Original Research Article

Eco-friendly management of fruit fly (*Bactrocera cucurbitae)* on infesting Bitter gourd

ABSTRACT

Aims: This study aimed to evaluate some Bio insecticides and bio-pesticides and management against fruit fly in bitter gourd.
Study Design: The experiment was laid out at a randomized complete block design with three replications.
Place and Duration of Study: Experimental farm of Sher-e-Bangla Agricultural University, Bangladesh during the period from February,2022 to july,2022.
Methodology: The experiment consisted of seven treatments viz. T_1(Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation), T_2(Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control), T_3 (Biomax M 1.2 EC+ Cuelure+ Sticky trap), T_4 (Lycomax 2g/ lit of water+ Sticky trap), T_5 (Biomax M 1.2 EC + Ceronock+ Cutrac), T_6 Sanitation+ Mechanical control+ Cuelure), T_7 (Untreated Control) were used at 7 days interval.

Results: The degree of the fruit fly (*Bactrocera cucurbitae*) infestation at various phases of bitter gourd ripening was investigated in the field and in the lab, as well as the effectiveness of some bio-pesticides and other control methods used in combination. Among all the highest number of fruit fly was captured in Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control treated plot (9.50 fruit/plot) healthy fruit per plant resulted from T_2 treated plot. whereas the maximum amount of infested fruit number (12.21 fruit/plot), number of puncture per fruit (6.74 puncture/fruit) and infested fruit weight (77.13gm) was found from the control plot. The highest percentage reduction of puncture number over control resulted in treatment T_2 treated plot which was 92.58% and treatment T_4 (85.16%) and also highest amount of healthy fruit weight (232.75 gm) came from T_2. In terms of maximum yield (2.54 kg/ plot) gained from Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control treated plot (T_2). From the study it was found that all the treatments except control (T_7) work effectively against fruit fly infestation.
Conclusion: It is concluded that T_2 treatment (Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control)

Keywords: Fruit fly; Bittergourd; Biomax ; Lycomax; Sticky trap; Ceronac; Mechanical control

1. INTRODUCTION

The Cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) is one of the most serious polyphagous insect pests of cucurbits representing 74.5% of the total number of flies infesting different vegetables growing in Bangladesh [1]. More than 125 host plants were reported worldwide while 81 crop plants were reported from Bangladesh [2]. It is a major pest of cucurbitaceous vegetables, especially the bitter gourd, musk melon, snap melon, snake gourd and ridge gourd in Bangladesh [3]. Thus, high prevalence of fruit fly infestation is a major constraint of cucurbit yield and quality of the cucurbitaceous vegetables. The maggots of B. cucurbitaei are responsible for causing damage by feeding internally on fruit pulp and make tunnels in fruits. The infested fruits become rotten and shed up prematurely. If not rotten, the fruits become deformed and market value reduced drastically. Sometimes, female adults make pseudo-puncture on the skin of the young fruits which also reduce market price adversely [4]. It is responsible for causing 30-100% yield losses depending on susceptible varieties, suitable weather condition as well as management practices [5]. Other than fruits, this pest also causes a loss of about 9.7% to female flowers [6]. Among different cucurbitaceous vegetables, bitter gourd (*Momordica charantia* L.) was reported as the most favorable host for *B. cucurbitae* having highest infestation rate (41-89%) and shortest pre-mating, pre-oviposition, incubation, larval and pupal periods [7].

Fruit fly management in the cucurbitaceous vegetable crops including bitter gourd is reasonably difficult because the maggot of *B. cucurbitae* is an internal feeder. Farmers of Bangladesh are exclusively relying on different kinds of broad spectrum chemical insecticides of different groups like organophosphorous, organocarbamate, nicotinoids, older pyrethroids etc. to control B. cucurbitae [8]. In some areas of Bangladesh farmers spend about 25% of the cultivation cost in bitter gourd production only to buy toxic pesticides [9]. About ninety-nine percent farmers sprayed insecticides and fungicides in their fields to protect crops from different insect pests and diseases. Thirty-nine percent farmers used pheromone trap for crop protection [10]. Majority of the farmers had moderately favorable attitude towards IPM technology for producing bitter gourd as shown by farmers' attitude index [11].

