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Efficacy of Different Traps for Controlling Cucurbit Fruit Fly, *Bactrocera Cucurbitae* (COQ) on Host Bottle Gourd, *Lagenaria Siceraria*

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Abstract: ***The experiment was conducted in the experimental field of the Sher-e-Bangla Agricultural University, Dhaka during the period from October, 2017 to March, 2018 to evaluate efficacy of different traps for controlling cucurbit fruit fly, Bactrocera cucurbitae (coq) on host bottle gourd, lagenaria siceraria in Bangladesh, using variety 'BARI-Lau 1', Sher-e-Bangla Agricultural University, Bangladesh. Treatments for the management were T_1 = Pheromone Trap, T_2 = Bait trap with sweet gourd mashed, T_3 = Vinegar with rotted fruit trap, T_4 = Bait trap with banana mashed, T_5 = Funnel pheromone Trap, T_6 = Sticky board trap, T_7 = Untreated control and laid out in a Randomized Complete Block Design (RCBD) with three replications. The highest adult captured in T_5 (Funnel Pheromone trap) at different days interval, whereas the lowest (3.07) was captured in T_6 (Sticky board trap) and no adult was caught in T_7 (untreated control) treatment. Considering the all yield attributing characteristic, such as percent healthy and infested fruits by both weight and number, percent infestation over control, total yield, the treatment T_5 showed the best performance for controlling of the B. cucurbitae among all the treatments. T_1 showed the second highest performance, whereas, T_6 showed the lowest performance. The lowest total fruit yield (57.32 t/ha) was obtained in T_7, followed by T_6 treatment during the cropping season of bottle gourd.***

Keywords: Cucurbit fruit fly, B. cucurbitae, Different traps, Bottle gourd, Control

1. Introduction

Vegetables are accessible source of vitamins and minerals which are essential for maintaining sound health. Bangladesh has a serious deficiency in vegetables. The daily requirement of vegetables for a full grown person is 285 gm (Ramphall and Gill, 1990). But in Bangladesh the percept consumption of vegetables is only 50 gm per day, which is the lowest among the countries of south and south East Asia (Rekhi, 1997). Cucurbitaceous vegetables play an important role to supplement this shortage during the lag period (Rashid 1993). The total area of cucurbit crops is around 81,720 hectares and the total production is about 308096 metric tons (BBS, 2008). Bangladesh produced 103 thousand tons of bottle gourds in the winter season and 77 thousand in the summer season of 2006-2007(BBS 2007). Bottle gourd is primarily a winter vegetable but now a- days it is available also in summer. Now bottle gourd is grown round the year. Unfortunately, bottle gourds are infested by a number of insect pests, which are considered to be the significant obstacles for its economic production. Among them, cucurbit fruit fly and red pumpkin beetle are the major pests responsible for considerable damage of cucurbits (Butani and Jotwai, 1984).

The fruit fly, *Bactrocera cucurbitae* (Coq.) (Diptera: Tephritidae) is one of the most serious pests of cucurbits in Bangladesh (Alam, 1969; Akhtaruzzaman *et al*., 1999 and 2000). This pest is also known as melon fly and sometimes as a cucurbit fruit fly. The fruit fly attacks the ultimate economic part, i.e. fruits of the crop that alone can inflict yield loss in different cucurbitaceous vegetables ranging from 30-100% depending upon cucurbit species and the season (Dhillon *et al*., 2005). It also poses major threat to global trade, since many countries have invoked restrictions to minimize the risk of establishment of exotic species. The damage caused by fruit fly is the most serious in melon and this may be up to 100 percent. Other cucurbitaceous fruits may also be infested upto 50 percent (Atwal, 1993). Yield losses due to fruit infestation vary from 19 to 70 percent in different cucurbits (Karim, 1995; Kabir *et al.*, 1992). Shah *et al.* (1948) observed the symptom of infestation as the formation of brown resinous deposit on the attracted fruits. The female fly drums on the skins of young fruits by her oviposit and sometimes on the young leaves or stems of the host plants and makes punctures for laying eggs (Chaudhary *et al.*, 2007). Afterward, fruit juice oozes out which transforms in to resinous brown deposit. After hatching in the fruit, the larvae feed into pulpy tissue and make tunnels in fruits and cause direct damage. They also damage the fruits indirectly by contaminating with frass and accelerated rotting of fruits by a pathogenic infection. Infested fruits if not rotten, become deformed and hardly which make it unfit for consumption. In Bangladesh where the production of vegetables is much below the requirements, the damage due to cucurbit fruit flies is undesirable. It is therefore, extremely important to devise means to reduce the extent of damage due to fruit flies without affecting the agro ecosystem.

Pheromone traps are important sampling means for early detection and monitoring of the fruit flies that have become an integrated component of integrated pest management. Pheromone traps attract only male fruit flies but this could be used as indicators of the total population. Pheromones are also increasingly efficient at low population densities, they do not adversely affect natural enemies, and they can, therefore, bring about a long-term reduction in insect populations that cannot be accomplished with conventional insecticides (Toledo *et al.*, 2010). The fruit flies have long been recognized to be susceptible to attractants. A successful suppression programme has been reported from different research works, where mass trapping using to reduced the infestation of *B. zonata* below economic injury levels.

In Bangladesh farmers solely rely on chemical pesticide for their welfare against this obnoxious insect pest and fail at most of the cases and damage the ecological balance. The application of insecticide, however, can cause several problems such as development of insecticide resistance pest insects, induction of resurgence of target pests, outbreak of secondary pests and undesirable effect on non-target organisms as well as serious environment pollution. Insecticide residues can exist in fruit which cause health hazard to consumers. Considering the hazardous impact of chemical pesticides on non-target organisms as well as environment, my study will be undertaken to assess the losses caused by *B. cucurbitae* and efficacy of different traps to get rid up fruit fly and aiming at development of eco-friendly and sustainable pest management system in cucurbits so that farmer can get satisfactory yield as well as consumer can get nontoxic fresh bottle gourd.

In view of the above facts, the main focus of this research work is lying in the following specific objectives: To highlight the establishment of an environmentally safe control measure in cucurbit crops which help to reduce the use of chemical pesticides.

2. Materials and Methods

The investigation was being undertaken in the central farm of Sher-e-Bangladesh Agricultural University, Dhaka-1207 during the period of October, 2017 to March, 2018. The details of the experiment including the rearing of the test insects are furnished below:

The variety BARI Lau 1 of Bottle gourd was selected for the experiment during Rabi season 2017-2018. The seed of this variety was collected from Bangladeesh Agricultural Research Institute, Joydebpur, Gazipur.

