in experimental cucumber (Green Rohini F1 Hybrid Cucumber) field during March 15, 2021– May 14, 2021. This study observed a less number of cucurbit fruit fly attack on cucumber fruits in Ginger treatment. In this treatment, only 7.06% fruits were infested by cucurbit fruit fly. The Ginger treatment reduced 14.17 times fruit fly infestation compare to control. However, a high number of cucurbit fruit fly infestations were found in Bitter gourd, young Tomato, Mahogany and Garden croton treatments. Cucurbit fruit fly infestation was low (12.50%) in Neem treatment. This treatment showed best performance on cucumber size (cm) and yield (gm). The lowest yield was found in Bitter gourd treatment. The Neem treatment kept about 3.54 times better performance in respect to cucumber yield than that of control treatment. Therefore, Neem leaves (*Azadirachta indica*) and Ginger (*Zingiber officinale*) extracts can be used as bio-pesticide for eco-friendly control of cucurbit fruit fly infestation in cucumber field.

**Keywords:** Botanicals, Cucumber, Cucumber fruit fly, Ginger, Screening

### Introduction

Cucumber (*Cucumis sativus* L.) is a creeping vine plant in the *Cucurbitaceae* family that bears usually cylindrical fruits and used as vegetables (Thoa, 1998). Cucumber is the main ingredient of salad. Besides being widely used for culinary purposes, cucumbers are also used in facial creams, lotions, and cleansers. This anti-inflammatory agent is known for its astringent and soothing properties (Azad *et al.*, 2013 and Schieberle *et al.*, 1990).

Cucurbit fruit fly (*Bactrocera cucurbitae*) is one of the serious pest that limits the production of cucumber. It is also known as melon fly and melon fruit fly. The extents of damage due to cucurbit fruit fly vary between 30 to 100% depending upon the season and susceptibility of the crops species and varieties (Dhillion *et al.*, 2005). Pradhan (1976) reported that the degree of infestation varied from 19.4-22.1% in cucumber. It prefers to infest young fruits (Maharjan *et al.*, 2015). When the humidity is high, intensity of cucurbit fruit fly damage becomes severe. Its abundance increases with increase in daily temperatures, however higher than 31°C is not ideal for its growth and reproduction (Dhillion *et al.*, 2005).

Chemical pesticides are generally used to control the cucurbit fruit fly. But chemical pesticides are very harmful to our environment as well as for living beings.

Alternatively 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. Botanicals are easily prepared and their use in controlling cucurbit fruit fly from local plants is sustainable (Azad *et al.*, 2012).

Therefore, the present study was conducted to screen some botanicals having insecticidal activity against cucurbit fruit fly and to identify the effect of botanical extracts on growth and yield of cucumber.

### Materials and Methods

#### *Experimental plot preparation for cucumber cultivation*

This experiment was carried out in Kharif-1 season during March 15, 2020 to May 14, 2021 at Botanical Pesticides Research Field of Institute of Environmental Science of University of Rajshahi. The soil of the experimental site is Gangetic alluvial and climate is sub-tropical.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with fourteen treatments. The plot size was 16 m x 4 m, line spacing and replication to replication distances were 1.0 m. The experimental land was first opened with a country plough. Ploughed soil is then brought into desirable final tilth condition by five operations of poughing followed by laddering. The grasses and weeds were removed from the field and the

land was leveled properly. To support the plant growth, cow-dung, Triple Super Phosphate (TSP), Murate of Potash (MP) and Urea fertilizers were applied. The whole amount of fertilizers was used as the basal dose during pit preparation. Then, the seeds were sown in the experimental plot (Table 1). The plot was irrigated with pump-water when necessary.

**Table 1.** Information about cucumber cultivation

Information	Variety and Cultivation Period
Name of Crop	Cucumber
Cucumber Variety	Green Rohini F1 Hybrid
Scientific Name	<i>Cucumis sativus</i> L.
Collection of seeds	Katakhali Nursery, Rajshahi
Date of seed sown	March 15, 2021
Fruits harvest completed	May 14, 2021
No of Spray	10 times
Spray Started	01-04-2021
Last Spray	07-05-2021

#### Preparation of aqueous botanical extracts for spray

Botanicals like green Chili (*Capsicum frutescens*), Garlic (*Allium sativum*), Onion (*Allium cepa*), Ginger (*Zingiber officinale*), Carrot leaves (*Daucuscarota subsp. Sativus*), Bitter gourd (*Momordica charantia*), young Tomato (*Solanum lycopersicum*), Mahogany seed (*Swietenia macrophylla*), Eucalyptus leaves (*Eucalyptus globulus*), Black plum leaves (*Syzygium cumini*), Jackfruit leaves (*Artocarpus heterophyllus*), Neem leaves (*Azadirachta indica*), Black pepper (*Piper nigrum*) and Garden croton leaves (*Codiaeum variegatum*) were collected from the campus of University of Rajshahi, Bangladesh. After collection, fruits, seeds and leaves were washed in running tap water. For the preparation of 10% extract, 100 gm of grinding or cutting fruits, seeds and leaves were dissolved in one liter of water and boiled for 30 minutes. Then the solutions were cool down and filtered with muslin cloth. The prepared aqueous extract was preserved in plastic bottles at room temperature.