However, the increasing use of synthetic chemical insecticides has led to a number of problems such as development of resistance to insecticides in insect pests, high insecticide residues in 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 to major ones, ecological imbalance and danger to health of the pesticide applicator [12]. Therefore, it is urgent needed to increase the uses of bio-pesticides and new types of short durational insecticides against B. cucurbitae due to their selective mode of action, low residual activity and safety for farmer's usage [13]. Therefore an attempt was taken to evaluate the efficacy of bio-pesticides combination with management practices against against fruit fly in bittergourd.

2. MATERIALS AND METHODS

2.1 Experimental site

The location of the present experimental field was at the central farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from February-2022 to july-2022. The soil in the experimental plot was a shallow reddish-brown terrace soil with a pH range of 5.8 to 6.5.

2.2 Experimental treatment and design

The test crop used in the experiment was the hybrid tomato variety "BARI Hybrid Bitter gourd 2" It is an imported high yielding variety with average yield 35-37 t/ha^{-1}. Seven treatments, viz. T1(Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation), T2(Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control), T3 (Biomax M 1.2 EC+ Cuelure+ Sticky trap), T4 (Lycomax 2g/ lit of water+ Sticky trap), T5 (Biomax M 1.2 EC + Ceronock+ Cutrac), T6 Sanitation+ Mechanical control
+ Cuelure), T7 (Untreated Control) were used at seven days interval. We laid out the experiment in a Randomized Complete Block Design (RCBD) with three replications. The area of a single plot of the experiment was 2m x 2 m, Inter plot distance 0.5m.

2.3 Crop husbandry

The seeds were collected from the BARI (Bangladesh Agricultural Institute) and were sown on the seedbed on October 15, 2017. The seedlings were raised on pots under special care on 24 February, 2022 and the germination of seedlings was started on 07 March, 2022. Before seed sowing, the seedbed was prepared well and made suitable for

seedling production. Manures and fertilizers were applied according to the recommended fertilizer doses for bitter gourd production per hectare by [14]. Healthy and uniform seedlings were transplanting in the experimental plots on 18 March, 2022. The seedlings were transferred carefully from the seed bed to experimental plots to avoid damage to the root system. To minimize the damage to the roots of seedlings, the seed beds were watered one hour before uprooting the seedlings. a routine irrigation was given at 3 days' intervals. Before seed sowing, the seedbed was prepared well and made suitable for seedling production.

2.4 Data collection

Five plants were randomly selected from each unit plot for the recording of necessary data on different crop attributes. The data were recorded considering the following parameters: a) Number of captured insects per plot, b) Number of infested fruits per plot, c) Number of puncture per fruit, d) Number of healthy fruits per plot, e) Weight of healthy fruits, f) Weight of infested fruits, and g) Yield. Harvesting of the bitter gourd was not possible on a certain or particular date because the marketable size in different plants were not uniform.

2.5 Statistical package

The data obtained for different parameters will be statistically analyzed following computer based software Statistix-10 and mean separation will be done by LSD at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Captured Fruit fly in bitter gourd field

Captured Fruit fly in bitter gourd field. The experimental plots are treated with bio control agents on the infestation of Cucurbit fruit fly and the findings are presented in line graph (Fig 1). This graph expresses that the highest number of captured fruit fly population was in the treatment T_2 treated plot and lowest number of captured fruit fly was at treatment T_6 treated plot. The similar result was also found after using combination of biopesticides and mechanical control [15] [16]. On the otherhand Treatment T_7 was the control plot, no fruit fly was captured**.**