Experimental design and layout
The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications in the central farm of SAU. The field with good tilth was divided into 3 blocks. Each block was sub-divided into 7 sub plots, each of which was of 3.5 m × 2.5 m maintaining plot to plot distance 1.0 m and row to row distance 0.5m

Land preparation, seeds sowing, seedling raising and transplanting
The selected plot of the experiment was opened with a power tiller, and then all steps were done to prepare plots. The plots were raised by 10 cm from the soil surface keeping the drain around the plots. Collecting seeds of BARI Lau 1 of Bottle gourd were soaked for 12 hours in water for rapid and uniform germination. Then seeds were sown in the polyethylene bags (12cm x 18cm) containing a mixture of equal proportion of well decomposed cowdung and loam soil in 1st week of October 2017 and irrigated regularly. After germination, the seedlings were sprayed with water by hand sprayer and sprayed was done once a day for two weeks. Seedlings were placed in a shady place. After 11 days of sowing, Seedlings were transplanted on 11th October, 2017 in the pits of the experimental field (two seedlings per pit and 2 pits per plot). At the time of transplanting, polyethylene bags was cut and removed carefully in order to keep the soil intact with root of the seedling. Finally one healthy plant was kept in each pit and damaged seedlings were replaced by new one. All cultural practices were done, whenever necessary for better growth and development of the bottle gourd plants.

Treatments of the experiment
T_1 = Using Pheromone trap
T_2 = Using Bait trap with Sweet gourd mashed at the 5 days interval
T_3 = Using Vinegar trap with rotted fruit trap
T_4 = Using Bait trap with Banana mashed at the 5 days interval
T_5 = Using Funnel Pheromone trap
T_6 = Using Sticky board trap
T_7 = Untreated control

Preparation of the different traps use as treatments
The pheromone, 'cuelure', which mimics the scent of female flies, attracts the male flies and traps them in large numbers resulting in mating disruption.

Sex Pheromone Trap: Pheromone trap was collected from Ispahani Agro-Biotec Ltd. Konabari, Gazipur and set in the experimental field (Plate 1). Sex pheromone trap designed by BARI with cue-lure and soapy water, were used to conduct this experiment. The traps were hung up under bamboo scaffold, 60 cm above the ground. The soap water was replaced by new soap water at an interval of 5 days each.

Bait trap with mashed Sweet gourd
The poison bait trap was prepared using mashed sweet gourd mixed with water and Sevin 50WP at the rate of 2gm per 100 gm of mashed sweet gourd. The bait was kept in a small earthen pot placed within a four splitted bamboo sticks, 50 cm above the ground. An earthen cover plate was placed 20 cm above the bait container to protect the bait material from sun and rain. The number of adult fruit flies (male and female) trapped in those bait traps were recorded at each four days interval in the morning. The old bait materials were changed at the interval of 4-5 days each and fresh ones were placed there for further use (Plate 2).

Plate 1: Sex pheromone trap in the experimental field

Plate 2: Bait trap with mashed sweet gourd

Plate 3: Vinegar trap with rotted or overripe fruit trap

Plate 4: Bait trap with Banana mashed

Plate 5: Funnel Pheromone trap

Plate 6: Sticky board trap

Vinegar trap with rotted or overripe fruit trap
It is a simple trap. This type of trap was prepared using vinegar 200ml with 2ml liquid dish soap and a piece of ripe or overripe fruit (papaya) 100gm. (At first, a plastic bottle was cutoff upper portion then all materials was kept in this plastic bottle and another cut portion inverted and insert into the mouth of the lower cut-portion of plastic bottle to form a makeshift funnel. Fruit fly entry by this funnel into vinegar trap and would not escape / get out from the trap. Vinegar traps were placed at 50 cm above the ground with the help of bamboo supports. (Plate 3).

Bait trap with Banana mashed This poison bait was prepared from mashed banana mixed with water and Sevin 50WP at the rate of 2gm per 100gm of mashed banana (Plate 4). Freshly prepared baits in earthen pots were placed at 50

cm above the ground with the help of bamboo supports. An earthen cover plate was placed 20 cm above the bait container to protect the bait material from sun and rain. Used baits were changed by freshly prepared baits within 3-4 days to attract more fruit flies.

Funnel Pheromone trap
Pheromone trap was made up of a plastic bottle of with its both sides had two funnel. Cuelure was hanged inside the plastic bottle (Plate 5).

Sticky board Trap
Sticky board trap was prepared with a yellow hard paper and glue was used as a sticky substances and it was applied on the hard paper twice in a week (Plate 6).

Data collection
The whole reproductive period of sweet gourd was divided into three stages viz., early, mid and late fruiting stages. First flower initiation to 20 days was treated as early fruiting stage; 20 days to 40 days was called mid fruiting stage and after 40 days to the end of the final harvest was called late fruiting stage. The results of the effectiveness of different treatments were explained and discussed on the basis of some parameters The following parameters were considered and detailed methodology was given below:

The number of adult fly captured per week in different traps was recorded. The data on the number of healthy and infested fruits were recorded from each treatment. The effectiveness of each treatment was evaluated on the basis of some parameters. The following parameters were considered during data collection at each stage of reproduction.

Per cent fruit infestation by number

After harvesting the healthy fruits (Plate 15) and the infested fruits (Plate 16) were separated by visual observation. The number of healthy fruits and the infested fruits of early, mid and late fruiting stages were counted and the per cent fruit Infestation for each treatment was calculated by using the following formula:

$$\%\,\text{Fruit Infestation by number} = \frac{\text{Number of infested fruits}}{\text{Total Number of fruits (healthy + infested fruits)}} \times 100$$

Fruit yield
After harvesting, the weight of healthy fruits (Plate 18) and infested fruits were separately recorded the total yield under each treatment was finally converted to determine the yield (t/ha). The per cent increase and decrease of yield over control was computed by using the following formula:

$$\%\,\text{Increase of yield over control} = \frac{\text{Yield of treated plot} - \text{Yield of control plot}}{\text{Yield of control plot}} \times 100$$

$$\%\,\text{Decrease of yield over control} = \frac{\text{Yield of control plot} - \text{Yield of treated plot}}{\text{Yield of control plot}} \times 100$$

Statistical analysis
Data were analyzed by MSTAT-C software for proper interpretation. The data recorded on different parameters were subjected to analysis of variance (ANOVA) and the means were compared according to Duncan's Multiple Range Test (DMRT) at 5% level of significance (Gomez and Gomez, 1984). Moreover, the graphical work was done using Microsoft Excel program

3. Results and Discussion

3.1 Number of captured insects/trap at different days after trap setting at the reproductive stage of bottle gourd

At the different day's interval the number of captured insects/trap at the reproductive stage of bottle gourd after trap setting were represented in Table1. From this table, it was found that, among the different treatments T_5 (Funnel pheromone trap) was showed the best performance in capturing adult cucurbit fruit fly during the study period. At the 5 days after trap setting (DATS), the highest number of fruit fly (6.53) was captured in T_5 (Funnel pheromone trap) treatment, which was significantly different from the all others treatment and followed by 5.87 and 5.40 in T_1 (pheromone trap) and T_3 (Vinegar with rotted fruit trap) respectively; whereas the lowest number of fruit fly (3.07) was captured in T_6 (Sticky board trap) which was closely followed by 3.87 in T_4 (Bait trap with banana mashed) treatment. As a result, the trends of captured adult cucurbit fruit fly in different traps is $T_5 > T_1 > T_3 > T_2 > T_4 > T_6$ at 5 days after trap setting at the reproductive stage of bottle gourd. Similar trend of results were also found from the rest of different days after trap setting at the reproductive stage of bottle gourd, except untreated control treatment T_7 (Table 1).