#### Spraying method

Botanicals extracts were sprayed on experimental cucumber field twice a week with the help of sprayer. One control treatment of without botanical pesticide was maintained in this experiment where only water was sprayed.

#### Cucumber fruits infestation monitoring

The cucumber field was visited every day and cucumber fruit infestation by fruit fly was counted every 3 days in a week. The percent (%) of infested cucumber fruits was calculated as per following formula:

$$\text{Infested Fruits (\%)} = \frac{\text{Number of damaged cucumber fruits}}{\text{Total number of harvested fruits}} \times 100$$

#### Statistical analysis of data

The observed values were statistically analyzed by one way ANOVA and the significant levels were tested by Duncan's Multiple Range Test (Duncan, 1951) (P < 0.05) using standard software.

#### Results and Discussion

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).

This experiment was carried out to evaluate the effects of some plant extracts on fruit fly infestation. Aqueous extracts of botanicals may act as effective insecticides against cucurbit fruit fly (*Bactrocera cucurbitae*) which affect the cucumber cultivation throughout the world. Therefore, efficacy of fourteen plant extracts was evaluated in experimental cucumber field and the results are presented here with possible interpretations.

showed best performance on plant length (242.67±34.35a) of cucumber. The extract of Garlic treatment showed moderate effect on plant length (239.67±15.60a), whereas the lowest plant length (cm) was found in Eucalyptus leaves treatment (119.00±4.58c). The Jackfruit treatment kept about 1.13 times better performance than that of control treatment(Table2).

Table 2 shows the effect of botanicals on plant growth (length) of cucumber. The Jackfruit leaves treatment

**Table 2.** Effect of botanicals on cucumber plant growth

	Plant length (cm)
Control	214.00±13.28ab
Green Chili 10%	170.67±29.45abc
Garlic 10%	239.67±15.60a
Onion 10%	153.33±34.44abc
Ginger 10%	176.33±26.21abc
Carrot Leaves 10%	182.67±33.20abc
Bitter Gourd10%	129.67±24.97bc
Young Tomato 10%	167.67±1.45abc
Mahogany Seed 10%	167.67±16.68abc
Eucalyptus Leaves 10%	119.00±4.58c
Black Plum Leaves 10%	168.67±15.30abc
Jackfruit Leaves 10%	242.67±34.35a
Neem Leaves 10%	184.67±27.42abc
Black Pepper 10%	210.67±52.21abc
Garden Croton Leaves 10%	207.67±28.49abc

Table 3 shows the effect of botanicals on number of fruits per plant and fruit fly infestation. The highest number of fruits per plant (8.00±1.15a) was observed in Neem treatment. The extract of Garlic treatment showed moderate number of fruits per plant (7.67±2.19ab) and the lowest number of fruits per plant (1.00±0.00c) was

found in Bitter gourd and young Tomato treatments. The Neem leaves treatment kept about 3 times better performance than that of control treatment (Table 3). This study also observed significant effect of other botanicals on number of fruits per plant of Cucumber.

**Table 3.** Fruits per plant and fruits infested by cucurbit fruit fly

Treatments	Fruits per Plant (Nos.)	Fruits Infested by Cucurbit Fruit Fly (Nos.)	Fruit Fly Infested Fruits (%)
Control	2.67±0.33abc	1.33±0.33a	49.81
Green Chili 10%	4.33±3.33abc	1.33±0.88a	30.71
Garlic 10%	7.67±2.19ab	2.00±0.58a	26.07
Onion 10%	3.67±1.20abc	0.67±0.33a	18.25
Ginger 10%	4.67±0.33abc	0.33±0.33a	7.06
Carrot Leaves 10%	4.00±1.73abc	1.67±0.67a	41.75
Bitter Gourd10%	1.00±0.00c	1.00±0.00a	100.00
Young Tomato 10%	1.00±0.00c	1.00±0.00a	100.00
Mahogany Seed 10%	5.67±3.67abc	2.67±1.67a	47.08
Eucalyptus Leaves 10%	4.00±0.58abc	1.33±0.33a	33.25
Black Plum Leaves 10%	2.33±0.33bc	1.00±0.00a	42.91
Jackfruit Leaves 10%	7.33±1.20ab	1.67±0.33a	22.78
Neem Leaves 10%	8.00±1.15a	1.00±0.58a	12.50
Black Pepper 10%	3.67±1.20abc	1.67±1.20a	45.50
Garden Croton Leaves 10%	6.33±1.20abc	2.67±1.67a	42.18

