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RELATIVE EFFICACY OF INDIGENOUS BOTANICALS AND SYNTHETIC INSECTICIDE AGAINST CUCURBIT FRUIT FLY (*Bactrocera cucurbitae)* ON BITTER GOURD

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Abstract

An experiment was conducted at farmer's field in Panchbibi, Joypurhat during September to December 2016 to evaluate the relative efficacy of homebased botanicals as compared to a synthetic insecticide used by the farmers in controlling cucurbit fruit fly, *Bactrocera cucurbitae* on bitter gourd. Effectiveness of one synthetic insecticides (Karate 2.5 EC) and four indigenous botanicals (Neem seed extract, Jute seed extract, Mahogani seed extract and Garlic extract) were evaluated to control cucurbit fruit fly on bitter gourd. Fruits got comparatively lower infestation where plants were treated with different plant extracts, while it was minimum in the plants treated with synthetic insecticide. Among the botanicals maximum fruits infestations (39.96-43.82%) were found in the case of garlic extract while minimum damages (19.20-27.47%) were found from jute seed extract that showed about similar effectiveness with the synthetic insecticide *viz*. Karate 2.5EC (16.24-31.04%). The highest fruit infestation was recorded from untreated control (56.93-58.42%).

***Keywords*:** Jute seed, mahogany seed, neem, garlic extract, Karate 2.5 EC.

Introduction

Cucurbits are infested by several insect pests which are the significant obstacles for economic production. Among them, cucurbit fruit fly, *Bactrocera cucurbitae* is the serious pest that is responsible for considerable damage of cucurbits (Alam, 1969; Butani and Jotwani, 1984). It can attack about 16 different types of cucurbit crops. Although the rate of attack varies among the crop, infestation can reduce both the yield and quality of the cucurbit fruits. Yield losses due to fruit fly infestation varies from 19.19 to 69.96% in different fruits and vegetables (Kabir *et al.,* 1991). The cucurbit fruit fly, *B. cucurbitae* is distributed widely in temperate, tropical, and sub-tropical regions of the world. It has been reported to damage 81 host plants and is a major pest of cucurbitaceous vegetables. The extent of losses varies between 30 and 100%, depending on the cucurbit species and season. Its abundance increases when the temperature falls below 32 °C and the relative humidity ranges between 60 and 70% (Dhillon *et al.,* 2005 and Sapkota *et al.,* 2010). In recent years, cultivation of bitter gourd has become costly and hazardous to farmers due to the increased use of synthetic insecticides combating insect pests and especially for cucurbit fruit fly, and it has been identified as a major pest of bitter gourd (Singh *et al.,* 2006). The production of bitter gourd is hindered due to several factors like disease and insect pests (Wasim *et al.,* 2010).

To control cucurbit fruit fly, most of the farmers of the country injudiciously apply different synthetic chemical insecticides. They use different types of insecticides belonging to Organophosphorus, Organo-carbamates, Synthetic Pyrethroids, etc. Several insecticides have been reported to be ineffective or less effective against cucurbit fruit fly. It's true that synthetic insecticides can kill the pupa directly and sometime the botanicals do not kill insects immediately; instead these repel and disrupt their growth and reproduction. A cluster method has been developed and suggested by Kapoor (1993) to control these pests. Among all these methods, the chemical control method is still popular to the Bangladeshi farmers because of its quick and visible results. The increasing use of synthetic insecticides has led to several problems such as development of resistance to insecticides in some insect pests, high insecticide residues in

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market produce, resurgence or increased infestation by some insect species due to the destruction of natural predators and parasitoids, changing pest status of mites and other minor insect pests, ecological imbalance and danger to health of the pesticide applicator.

When indiscriminate use of synthetic insecticides developing insecticides resistance, cause hazard to human and animal health, damage natural ecosystem, then the use of botanical insecticides may be an alternative and environment-friendly way to control the cucurbit fruit fly. In different laboratory and field tests, many botanicals have shown their effectiveness in controlling the different insect pests. Therefore, studies to find out the relative efficacy of indigenous botanicals and synthetic insecticide against cucurbit fruit fly of bitter gourd are also important.

Insecticides impart undesirable effects on the environment and human health. Several countries, including Bangladesh have introduced integrated pest management (IPM) approaches that are based on restoring the natural balance between pests and their predators in ecological systems. It is a comprehensive system approach as well as a decision-making process in which all interventions are focused on a pest problem and on the goal of providing the safest and most effective, economical, and sustained remedy. Considering the alarming consequences of insecticide usage and residual effect on the environment, pragmatic programme is now needed worldwide to minimize the dependency on insecticides without hampering crop production.