More or less similar results were also reported by several researchers as Hossen (2012); Akhtaruzzaman *et al*. (2000); Rakshit *et al*. (2011) and Islam (2013). Such as Hossen (2012), who reported that Pheromone trap with funnel + Bait trap was most effective in capturing the adult fruit fly and Pheromone trap with funnel showed the second highest performance. Islam (2013) reported that pheromone trap with bait trap showed the best performance in capturing adult cucurbit fruit fly than Funnel pheromone trap.

Table 1: Number of captured insects/trap at different days after trap setting at the reproductive stage of bottle gourd

Treatments	Number of captured insects/trap at different days after setting of trap									
	5DATS	10 DATS	15 DATS	20 DATS	25 DATS	30 DATS	35 DATS	40 DATS	45 DATS	50 DATS
T_1	5.87 b	5.00 b	4.70 b	3.70 b	2.93 b	2.40 b	2.97 a	2.67 b	2.67 b	1.77 b
T_2	4.47 c	4.20 c	3.60 cd	2.50 d	2.73 bc	1.80 c	2.07 b	2.20 c	2.05 c	1.21 d
T_3	5.40 b	4.87 b	4.10 bc	3.30 c	2.80 bc	2.07 bc	2.37 b	2.65 b	2.07 c	1.50 c
T_4	3.87 d	3.80 c	3.30 d	1.90 e	2.60 c	1.20 d	1.57 c	1.90 d	1.80 d	1.17 d
T_5	6.53 a	5.67 a	5.40 a	4.10 a	3.27 a	3.27 a	3.07 a	3.03 a	2.93 a	2.33 a
T_6	3.07 e	3.00 d	2.10 e	1.30 f	1.10 d	1.00 d	1.07 d	1.00 e	1.10 e	0.70 e
T_7	--	--	--	--	--	--	--	--	--	--
$LSD_{(0.05)}$	0.508	0.450	0.595	0.390	0.293	0.531	0.308	0.180	0.233	0.138
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CV(%)	6.23	5.94	8.50	7.75	6.37	8.34	7.92	6.83	9.09	7.56

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability; Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

3.2 Efficacy of different traps on the number of captured insects/trap at the different reproductive stages of bottle gourd

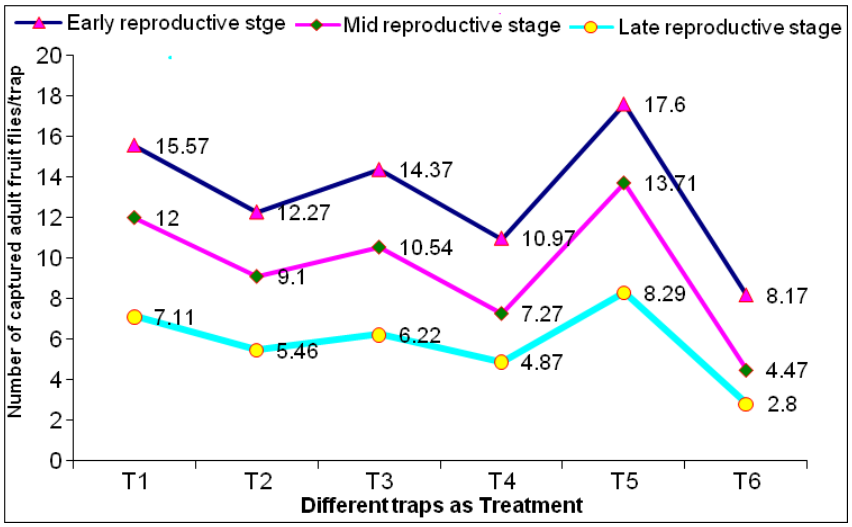

Figure 1: Efficacy of different traps on the no. of captured insects/trap at the early, mid and late reproductive stages of bottle gourd

At the early, mid and late reproductive stages of bottle gourd, the number of adult fruit fly captured/trap in the different traps shown in Figure 1. The graph expressed that T_5 (Funnel pheromone trap) showed the best performance in capturing adult fruit fly during the study period. The highest number of captured fruit fly/trap (17.6) was observed from T_5 (Funnel pheromone trap); almost same level of adult fruit fly was caught in T_1 (Pheromone trap) treatment by 15.57, whereas the lowest number of captured fruit fly/trap (8.17) was recorded from T_6 (Sticky board trap). Similar trends of adult fruit fly captured in different traps at mid and late reproductive stages of bottle gourd during the study period (Figure 1).

3.3 Efficacy of different traps against cucurbit fruits fly, *B. cucurbitae* on the basis of healthy and infested fruits by number and fruit infestation of bottle gourd

3.3.1 At the early reproductive stage of bottle gourd

At the early reproductive stage of bottle gourd, the consequence of different traps on the number of healthy fruits/plot as been shown in Table 2. From this table it was revealed that, the highest number of healthy fruits/plot (9.73) was recorded from T_5 (Funnel pheromone trap) closely followed by 9.20 in T_1 (Pheromone trap) treatment, whereas the lowest number of healthy fruits/plot (6.67) was recorded from T_7 (Untreated control) treatment.

In case of number of infested fruits/plot at the early reproductive stage of bottle gourd, the highest number of infested fruits/plot were collected from T_7 (Untreated control) which was statistically similar by T_6 (Sticky board trap), on the other hand, the lowest number of infested fruits/plot were collected from T_5 (Funnel pheromone trap) which was closely followed by 0.33 in T_1 (Pheromone trap) and T_3 (Vinegar with rotted fruit trap) treatment (Table 2).

In the same way, the lowest percent of infestation (2.67) were observed from T_5 (Funnel pheromone trap) treatment which was closely followed by 3.50 and 3.61 in T_1 (Pheromone trap) and T_3 (Vinegar with rotted fruit trap) treatment respectively. On the other hand, the highest percent of infestation (10.65) were observed from T_7 (Untreated control) which was closely followed by 7.45 in

T_6 (Sticky board trap), 6.14 in T_4 (Bait trap with banana mashed) treatment.