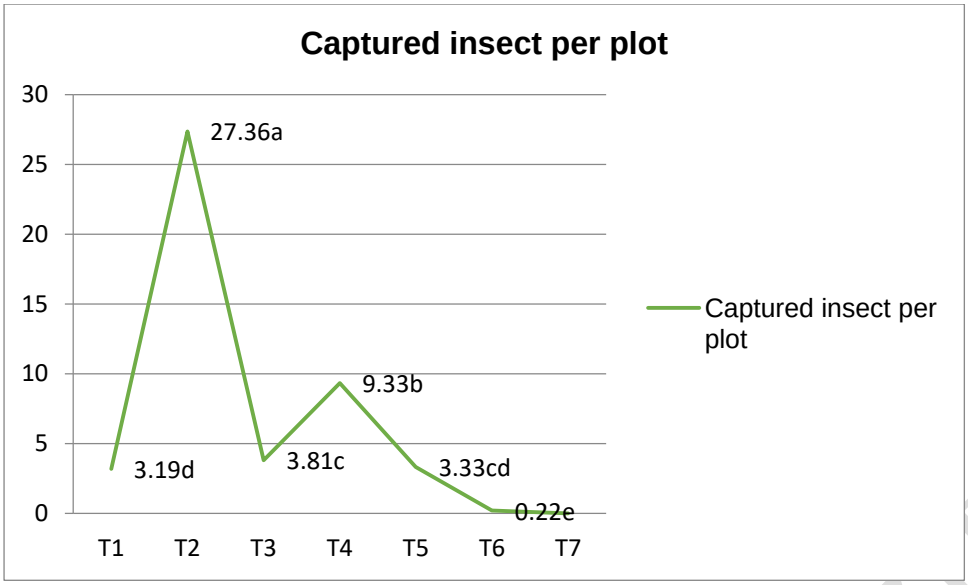

Fig 1. A line graph showing the number of captured fruit fly in the experimental plot

[T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation, T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control, T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap, T_4 = Lycomax 2g/ lit of water+ Sticky trap, T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac, T_6 = Sanitation+ Mechanical control+ Cuelure and T_7 = Control]

3.2 Obtained healthy fruit and its weight in the experimental field

The setting up of different bio control agents shows effective result in the experimental field and the result is presented at Table 1. Bio control agents were worked effectively against fruit fly and after controlling the fruit fly infestation, the maximum number of healthy fruits comes from treatment T_2 treated plot. Other treatments are also given near about same result then control plot [17] was also found more or less similar trend of result after their study. whereas the minimum number of healthy fruits obtained from treatment T_7, the control plot. And the finding also shows that the poor weight of healthy fruit was at control plot and maximum weighted healthy fruit from treatment T_2 plot.

Table 1. Effect of different bio control agents in healthy fruit and its weight during whole study period

Treatment	**No of Healthy fruit per plot**	**Weight of healthy fruit per plot (gm)**
T_1	4.72e	99.42 e
T_2	9.50 a	232.75 a

T_3	7.00 c	163.00 c
T_4	8.06 b	176.75 b
T_5	6.19 d	151.17 d
T_6	4.47 e	95.83 e
T_7	1.83 f	42.67 f
LSD	0.7920	11.337
CV%	7.46	4.64

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.

T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation
T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control
T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap
T_4 = Lycomax 2g/ lit of water+ Sticky trap
T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac
T_6 = Sanitation+ Mechanical control+ Cuelure
T_7 = Control

3.3 Number of infested fruits under different bio control agents in the bitter gourd field

The significant variations were observed among the different treatments in terms of infested fruit number. Table 2 shows that the highest number of infested fruit resulted in treatment T_7 treated plot which was the control plot. And the fruit fly infestation was checked effectively in treatment T_2 treated plot and minimum number of infested fruit was resulted from it which result was statistically identical with T_3 and T_4. A notable percentage reduction (89.76 %) of infested fruit over control was found with treatment T_2 treated plot found the similar result after using bio-pesticides [18].

Table 2. Effect of different bio control agents in fruit infestation during whole study period

Treatment	No of Infested fruit per plot	% Reduction of infested fruit over control
T_1	3.61 c	70.43

T_2	1.25 e	89.76
T_3	2.19 de	82.06
T_4	1.33 de	89.11
T_5	2.25 d	81.57
T_6	4.74 b	61.18
T_7	12.21 a	-
LSD	0.9465	
CV%	13.50	

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.

T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation
T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control
T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap
T_4 = Lycomax 2g/ lit of water+ Sticky trap
T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac
T_6 = Sanitation+ Mechanical control+ Cuelure
T_7 = Control

3.4 Number of puncture in fruit under different bio control agents in the bitter gourd field

The significant variations were observed among the different treatments in terms of puncture number in fruit of bitter gourd.