In view of above facts and scarcity of related information on *B. Cucurbitae* with special reference to bitter gourd, the present investigation was undertaken to find out the efficacy of different indigenous botanicals as compared to synthetic insecticide *viz.* Karate 2.5 EC used by the farmers in controlling cucurbit fruit fly, *Bactrocera cucurbitae.*

Materials and Methods

The experiment was conducted from September to December 2016 at farmer's field in Panchbibi upazila under Joypurhat district to know the relative efficacy of indigenous botanicals and synthetic insecticide against cucurbit fruit fly of bitter gourd.

Treatments and replications

There were six treatments viz. T1 = Control (untreated), T2 = Spraying of neem seed extract (@ 25 ml l^{-1} water), T3 = Spraying of jute seed extract (@ 25 ml l^{-1} water), T4 = Spraying of mahogany seed extract (@ 25 ml l^{-1} water), T5 = Spraying of garlic extract (@ 25 ml l^{-1} water) and T6 = Spraying of Karate 2.5EC (@ 1 ml l^{-1} water) and each with three replications. Spraying was started from the first incidence of the pest with the recommended doses. Karate 2.5EC (@ 1 ml l^{-1} water) was selected for its extensive use at farmers level to control cucurbit fruit fly of bitter gourd.

Experimental design

Experiments were conducted in Randomized Complete Block Design where land size was 20 m × 19 m = 380 m^2 and the subplot size was 5.66 m × 2.75 m = 15.57 m^2.

Preparation of neem seed extract

Neem seed extract was prepared by crushing 250 g of neem seeds mixing with little amount of water with the help of pestle and after that extract was separated by fine cotton cloth and mixed with 10 liters of fresh water to spray to the bitter gourd field.

Preparation of jute seed extract

To prepare jute seed extract, 250 g jute seeds was mixed with little amount of water and crushed with the help of pestle and extract was separated by fine cotton cloth. After that it was mixed with 01 liter of fresh water and 10 g soap powder was added and mixed properly. This soap mixed jute extract was diluted with 10 liters of fresh water to spray to the field. For spraying the diluted jute seed extract knapsack sprayer was used.

Preparation of Mahogany seed extract

Mahogany seed extract was prepared by crushing 250 g of mahogany seeds mixing little amount of water with the help of pestle and extract was separated by fine cotton cloth and after that it was mixed with 10 liters of fresh water to spray to the bitter gourd field.

Preparation of Garlic seed extract

To prepare garlic extract, 250 g of garlic was mixed with little amount of water after that crushed with the help of pestle and extract was separated by fine cotton cloth and after that it was mixed with 10 ml kerosene oil properly. After that the kerosene mixed garlic extract was diluted with 10 liters of fresh water to spray to the field, and for spraying knapsack was used.

$$\% \text{ infested fruits } = \frac{\text{Number of damaged bitter gourd fruits}}{\text{Total number of harvested fruits}} \times 100$$

Cultural management

Planting distance 182 cm × 158 cm was maintained. Between two plots 50 cm gap was maintained for proper irrigation and drainage. Fertilizers, whole of Compost: 1000 kg, TSP: 4 kg, MoP: 2.5 kg, Boron: 250 g and Zinc: 250 g and one third of Urea: 1.25 kg was applied to the field with necessary intercultural operations.

Data collection and statistical analysis

Data were recorded on level of infestation (%) one and two weeks after spraying (WAS) to find out effectiveness of different treatments. The level of infestation was maintained up to zero before of each spraying through proper sanitation, like - removing of infested and rotten fruits. The number of healthy and damaged bitter gourd in 15.57 m^2 area was counted and recorded distinctly from randomly selected five farmers' field at each location. The percentage of infestation was calculated by using the following formula:

The recorded data were arranged in tabular form using excel worksheet and processed for further analysis. All the statistical analyses were performed using SPSS statistical package 11.5 version, at 1% level of significance.

Results and Discussion

Infestation status in different weeks after first spray

After 1 week of first spray of different indigenous botanicals, a significant difference was found ($p \leq 0.01$) in percent of infested fruits (Table 1). The highest percent of infested fruits was found in the untreated control treatment (65.93%) and the lowest (22.78%) was in the treatment spraying of jute seed extract, which showed a statistical similarity with the treatment Karate 2.5EC (24.11%). The second highest percentage of infested fruits found in the treatment of garlic extract (39.96%) and showed statistical similarity with the treatment mahogany seed extract (34.73%) and the third highest infested fruits recorded from the treatment of neem seed extract (33.76%) showing its statistical similarity with the treatment spraying of mahogany seed extract (35.73%). After week 1, findings of this trial indicated that the untreated control was always vulnerable to cucurbit fruit fly infestation and as a botanical insecticide spraying of jute seed extract is as effective as the synthetic insecticide Karate 2.5EC.