Table 2: Efficacies of different traps against cucurbit fruits fly on the basis of infested fruits and fruit infestation by number at early reproductive stage of bottle gourd

Treatments	Number of fruits/plot		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T_1	9.20 bc	0.33 cd	3.50 d	67.14
T_2	8.67 d	0.40 bcd	4.42 cd	58.50
T_3	8.87 cd	0.33 cd	3.61 d	66.10
T_4	8.13 e	0.53 bc	6.14 bc	42.35
T_5	9.73 a	0.27 d	2.67 d	74.93
T_6	7.47 f	0.60 ab	7.45 b	30.05
T_7	6.67 g	0.80 a	10.65 a	--
$LSD_{(0.05)}$	0.468	0.205	2.209	--
Level of significance	0.01	0.01	0.01	--
CV(%)	4.22	12.17	15.02	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

From the results in table 5 showed significant variations due to the effect of different traps on percent of reduction of *B. cucurbitae* at the early reproductive stage of bottle gourd. Among different traps, T_5 (Funnel pheromone trap) showed more reduction (74.93%) of infestation due to cucurbit fruit fly and supported to make sure the more yield of bottle gourd.

In the similar trend, T_6 (Sticky board trap), showed lower performance to control cucurbit fruit fly while minimum reduction (30.05%) was recorded on bottle gourd (Table 5). As a result, the order of efficacy of different traps in terms of fruit infestation reduction at early reproductive stage is $T_5 > T_1 > T_3 > T_2 > T_4 > T_6 > T_7$

3.3.2 At the mid Fruiting Stage

At the mid reproductive stage of bottle gourd, the consequence of different traps on the number healthy fruits/plot as been shown in Table 6. From this table it was revealed that, the highest number of healthy fruits/plot (11.67) was harvested from T_5 (Funnel pheromone trap) which was closely followed by 11.07 in T_1 (Pheromone trap) treatment, whereas the lowest number of healthy fruits/plot (7.67) was harvested from T_7 (Untreated control) treatment which was closely followed by 8.33 in T_6 (Sticky board trap).

In case of number of infested fruits/plot at the mid reproductive stage of bottle gourd, the highest number of infested fruits/plot were collected from T_7 (Untreated control) by 0.87 which was statistically similar by 0.80 in T_6 (Sticky board trap) and closely followed by 0.73 in T_4: Bait trap with banana mashed, on the other hand, the lowest number of infested fruits/plot were collected from T_5 (Funnel pheromone trap) by 0.27 which was closely followed by 0.40 in T_1 (Pheromone trap) treatment (Table 3).

In the same way, the lowest percent of infestation (2.22) were observed from T_5 (Funnel pheromone trap) and closely followed by 3.49 in T_1 (Pheromone trap); closely followed in T_3 (Vinegar with rotted fruit trap) treatments. On the other hand, the highest percent of infestation (10.15) were observed from T_7 (Untreated control) which was closely followed by 8.77 in T_6 (Sticky board trap) treatment (Table 3).

At the mid reproductive stage of bottle gourd, considering the reduction of fruit infestation, from the results in table 6 showed significant variations due to the effect of different traps on percent of reduction of *B. cucurbitae*. Among different traps, T_5 (Funnel pheromone trap) showed more reduction (78.13%) of infestation due to cucurbit fruit fly and supported to make sure the more yield of bottle gourd and second highest infestation reduction were observed in T_1 (Pheromone trap).

In the similar trend, T_6 (Sticky board trap), showed lower performance to control cucurbit fruit fly while minimum reduction (13.60%) was recorded on bottle gourd. As a result, the order of efficacy of different traps in terms of fruit infestation reduction at mid reproductive stage is $T_5 > T_1 > T_3 > T_2 > T_4 > T_6 > T_7$ (Table 3).

Table 3: Efficacies of different traps against cucurbit fruits fly on the basis of infested fruits and fruit infestation by number at mid reproductive stage of bottle gourd

Treatments	Number of fruits/plot		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T_1	11.07 b	0.40 def	3.49 efg	65.62
T_2	10.27 d	0.53 cd	4.93 de	51.43
T_3	10.73 c	0.47 cde	4.16 ef	59.01
T_4	9.27 f	0.73 ab	7.31 bc	27.98
T_5	11.67 a	0.27 f	2.22 g	78.13
T_6	8.33 g	0.80 a	8.77 ab	13.60
T_7	7.67 h	0.87 a	10.15 a	--
$LSD_{(0.05)}$	0.319	0.164	1.516	--
Level of significance	0.01	0.01		--
CV(%)	4.85	17.49	15.87	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

3.3.3 At the late reproductive stage of bottle gourd

At the late reproductive stage of bottle gourd, the consequence of different traps on the number healthy fruits/plot has been shown in Table 7. From this table it was revealed that, the highest number of healthy fruits/plot (10.27) was recorded from T_5 (Funnel pheromone trap) and closely followed by 10.07 in T_1 (Pheromone trap) treatment,

whereas the lowest number of healthy fruits/plot (7.40) was recorded from T_7 (Untreated control) treatment which was closely followed by 8.20 in T_6 (Sticky board trap).

In case of number of infested fruits/plot at the late reproductive stage of bottle gourd, the highest number of infested fruits/plot were collected from T_7 (Untreated control) by 1.00 which was statistically similar by 0.87 in T_6 (Sticky board trap), on the other hand, the lowest number of infested fruits/plot were collected from T_5 (Funnel pheromone trap) by 0.33 which was closely followed by 0.40 in T1 (Pheromone trap) and T_3 (Vinegar with rotted fruit trap) treatment (Table 4). In the same way, the lowest percent of infestation (3.13 and 3.82) were observed from T_5 (Funnel pheromone trap) and T_1 (Pheromone trap) treatments respectively. On the other hand, the highest percent of infestation (11.92) were observed from T_7 (Untreated control) which was closely followed by 9.57 in T_6 (Sticky board trap) treatment (Table 4). As a result, the order of efficacy of different traps in terms of reducing fruit infestation at late reproductive stage is $T_5 > T_1 > T_3 > T_2 > T_4 > T_6 > T_7$.

Considering the reduction of fruit infestation, from the results in table 7 showed significant variations due to the effect of different traps on percent of reduction of *B. cucurbitae* at the late reproductive stage of bottle gourd. Among different traps, T_5 (Funnel pheromone trap) showed more reduction (73.74%) of infestation due to cucurbit fruit fly and supported to make sure the more yield of bottle gourd. In the similar trend, T_6 (Sticky board trap), showed lower performance to control cucurbit fruit fly while minimum reduction (19.71%) was recorded on bottle gourd (Table 4). As a result, the order of efficacy of different traps in terms of fruit infestation reduction at late reproductive stage is $T_5 > T_1 > T_3 > T_2 > T_4 > T_6 > T_7$.

