

Incidence and Ecofriendly Management of Capsicum Fruit Borer

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Abstract: An experiment was conducted in the experimental field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from October 2021 to February 2022 to study the incidence and ecofriendly Management of Capsicum fruit borer. The experiment consists of control measures and plant extract. The experiment was laid out in Randomized Complete Block Design replicated with four times. For this study having six treatment, viz. Treatment T_1 : Sanitation + Netting; T_2 : Field sanitation + Mulching of soil; T_3 : Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T_4 : Mulching + leaf extract of neem at the 7 days intervals; T_5 : Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T_6 : Control were included in this study. were used. Results showed that the significant variations were observed among seven treatments, it was observed that treatment T_3 (Field sanitation + Spinosad at the 7 days intervals at the 7 days intervals) was the most effective treatment for reducing insect pest's infestation at total growing stages. The lowest performance observed in T_6 (Control) was followed by T_1 (Sanitation + Netting) treatment. The highest total yield hectare⁻¹ was found from P_2 (28.43 ton), while the lowest yield hectare⁻¹ was found from T_6 (24.54 ton) treatment. The yield of capsicum was highly significant ($p=0.05$), very strong and negatively correlated with infested fruit yield (t/ha) i.e., the total yield of capsicum increased with the infested fruit yield (t/ha) decreased

Keywords: Entomology, Capsicumfruitborer, Field sanitation, Eco; management

I. INTRODUCTION

Bangladesh is an agricultural country. The agro-ecological condition of Bangladesh is highly favorable for the cultivation of different fruits and vegetables. Sweet pepper is one of the most important vegetable crops grown extensively throughout the world especially in the temperate countries. In Bangladesh, fruit cultivation area is about 137,557.08 ha with the production of 45869,188 tons in 2017–2018 (BBS 2018). In Bangladesh Capsicum cultivation is profitable but there are some problems faced by the Capsicum producers which is the damage caused by infestation of major Capsicum insect pests. Among them Aphids, pepper weevils, maggots, flea beetles, hornworms, leaf miners, and cutworms are the most common capsicum insect pests. They cause severe damage during the different growing periods of Capsicum production Viral diseases usually cause abnormal growth since they affect the metabolism of plant cells. Aphids spread mosaic virus from one plant to another. Seed production for capsicum is inadequate. Most of the seeds used for cultivation are imported. Capsicum (*Capsicum annuum* L.), commonly known as sweet pepper, belongs to family Solanaceae, and is one of the most important economical and popular vegetable crops cultivated as an annual crop worldwide. The species spreads by seed, which it produces profusely, and it has been transported through human and animal consumption as well as economic trade for hundreds of years (Basu and De 2003). It has been widely cultivated around the world as a valuable food and medicinal plant (Basu and De 2003; FAO EcoCrop 2014). The world's main pepper-producing countries include China, Mexico, and Turkey, with over 17.4, 2.7, and 2.5 million pepper tons in 2016, respectively (Aman Dekebo 2022). Other European countries and Canada are important producers of greenhouse peppers, with 135 million kg of peppers grown where yield is ≤ 12 t/ha, and sweet pepper is subject to several pests, such as beetles, caterpillars, aphids, and thrips. Alternative control methods of pests to exclusively use of insecticides and integrated pest management (IPM) such as cultural, biological, and chemical treatments were used to manage sweet pepper pests (Aman Dekebo 2022). It is one of the important cash crops grown in almost all parts of the

country and is widely grown in the tropics and subtropics as also under glass houses in temperate regions. China, Spain, Mexico, Romania, Yugoslavia, Bulgaria, USA, India, Europe and Central and South America are the major countries of capsicum production. The insect pests cause significant damage to the chilli crop. There are 39 genera and 51 species of insects and mites attacking chilli in the field, and in the storage, which includes thrips, aphids, whiteflies, fruit borers, cutworms, plant bug, mites and other minor pests (Sorensen 2005). Aphids, thrips, and jassids are the major insect pest of chilli (Jadhav *et al.* 2014). Aphids, Thrips and pod borer are the common pest of Capsicum. Thrips suck the sap from the leaves. It can be controlled by the spraying of 0.25% Nicotine sulphate. Aphids suck the cell sap from the leaves and petioles and cause considerable plant damage. This can be controlled by the application of Dimeton Methyl (0.05-0.02%). There are a number of predators available for biological control of thrips: predatory mites *Amblyseiusdegenerans*, *Amblyseiuscucumeris*, *Hypoaspis miles* and *Hypoaspisaculeifer* and predatory bugs, *Oriusinsidiosus* and other *Orius* species. To find out the effective method for controlling a particular pest, it is necessary to know the biology and ecology of the pest, its habit and habitats, its food and feeding pattern etc. In Bangladesh sufficient information on Aphids, Thrips and Mites, pod borer for its management in relation to capsicum is not available so far and no in-depth studies have been made. The chemical insecticides still remain the key tools for the management of the pest. Under the perspective, application of these integrated management packages thought to be eco-friendly components for the management of selected insects.

II. MATERIALS AND METHODS

The experiment was conducted to study the Incidence and Ecofriendly Management of Capsicum fruit borer during the period from January 2021 to March 2021 in the experimental area of Shere-Bangla Agricultural University (SAU), Shere-Bangla Nagar, Dhaka-1207, Bangladesh. The location of the site is 23°74'N latitude and 90°35'E longitude with an elevation of 8.4 meter from sea level.