After 2 weeks of first spray of botanicals, a significant difference ($p \leq 0.01$) found among treatments in percentage of fruit infestation (Table 1). The highest percent of infested fruits found in the control treatment (57.36%) and the lowest percent of infested fruit was found in the treatment of spraying Karate 2.5EC (27.97%) having statistical similarity with the treatment of spraying jute seed extracts (31.72%). The second highest infested fruit was found the treatment of spraying mahogany seed extract (47.21%) which showed statistical similarity with the treatments spraying garlic extract (45.78%) and neem seed extract (44.36%). After 2 weeks of first spray, the result of present study revealed that the untreated control is vulnerable to cucurbit fruit fly infestation and as a botanical insecticide spraying jute seed extract is as effective as the synthetic insecticide Karate 2.5EC. Though a lesser performance was found in neem and mahogany seed extract than jute seed extract, but they also have good efficacy in controlling cucurbit fruit fly.

Table 1. Effects of different botanicals after 1 week and 2 weeks of first spray

Treatments	% of infested bitter gourd at 2-time intervals of spraying	
	After 1 week	After 2 weeks
Spraying of Neem Seed Extract @ 25 ml l^{-1}	33.76 ± 4.10^{c}	44.36 ± 4.26^{b}
Spraying of Jute Seed Extract @ 25 ml l^{-1}	22.78 ± 8.55^{d}	31.72 ± 3.26^{c}
Spraying of Mahogany Seed Extract @ 25 ml l^{-1}	34.73 ± 7.80^{bc}	47.21 ± 4.01^{b}
Spraying of Garlic Extract @ 25 ml l^{-1}	39.96 ± 6.12^{b}	45.78 ± 3.46^{b}
Spraying of Karate 2.5EC @ 1 ml l^{-1}	24.11 ± 5.40^{d}	27.97 ± 5.21^{c}
Control	65.93 ± 7.69^{a}	57.36 ± 8.34^{a}
F- Value	18.64	12.48
P- Value	0.01	0.01

Means in a column followed by same letter(s) are not significantly different at 1% level of DMRT.

Infestation status in different weeks after second spray

After 1-week of second spray, significant difference ($p \leq 0.01$) was found among the treatments in percent of fruit infestation. The highest percent of infested fruit was found in the treatment untreated control (65.45%) and the lowest was in the treatment spraying of Karate 2.5EC (16.24%) and spraying of jute seed extract (19.20%). The second highest percent fruit infestation found in the treatment spraying garlic extract (41.69%) which was identically similar with the treatments spraying mahogany seed extract (39.21%) and spraying neem seed extract (38.61%). After 2 weeks of second spray of different botanicals and synthetic insecticide, statistically there were no significant differences among the treatments in percentage fruit infestation (Table 2). After 1 week of spray of different treatments, the botanical treatment spraying of jute seed extract did better and showed very similar result with the treatment of synthetic insecticide Karate 2.5EC and it reveals that the properties of jute seed extract is as effective as the lambda cyhalothrin that act as active ingredient of Karate 2.5EC. It also acted as a repellent to the cucurbit fruit fly and gave safety fruits from being infested.

After 2 weeks of second spray significant differences were not found among the treatments which might be for improper doses or improper application methods of used botanicals and synthetic insecticide. It also might be for weather factors like temperature, relative humidity or scorching sun light. The cause may also be for slow release of active ingredient of used botanicals and synthetic insecticide. Due to these possible factors' percent of infestation in all treatments was same and showed insignificant differences among them.

Infestation status in different weeks after third spray

After 1 week of third spray, significant difference ($p \leq 0.01$) was found among treatments in percentage fruit infestation (Table 3). The highest percent of infested fruit was found in the control treatment (58.42%) showing statistical similarity with the treatment spraying mahogany seed extract (53.06%). The lowest percent was in the treatment jute seed extract (27.47%) and showed its similarity with the treatment Karate 2.5EC (31.04%). The second highest percentage of fruit infestation was in the treatment spraying mahogany seed extract (53.06%) and spraying garlic extract (43.82%). The third highest percent infested fruits were found in the treatment garlic extract (43.82%) which showed a statistical similarity with the treatment spraying neem seed extract (39.64%). The fourth highest percentage fruit infestation found in the treatment spraying neem seed extract (39.64%) which was identically similar with the treatment spraying Karate 2.5EC (31.04%). In the previous week the treatment spraying of mahogany seed extract did better, but after 1 week of third spray its performance reduced, which might be losing efficacy of botanicals. The improper doses or improper application of mahogany seed extract also might be causing to lose efficacy of botanicals.