Table 4: Efficacy of different traps against cucurbit fruits flies on the basis of infested fruits and fruit infestation by number at late reproductive stage of bottle gourd

Treatments	Number of fruits/plot		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T_1	10.07 ab	0.40 ef	3.82 e	67.95
T_2	9.20 d	0.60 cd	6.12 d	48.66
T_3	9.67 c	0.53 de	5.23 d	56.12
T_4	8.60 e	0.80 b	8.51 bc	28.61
T_5	10.27 a	0.33 f	3.13 e	73.74
T_6	8.20 f	0.87 ab	9.57 b	19.71
T_7	7.40 g	1.00 a	11.92 a	--
$LSD_{(0.05)}$	0.367	0.134	1.326	--
Level of significance	0.01	0.01	0.01	--
CV(%)	5.34	12.23	11.51	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

Plate 7: Infested and healthy bottle gourd in the Experimental field

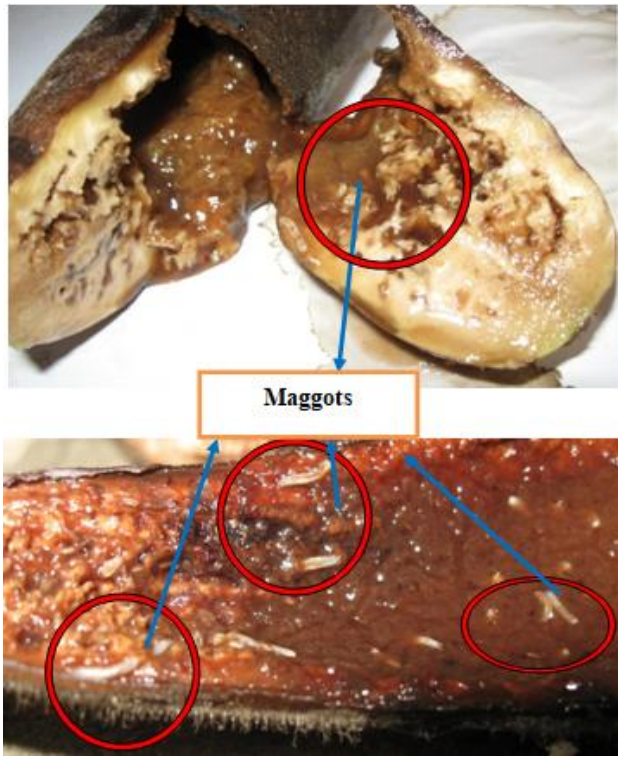

Plate 8: Completely rotted infested fruits of bottle gourd with Maggot due to *B. cucurbitae*

3.4 Efficacy of different traps against cucurbit fruits fly, *B. cucurbitae* on the basis of healthy and infested fruits by weight and fruit infestation at the reproductive stage of bottle gourd

3.4.1 At the early reproductive stage of bottle gourd

At the early reproductive stage of bottle gourd, the consequence of different traps on the weight of healthy fruits/plot as been shown in Table 5. From this table it was revealed that, the highest weight of healthy fruits/plot (24.60 kg) was recorded from T_5 (Funnel pheromone trap) closely followed by 23.47 kg in T_1 (Pheromone trap) treatment, whereas the lowest number of healthy fruits/plot (17.60 kg) was recorded from T_7 (Untreated control) treatment.

In case of weight of infested fruits/plot and percent of infestation at the early reproductive stage of bottle gourd, the highest weight of infested fruits/plot (2.12 kg) were harvested from T_7 (Untreated control) which was statistically

similar by 2.00 kg in T_6 (Sticky board trap), whereas, the lowest weight of infested fruits/plot (1.13 kg) were collected from T_5 (Funnel pheromone trap) which was closely followed by 1.47 kg in T_1 (Pheromone trap) treatment. On the other hand, the lowest percent of infestation (4.40) were observed from T_5 (Funnel pheromone trap) treatment which was closely followed by 5.88 in T_1 (Pheromone trap). In the same way, the highest percent of infestation (10.53) were observed from T_7 (Untreated control) which was closely followed by 9.36 in T_6 (Sticky board trap) treatment (Table 5).

Table 5: Efficacies of different traps against cucurbit fruits fly on the basis of infested fruits and fruit infestation by weight at early reproductive stage of bottle gourd

Treatments	Weight of fruits/plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (kg)		
T_1	23.47 ab	1.47 d	5.88 d	44.16
T_2	21.53 cd	1.73 bc	7.45 c	44.16
T_3	21.87 bc	1.40 d	6.02 d	42.83
T_4	20.07 de	1.87 bc	8.51 bc	19.18
T_5	24.60 a	1.13 e	4.40 e	58.21
T_6	19.40 e	2.00 ab	9.36 b	11.11
T_7	17.60 f	2.12 a	10.53 a	--
$LSD_{(0.05)}$	1.69	0.18	1.10	--
Level of significance	0.05	0.05	0.05	--
CV(%)	4.86	5.32	6.93	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications
[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

From the results in table 5 showed significant variations due to the effect of different traps on percent infestation of reduction over control of bottle gourd at the early reproductive stage. Among different traps, T_5 (Funnel pheromone trap) showed more reduction (58.21%) of infestation due to cucurbit fruit fly and supported to make sure the more yield of bottle gourd.

In the similar trend, T_6 (Sticky board trap), showed lower performance to control cucurbit fruit fly while minimum reduction (11.11%) was recorded on bottle gourd (Table 5). As a result, the order of efficacy of different traps in terms of fruit infestation reduction by weight at early reproductive stage is T_5> T_1 and T_2> T_3> T4> T_6> T_7.

3.4.2 At the mid reproductive stage of bottle gourd

At the mid reproductive stage of bottle gourd, the consequence of different traps on the weight of healthy fruits/plot has been represented in Table 6. From this table it was observed that, the highest weight of healthy fruits/plot (34.60 kg) was recorded from T_5 (Funnel pheromone trap) closely followed by 32.20 kg and 31.87 in T_1 (Pheromone trap) and T_3 (Vinegar with rotted fruit trap) treatments respectively, whereas the lowest weight of healthy fruits/plot (25.80 kg) was harvested from T_7 (Untreated control) treatment which were followed with 28.40 in T_6 (Sticky board trap) treatment.

Accordingly weight of infested fruits/plot and percent of infestation at the early reproductive stage of bottle gourd, the highest weight of infested fruits/plot (5.00 kg) were harvested from T_7 (Untreated control) which was statistically similar by 4.20 kg in T_6 (Sticky board trap), whereas, the lowest weight of infested fruits/plot (2.20 kg) were collected from T_5 (Funnel pheromone trap) which was closely followed by 2.60 kg in T_1 (Pheromone trap) treatment. On the other hand, the lowest percent of infestation (5.97) were observed from T_5 (Funnel pheromone trap) treatment which was closely followed by 7.48 in T_1 (Pheromone trap). In the same way, the highest percent of infestation (16.24) were observed from T_7 (Untreated control) which was closely followed by 12.88 in T_6 (Sticky board trap) treatment (Table 6).

From the results in table 6 showed significant variations due to the effect of different traps on percent infestation of reduction over control of bottle gourd at the mid reproductive stage. Among different traps, T_5 (Funnel pheromone trap) showed more reduction (63.24%) of infestation due to cucurbit fruit fly and supported to make sure the more yield of bottle gourd.