The number of fruits infested by cucurbit fruit fly was regularly monitored during this study. Table 3 shows the effect of botanicals on numbers of fruits infested by cucurbit fruit fly. The highest number of fruits (2.67±1.67a) infested by cucurbit fruit fly was found in Mahogany seed and Garden croton treatments. The moderate infestation of cucurbit fruit fly (0.67±0.33a) was found in Onion treatment and the lowest number of infested fruits (0.33±0.33a) was found in Ginger treatment. In Ginger and Neem leaves treatments, 7.06% and 12.50% cucumber fruits were infested by cucurbit fruit fly, respectively. However, 100% fruits were infested in the Bitter gourd and Tomato treatments (Table 3). The Ginger treatment kept about 14.17 times better performance than that of control.

Agrawal and Dev (2013) observed that 5% aqueous neem seed kernel extract caused 66.3% pupae mortality of melon fruit fly (*Bactrocera cucurbitae* Coq.). According to Ranganath *et al.* (1997), neem oil (1.2%) was found most effective against the melon fruit fly infestation on cucumber and neem cake (4.0%) was found effective against pest attack on ridge gourd in south Andaman, India. These observations are similar with the present findings.

Table 4 shows the effect of botanicals on average fruit size of cucumber (cm). The Neem treatment showed the best performance on average fruit size (14.74±1.10a) of cucumber and the extract of Carrot leaves treatment showed moderate fruit size (13.43±0.16ab), whereas the lowest fruit size (119.00±4.58c) was found in Bitter gourd treatment. The Neem leaves treatment kept about 1.10 times better performance than that of control treatment (Table 4).

**Table 4.** Effect of botanicals on cucumber fruit size

Treatments	Fruit Size (cm)
Control	13.44±0.99ab
Green Chili 10%	12.66±1.30abcd
Garlic 10%	12.92±0.39abcd
Onion 10%	11.39±1.24bcde
Ginger 10%	11.27±0.79bcde
Carrot Leaves 10%	13.43±0.16ab
Bitter Gourd 10%	9.90±0.83e
Young Tomato 10%	11.50±0.58bcde
Mahogany Seed 10%	10.54±1.11cde
Eucalyptus Leaves 10%	12.63±0.50abcd
Black Plum Leaves 10%	10.34±0.39de
Jackfruit Leaves 10%	13.07±0.08abc
Neem Leaves 10%	14.74±1.10a
Black Pepper 10%	12.27±0.24abcde
Garden Croton Leaves 10%	13.09±0.75abc

Table 5 shows the effect of botanicals on total yield of cucumber (gm). The Neem leaves treatment showed the best performance on yield (895.67±119.15a) of cucumber. The extract of Onion treatment showed

moderate yield (260.00±83.52bc) and the lowest yield (56.33±7.06c) was found in Bitter gourd treatment. The Neem leaves treatment kept about 3.54 times better performance on cucumber yield than that of control treatment (Table 5).

**Table 5.** Total yield of cucumber

Treatments	Yield (gm)
Control	253.00±61.25bc
Green Chili 10%	497.00±428.10abc
Garlic 10%	760.67±213.12ab
Onion 10%	260.00±83.52bc
Ginger 10%	338.67±58.89abc
Carrot Leaves 10%	319.67±220.42abc
Bitter Gourd 10%	56.33±7.06c
Young Tomato 10%	79.67±2.60c
Mahogany Seed 10%	525.67±360.56abc
Eucalyptus Leaves 10%	295.67±47.76abc
Black Plum Leaves 10%	219.33±26.89bc
Jackfruit Leaves 10%	606.33±155.45abc
Neem Leaves 10%	895.67±119.15a
Black Pepper 10%	398.00±169.82abc
Garden Croton Leaves 10%	738.67±186.14ab

The result showed that plant extracts not created any bad effect on cucumber production except Bitter gourd and young Tomato treatments. These observations are similar with the findings of Azad *et al.* (2013) and Maharjan *et al.* (2015). The present study revealed that cucurbit fruit fly infestation was significantly reduced by some botanical extracts that can be incorporated into IPM practice to reduce the synthetic pesticide application in cucumber field.

### Conclusion

Out of fourteen botanicals, Ginger (*Zingiber officinale*) treatment showed best performance for the control of cucurbit fruit fly infestation in experimental cucumber field. A low fruit fly infestation (12.50%) was found in the Neem leaves (*Azadirachta indica*) treatment. This treatment also produced the highest production of cucumber. Therefore, Neem leaves and Ginger extracts can be used as bio-pesticides instead of toxic pesticides in cucumber field to manage the cucurbit fruit fly infestation in eco-friendly way.

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