Table 3 shows that the highest number of puncture in fruit resulted in treatment T_7 treated plot which was the control plot due to fruit fly infestation. And the fruit fly infestation was checked effectively in treatment T_2 that's why minimum number of puncture in fruit was resulted from treatment T_2 and it gave the highest percentage reduction of fruit puncture over control (92.58%).

Table 3. Effect of different bio control agents on puncture in fruit during whole study period

Treatment	No of Puncture per fruit	% Reduction of puncture over control
T_1	2.19 c	67.51

T_2	0.50 e	92.58
T_3	1.33 d	80.27
T_4	1.00 de	85.16
T_5	1.49 d	77.89
T_6	3.11 b	53.86
T_7	6.74 a	-
LSD	0.5406	
CV%	12.99	

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.

T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation
T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control
T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap
T_4 = Lycomax 2g/ lit of water+ Sticky trap
T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac
T_6 = Sanitation+ Mechanical control+ Cuelure
T_7 = Control

3.5 Infested fruit weight under different bio control agents in the bitter gourd field

The significant variations were observed among the different treatments in terms of infested fruit weight of bitter gourd during the study period.

Table 4 shows that the maximum amount of infested fruit weight resulted in treatment T_7 treated plot which was the control and this happened due to the fruit fly infestation. And the fruit fly infestation was checked effectively in treatment T_2 and T_4 that's why minimum amount of infested fruit weight was resulted from treatment T_2 and T_4. Highest percentage reduction of infested fruit weight over control was 68.99% at T_2. Kariyasa and Dewi also found the same trend of results during their study [17].

Table 4. Effect of different bio control agents on infested fruit weight during whole study period

Treatment	Weight of Infested fruit per plot (gm)	% Reduction of infested fruit weight over control

T_1	47.33 c	38.64
T_2	23.92 e	68.99
T_3	33.75 de	56.24
T_4	27.50 e	64.35
T_5	41.75 cd	45.87
T_6	62.00 b	19.62
T_7	77.13 a	-
LSD	10.345	
CV%	12.99	

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.

T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation
T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control
T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap
T_4 = Lycomax 2g/ lit of water+ Sticky trap
T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac
T_6 = Sanitation+ Mechanical control+ Cuelure

3.6 Efficacy of different bio control agents on yield during study period

The significant variations were observed among the different bio agents on yield of bitter gourd. Table 5 shows that the minimum amount of yield resulted in treatment T_7 treated plot which was the control and this happened due to the fruit fly infestation. And the fruit fly infestation was checked effectively in treatment T_2 for that maximum amount of yield was resulted from treatment T_2 (2.54 kg/ plot). Murititthi et al. and Alam & Khan found the similar result after using the IPM practice to control the fruit fly management in bittergourd [20] [21].

Table 5. Effect of different bio agents on yield of bitter gourd during study period

Treatment	Yield per plot(gm)	Yield per plot (kg)
T_1	1838.3 e	1.84
T_2	2535.7 a	2.54
T_3	2332.3 c	2.33
T_4	2437.3 b	2.44
T_5	2152.3 d	2.15
T_6	1771 e	1.77
T_7	1199 f	1.20
LSD	97.415	
CV%	2.69	

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.

T_1 = Lycomax 2g/lit of water+ Cutrac+ Sticky trap+ Sanitation
T_2 = Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control
T_3 = Biomax M 1.2 EC+ Cuelure+ Sticky trap
T_4 = Lycomax 2g/ lit of water+ Sticky trap
T_5 = Biomax M 1.2 EC + Ceronock+ Cutrac
T_6 = Sanitation+ Mechanical control+ Cuelure
T_7 = Control

CONCLUSION

Results showed that the significant variations were observed among different bio agent treated plots. The highest number of captured fruit fly population was in the treatment T_2 (Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control) treated plot and that's why healthy fruit (9.50 fruit/plant) and highest amount of healthy fruit weight (232.75 gm) resulted from it. The control plot resulted the highest amount of infested fruit (12.21fruit/plot) and highest number of puncture (6.74 puncture/fruit) also come from the control plot. While among the treatments (Lycomax 2g/lit of water+ Ceranock+ Sticky trap+ Mechanical control) was the best one to manage the fruit fly control.

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