On the other hand, T_6 (Sticky board trap), showed lower performance to control cucurbit fruit fly while minimum reduction (20.69%) was recorded on bottle gourd.

Similar trend of results were also observed at the late reproductive stage of bottle gourd on the basis of healthy fruits, infested fruits and fruit infestation by weight from Table 7.

As a result, the order of efficacy of different traps in terms of fruit infestation reduction by weight at mid and late reproductive stage of bottle gourd is T_5> T_1 > T_3> T_2> T_4> T_6> T_7.

Table 6: Efficacies of different traps against cucurbit fruits fly on the basis of infested fruits and fruit infestation by weight at mid reproductive stage of bottle gourd

Treatments	Weight of fruits/plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (kg)		
T_1	32.20 ab	2.60 f	7.48 g	53.94
T_2	30.20 bc	3.80 c	11.18 d	53.94
T_3	31.87 ab	3.00 e	8.61 f	46.98
T_4	30.07 bc	3.40 d	10.16 e	37.44
T_5	34.60 a	2.20 g	5.97 h	63.24
T_6	28.40 cd	4.20 b	12.88 c	20.69
T_7	25.80 de	5.00 a	16.24 a	--
$LSD_{(0.05)}$	3.04	0.40	0.64	--
Level of significance	0.05	0.05	0.01	--
CV(%)	6.14	5.55	4.90	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications
[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana

mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

Table 7: Efficacies of different traps against cucurbit fruits fly on the basis of infested fruits and fruit infestation by weight at late reproductive stage of bottle gourd

Treatments	Weight of fruits/plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (kg)		
T_1	30.80 b	2.53 d	7.64 e	47.46
T_2	28.20 c	2.87 cd	9.24 d	47.46
T_3	30.60 b	2.13 e	6.52 e	55.16
T_4	27.80 c	3.20 bc	10.32 cd	29.02
T_5	33.20 a	1.80 e	5.13 f	64.72
T_6	26.20 c	3.40 ab	11.50 c	20.91
T_7	21.20 e	3.60 a	14.54 a	--
$LSD_{(0.05)}$	2.21	0.33	1.22	--
Level of significance	0.05	0.01	0.05	--
CV(%)	4.82	5.80	6.19	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

3.4 Effect of different traps against cucurbit fruit fly and its impact on yield contributing characters of bottle gourd, *Lagenaria siceraria*

Length of fruit: The impact of different traps on length of healthy fruits of bottle gourd has been shown in Table 8. Significant variations were observed among the treatments in terms of length of healthy fruits. The highest length of single fruit (55.91cm) was recorded in T_5 (Funnel Pheromone trap) which was statistically similar with 55.27cm in T_1(Pheromone trap), 54.21cm in T_3 (Vinegar with rotted fruit trap), 53.52cm in T_2 (Bait trap with sweet gourd mashed) and followed by 51.08cm in T_4 (Bait trap with banana mashed). On the other hand the lowest length of bottle gourd was 45.39 cm in T_7 (Untreated control), which was statistically similar with 48.68 cm in T_6 (Sticky board trap) treatment.

From the above finding it was observed that, T_5 (funnel pheromone trap) treatment was showed the best performance for the length of bottle gourd.

Girth of fruit: The impact of different traps on Girth of healthy fruits of bottle gourd has been shown in Table 8. Significant variations were observed among the treatments in terms of girth of healthy fruits. The highest girth of single fruit (25.0 cm) was recorded in T_5 (Funnel Pheromone trap) which was statistically similar with 24.55 cm in T_1 (Pheromone trap) and closely followed by 22.97cm and 22.28 in T_3 (Vinegar with rotted fruit trap) and in T_2 (Bait trap with sweet gourd mashed) treatments respectively. On the other hand, the lowest girth of bottle gourd was 20.97 cm recorded in T_7 (Untreated control) which was statistically similar with 21.11 cm in T_6 (Sticky board trap) and followed by 21.86 cm in T_4 (Bait trap with banana mashed) treatment (Table 8).

From the above finding it was observed that the highest bottle gourd girth was found in T_5 funnel pheromone trap.

Single fruit weight: The impact of different traps on single fruit weight of healthy fruits of bottle gourd has been shown in Table 8. Significant variations were observed among the treatments in terms of single fruit weight of healthy fruits. From this table, it was revealed that the highest single fruit weight was (2.95 kg) recorded in T_5 (Funnel Pheromone trap) which was statistically similar with 2.85 kg in T_1 (Pheromone trap) treatment. On the other hand the lowest single fruit weight was 1.90kg recorded in T_7 (Untreated control) which was statistically similar with 1.95kg in T_6 (Sticky board trap) followed by 2.20 in T_4 (Bait trap with banana mashed) treatment.

Table 8: Effect of different traps against cucurbit fruit fly and its impact on yield contributing characters of bottle gourd, *Lagenaria siceraria*

Treatments	Length of single fruit (cm)	Girth of single fruit (cm)	Single fruit weight (kg)
T_1	55.27 ab	24.55 ab	2.85 ab
T_2	53.52 ab	22.28 abc	2.35 c
T_3	54.21 ab	22.97 abc	2.65 b
T_4	51.08 abc	21.86 bc	2.20 cd
T_5	55.91 a	25.00 a	2.95 a
T_6	48.68 bc	21.11 c	1.95 de
T_7	45.39 c	20.97 c	1.90 e
$LSD_{(0.05)}$	6.134	2.696	0.246
Level of significance	0.01	0.05	0.01
CV(%)	6.73	7.72	7.37

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

3.5 Effect of different traps against cucurbit fruit fly in bottle gourd on the basis of yield/ha during total cropping season

3.5.1 On the basis healthy fruits yield by weight during total cropping season

Significant variation was observed in terms of healthy fruit yield and increase of healthy fruit yield over control at the total cropping season of bottle gourd. Result showed that the highest yield of healthy fruits (69.96 t/ha) was observed in T_5 (Funnel Pheromone trap) treatment which was closely followed by 66.89 t/ha in T_1 (Pheromone trap); 65.14 t/ha in T_3 (Vinegar with rotted fruit trap) treatment, whereas the lowest yield of healthy fruits (57.32 t/ha) was observed in untreated control (T_7) treatment which was followed by 60.74 t/ha and 63.91 t/ha in T_6 (Sticky board trap) and in T_4 (Bait trap with banana mashed) treatments respectively. In the same way, the per cent increase of healthy fruit yield over control during the cropping season of bottle gourd was

18.07% in treatment T_5 (Funnel Pheromone trap) followed by 14.31% in T_1 (Pheromone trap). The transitional per cent increase of yield over control was recorded in T_3 (14.31%) treatment (Table 9).