Table 2. Effects of different botanicals after 1 week and 2 weeks of second spray

Treatments	% of infested bitter gourd at 2-time intervals of spraying	
	After 1 week	After 2 weeks
Spraying of Neem Seed Extract @ 25 ml l^{-1}	38.61 ± 4.46^{b}	48.21 ± 6.24
Spraying of Jute Seed Extract @ 25 ml l^{-1}	19.20 ± 3.49^{c}	41.82 ± 18.44
Spraying of Mahogany Seed Extract @ 25 ml l^{-1}	39.21 ± 8.62^{b}	36.48 ± 12.68
Spraying of Garlic Extract @ 25 ml l^{-1}	41.69 ± 2.83^{b}	34.72 ± 2.41
Spraying of Karate 2.5EC @ 1 ml l^{-1}	16.24 ± 5.07^{c}	31.67 ± 20.21
Control	65.45 ± 2.60^{a}	52.81 ± 6.96
F- Value	23.42	2.81
P- Value	0.01	NS

Means in a column followed by same letter(s) are not significantly different at 1% level of DMRT

After 2 weeks of third spray, a significant difference ($p \leq 0.05$) was found among treatments in percentage of fruit infestation (Table 3). The highest percent of infested fruits was found in the control treatment (61.19%) and showed statistical similarity with the treatment spraying of mahogany seed extract (57.29%). The lowest percent of infested fruit was in the treatment spraying of Karate 2.5EC (41.94%) showing its statistical similarity with the treatments spraying of neem seed extract (48.36%), spraying of jute seed extract (49.27%) and spraying of garlic extract (49.74%).

Table 3. Effects of different botanicals after 1 week and 2 weeks of third spray

Treatments	% of infested bitter gourd at 2-time intervals of spraying	
	After 1 week	After 2 weeks
Spraying of Neem Seed Extract @ 25 ml l^{-1}	39.64 ± 5.50^{cd}	48.36 ± 6.37^{b}
Spraying of Jute Seed Extract @ 25 ml l^{-1}	27.47 ± 6.01^{e}	49.27 ± 1.78^{b}
Spraying of Mahogany Seed Extract @ 25 ml l^{-1}	53.06 ± 8.41^{ab}	57.29 ± 4.48^{ab}
Spraying of Garlic Extract @ 25 ml l^{-1}	43.82 ±8.96^{bc}	49.74 ± 4.50^{b}
Spraying of Karate 2.5EC @ 1 ml l^{-1}	31.04 ± 5.34^{de}	41.94 ± 5.64^{b}
Control	58.42 ± 0.80^{a}	61.19 ± 2.40^{a}
F- Value	14.26	2.71
P- Value	0.01	0.05

Means in a column followed by same letter(s) are not significantly different at 1% and 5% level of DMRT

After week 2, all botanicals showed kind of similar effectiveness to save bitter gourd fruits from fruit fly infestation. The treatments also revealed that after 2 weeks of spray effectiveness decreased in comparison to the effectiveness of spraying botanicals and synthetic insecticide after week 1. In a study, conducted by Mordue and Black well (1993) found that neem (*Azadirachta indica*) (Meliaceae) has emerged as an excellent alternative to synthetic insecticides for the management of insect pests. Azadirachtin is example of natural chemical defense by plants, affecting feeding primarily through chemoreception (deterrence) and secondly through toxic effects. In a study, Mahfuza *et al.* (2007) described that neem leaf dust and commercial formulation of neem can minimize the population and damage of fruit fly species. It also blocks the ovary development. Soman *et al.* (1999) stated that neem is widely used and recommended in India - the plant grows easily along hedgerows and its properties are widely known by farmers and it has been successfully used against pests of fruit fly protection in guava, jujube and cucurbits. Ranganath *et al.* (1997) found that

neem oil (1.2%) and neem cake (4.0 %) have also been reported to be as effective as Dichlorvos (0.2%). Datta and Saxena (2001) studied that the *Parthenium hysterophorus* and its derivatives can be used for control of different insects. Though the present study is not exact with the experiment of above-mentioned authors, but it indicates that the untreated control was always vulnerable to cucurbit fruit fly and the botanicals has some good power to control insect pests through repealing them or killing them or hampering their life cycle. In the present study, it is found that as an insect controlling substance jute seed extract has a great role to reduce the infestation of cucurbit fruit fly in bitter gourd. In most cases all botanicals are found as effective as the synthetic insecticide Karate 2.5EC.

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