3.5.2 On the basis infested fruits yield by weight during total cropping season

From table 9, significant variation was observed in terms of infested fruit yield and decrease of infested fruit yield over control at the total cropping season of bottle gourd. Result showed that the highest yield of infested fruits (25.71 t/ha) was observed in untreated control (T_7) treatment which was closely followed by 24.64 t/ha in T_6 (Sticky board trap) treatment, whereas the lowest yield of infested fruits (19.45 t/ha) was observed in T_5 (Funnel Pheromone trap) treatment which was followed by 21.38 t/ha in T_1 (Pheromone trap); 22.50 t/ha and in T_2 (Bait trap with sweet gourd mashed) and 22.44 t/ha in T_3 (Vinegar with rotted fruit trap) treatments respectively. Similarly, the per cent decrease of infested fruit yield over control during the cropping season of bottle gourd was 32.19% in treatment T_5 (Funnel Pheromone trap) followed by 20.25% in T_1 (Pheromone trap). The transitional per cent decrease of yield over control was recorded in T_2 (14.27%) treatment.

Table 9: Effect of different traps against cucurbit fruit fly in bottle gourd on the basis of yield/ha during total cropping season

Treatments	Healthy fruit yield (t/ha)	Percent increase over control	Infested fruit yield (t/ha)	Percent decrease over control
T_1	66.89 ab	14.31	21.38 d	20.25
T_2	64.35 abc	10.92	22.50 cd	14.27
T_3	65.14 ab	12.00	22.44 cd	0.73
T_4	63.91 abc	10.31	23.69 bc	0.48
T_5	69.96 a	18.07	19.45 e	32.19
T_6	60.74 bc	5.97	24.64 ab	0.26
T_7	57.32 c	--	25.71 a	--
$LSD_{(0.05)}$	6.868	--	1.705	--
Level of significance	0.05	--	0.01	--
CV(%)	6.54	--	5.14	--

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. Values are the means of three replications

[T_1: Pheromone trap; T_2: Bait trap with sweet gourd mashed; T_3: Vinegar with rotted fruit trap; T_4: Bait trap with banana mashed; T_5: Funnel pheromone trap; T_6: Sticky board trap and T_7: Untreated control]

3.6.1 Relationship between number of captured fruit fly and percent of fruit infestation among different traps:

Correlation study was done to establish the relationship between number of captured fruit fly and percent of fruit infestation among different traps. From the Figure 2, it was revealed that negative correlation was observed between the parameters. It was evident that the equation y = - 0.519x + 11.46 gave a good fit to the data and the co-efficient of determination (R^2 = 0.943) fitted regression line had a significant regression co-efficient. It may be concluded from the figure that the percent of fruit infestation was strongly as well as negatively correlated with number of captured fruit fly/trap. Percent of fruit infestation /treated plot was decreased due to increase of the number of captured fruit fly/trap.

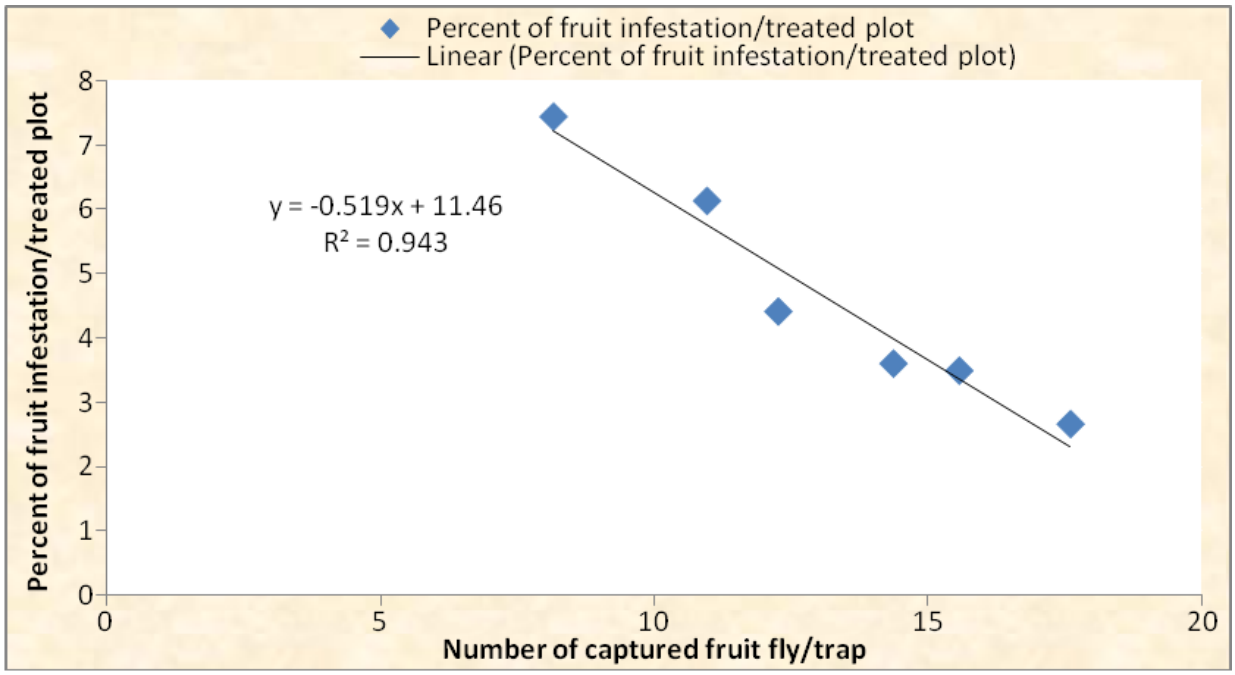

Figure 2: Relationship between number of captured fruit fly and percent of fruit infestation among different traps

3.6.2 Relationship between number of captured fruit fly and Healthy fruit yield among different traps

Correlation study was done to establish the relationship between number of captured fruit fly and Healthy fruit yield (ton/ha) among different traps. From the Figure 3, it was revealed that positive correlation was observed between the parameters. It was evident that the equation y = = 0.886x + 53.49 gave a good fit to the data and the co-efficient of determination (R^2 = 0.945) fitted regression line had a significant regression co-efficient. It may be concluded from the figure that the Healthy fruit yield was strongly as well as positively correlated with number of captured fruit fly/trap. Healthy fruit yield (ton/ha) was increased due to increase of the number of captured fruit fly/trap.

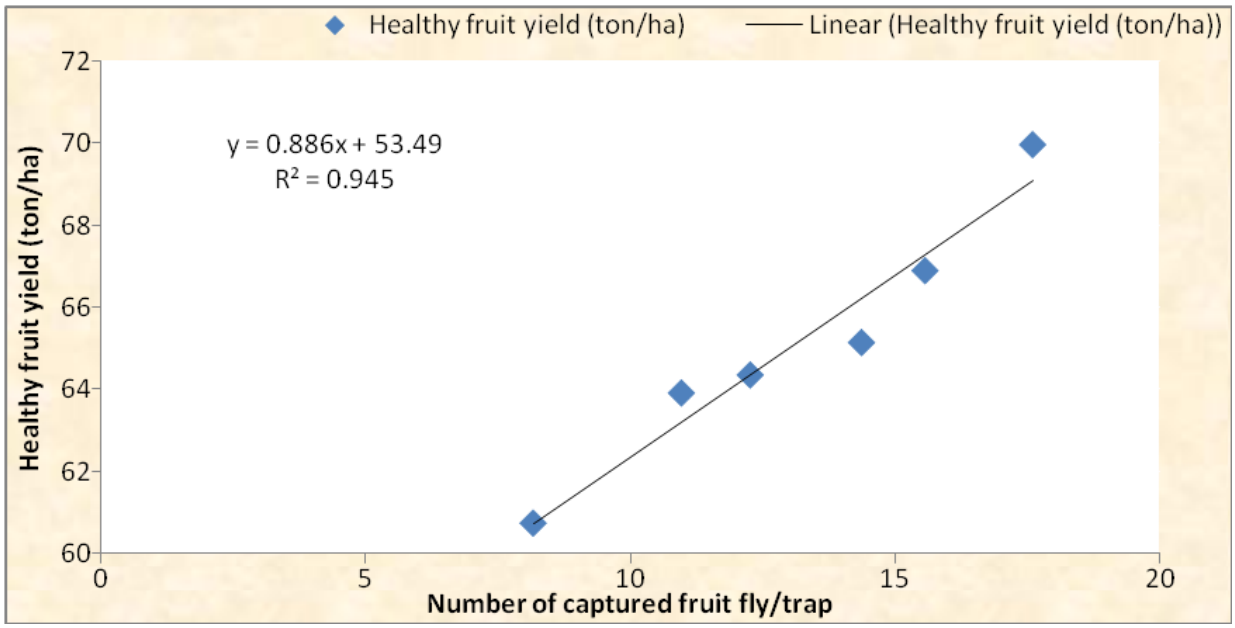

Figure 3: Relationship between number of captured fruit fly and healthy fruit yield among different traps

References

[1] Agarwal, M.I., Sharma, D.D. and Rahman, O. (1987). Melon fruit fly and its control. *Indian Hort*. **32**(2): 10-11.

[2] Akhtaruzzaman, M., Alam, M.Z. and Sardar, M.A. (2000). Efficacy of different bait sprays for Suppressing fruit fly on cucumber. Bulletin of the Institute of the Tropical Agriculture, Kyushu University**. 23:** 15-26.

[3] Alam, M.Z. (1969). Insect pests of vegetables and their control in East Pakistan. ARI, Dacca Farm, Dacca-1215, 144 p.

[4] Anonymous. (2001). Research and development of vegetables crops. Paper presented in the workshop on research and development of vegetable crops; held on march 9-10,2001 at IPSA, Gazipur, Bangladesh.pp1-7.

[5] Banerji, R. Sahoo, S.K. Das, S.K. and Jha, S. (2005). Studies on incidence of melon fly, *Bactrocera cucurbitae* (Coq.) in relation to weather parameters on bitter gourd in new alluvial zone of West Bengal. *J. of Entomol. Res.*, **29**: 179-82.

[6] BBS. (2008). *Statistical Year Book of Bangladesh 2002. Bangladesh Bureau of Statistics (BBS).* Planning Division, Ministry of Planning, Governrnent of the Peoples Republic of Bangladesh, Dhaka.144p

[7] Butani, D.K. and Jotwani, M.G. (1984). Insects in vegetables. Periodical Expert Book Agency. Vivek-vihar, Delhi, India. 69p.

[8] Chaudhary, F. K., Patel G. M. (2007). Biology of melon fly, *Bactrocera cucurbitae* (Coq.) on pumpkin. *Indian Journal of Entomology*, 69(2): 168-171.

[9] Gupta, D. and Verma, A.K. (1995). Host specific demographic studies of the melon fruit fly, *Dacus cucurbitae* Coquillett (Diptera: Tephritidae). *J. Insect Sci*. **8**: 87-89.

[10] Hollingsworth, R., Vagalo, M. and Tsatsia, F. (1997). Biology of melon fly, with special reference to the Solomon Islands. In: Allwood AJ and Drew RAI editors. Management of fruit flies in the Pacific. *Proc. Australian Ind. Agric. Res*. **76**: 140-144.

[11] Kabir, S.M. Rahman , H., R. and Molla, M.A.S. (1991). Host plants of Dacinae fruit flies (Diptera: Tephritidae) of Bangladesh. *Bangladesh Journal of Entomology*. **1**:60-75.

[12] Karim, M. A. (1992). Management of insect pests of vegetables. **In**: M.L. Chandha, K. U. Ahmed, S. Shanmugasundaram and A. Quasem 1995. (eds.) vegetable crops

[13] Khan, L., Haq, M.U., Mohsin, A.U. and Inayat-Tullah, C. (1993). Biology and behavior of melon fruit fly, *Dacus cucurbitae* Coq. (Diptera: Tephritidae). *Pakistan J. Zool.* **25**: 203-208.

[14] Koul, V.K. and Bhagat, K.C. (1994). Biology of melon fruitfly, *Bactrocera (Dacus) cucurbitae* Coquillett (Diptera: Tephritidae) onbottle gourd. *Pest Manage. Econ. Zool.* **2**: 123-125.

[15] Lalla, B. S., Sinha, S. N. (1959). On the biology of the melon fly, *Dacus cucurbitae* Coquillet (Diptera: Trypetidae) *Science Culture*, 25(2): 159-160.

[16] Laskar, N. (2013). Biology and biometrics of melon fruit fly, *Bactrocera cucurbitae* (Coq.) on bitter gourd, *Momordica charantia* L. and pumpkin, *Cucurbita pepo* L. *Current Biotica,* **7**(1&2): 51-59

[17] Narayanan, E.S. and Batra, H. N. (1960). Fruit flies and Their Control Indian Council of Agricultural Research, New Delhi. p. 68.
[18] Patel, R.K. and Patel, C.B. (1996). Influence of weather parameters on incidence of fruit fly, *Dacus ciliatus* on little gourd. *Indian J. of Entomol.*,**58**(3): 239-44.
[19] Patel, N. V. (2007). Biology of fruit fly *D. cucurbitae* Coq. on cucurbits and chemical on bittergourd. M.Sc. (Agri.) thesis submitted to the Gujarat Agricultural University, Sardarkrushinagar, pp-125.
[20] Patnaik, H.P. Sarangi, P.K. Mahapatra, P. (2004). Studies on the incidence of fruit flies and jassids on summer bitter gourd and their control. *Orissa J. of Hort.*, **32**(2): 87-90.
[21] Shah, M.I., Batra, H.N. and Ranjhen, P.L. (1984). Notes on the biology of *Dacus* (Strumeta) *ferrugineus* Fab. and other fruit flies in the North-West Frontier Province. *Indian J.Entomol*.**10**:249–266.