A. Weather condition during the crop season

The climate of experimental site was subtropical, characterized by the winter season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al.*, 1979). The mean highest and mean lowest temperatures in the 6 months are 31.6°C and 18.17°C respectively.

B. Soil

The soil of the experimental field belongs to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon soil series. Ranges of soil PH from 5.4-5.6.

C. Land preparation

The target land was divided into 24 equal plots (1.2 m×1.5m) with plot to-plot distance of 0.50 m and block to block distance is 0.75 m. The land of the experimental field was ploughed with a power tiller. After ploughing and laddering, all the stubbles and uprooted weeds were removed and then the land was ready. The field layout and design of the experiment were followed immediately after land preparation.

D. Manure and fertilizer

Recommended fertilizers were applied at the rate of 60 kg urea, 70 kg triple super phosphate (TSP), 60 kg muriate of potash (MoP), 25 kg Gypsum and 1.25 kg Zinc oxide per hectare were used as source of nitrogen, phosphorus, potassium, Sulphur and zinc, respectively. Moreover, well-decomposed cow dung (CD) was also applied at the rate of 20 ton/ha to the field at the time of land preparation (Miah *et al.* 2005).

E. Design of experiment and layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The whole area of experimental field was divided into 4 blocks and each block was again divided into 6-unit plots. Total plot was 24. The size of the unit plot was 1.5 m×1.5 m. The block to block and plot-to-plot distance was .75m and 0.50m, respectively.

F. Collection of seed, seedling raising

The seeds of selected capsicum varieties i.e. Yellow capsicum (bell pepper) were collected from Siddik Bazar, Gulistan, Dhaka. Before sowing, the germination test of seeds was done and, on an average, 92% germination was found for these varieties. After germination, the seedlings were sprayed with water by a hand sprayer. Soil was spaded 3 or 4 days a week.

G. Seedling transplanting

The 20 days old healthy and uniform sized seedlings of capsicum varieties were transferred in polybag. Then 25 days old healthy transferred seedlings were transplanted in the main field. Each plot contains 12 seedlings of capsicum with 2 rows followed by 50cm x 50cm (row to row and plant to plant distance, respectively).

H. Cultural practices

After transplanting, a light irrigation was given. Subsequent irrigation was applied in all the plots as and when needed. Various intercultural operations like gap filling, weeding, earthen up, drainage, sticking, netting, fencing, binding etc. was done as and when necessary to cultivate capsicum.

I. Treatments

Six treatment combinations will be tested in this experiment:

T₁: Sanitation + Netting

T₂: Field sanitation + Mulching of soil

T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals

T₄: Mulching + leaf extract of neem at the 7 days intervals

T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals

T₆: Control

J. Data collection

Data were collected some pre-selected parameters like incidence of insect pest and yield contributing characteristics was counted from treated and untreated plots of capsicum throughout the growing stage starting from 20 days after transplanting.

K. Number of insect pests of Capsicum and number of infested fruits caused by fruit borer

Incidence of insect pest

Data were collected on the number of insect pest randomly selected four tagged plants per plot and counted separately for each treatment. Then larvae were counted using hand magnifying glass and calculated as plant⁻¹. This operation was done at an interval of 10 days at each harvest during different stage of the plant from six plants of each plot.

Number and weight of the healthy and infested capsicum fruits

Data were collected on the number of healthy and infested capsicum fruits per plot which was harvested at fully mature stage of fruit and weighted separately for each treatment.

Percent of infested fruit by insect pests of capsicum

Number of fruits was counted from total fruit per four plants and percent fruit infestation by insect pests of capsicum were calculated as follows:

$$\% \text{ Of infested fruit} = \frac{\text{Number of infested capsicum leaves}}{\text{Total number of capsicum leaves}} \times 100$$

Percent fruit infestation by number

Infested fruits were counted from total harvested and the percent capsicum fruit infestation was calculated using the following formula:

$$\% \text{ Fruit infestation (number)} = \frac{\text{Number of the infested fruit}}{\text{Total number of fruits}} \times 100$$

Percent fruit infestation by weight

Weight of the infested capsicum fruits were recorded from total weight of the harvested capsicum fruit and the percent capsicum fruit infestation by weight was calculated using the following formula:

$$\% \text{ Fruit infestation (number)} = \frac{\text{Number of the infested fruit}}{\text{Total number of fruits}} \times 100$$

Percent fruit infestation by weight

Weight of the infested capsicum fruits were recorded from total weight of the harvested capsicum fruit and the percent capsicum fruit infestation by weight was calculated using the following formula.

$$\% \text{ Fruit infestation (weight)} = \frac{\text{Weight of the infested fruit}}{\text{Total weight of fruit}} \times 100$$

Percent reduction of capsicum fruit infestation over control

The number and weight of infested capsicum fruit and total capsicum fruit for each treated plot and untreated control plot were recorded and the percent reduction of capsicum fruit infestation in number and weight was calculated using the following formula:

$$\% \text{ Fruit infestation reduction over control} = \frac{X_2 - X_1}{X_2} \times 100$$

Where, X₁ = the mean value of the treated plot

X₂ = the mean value of the untreated plot

Statistical analysis

Data statistically analyzed by randomized complete block design through Statistic 10.0 software and LSD range tests was used to determine the Incidence and Ecofriendly Management of Capsicum fruit borer with regards to study fruit borer infestation and yield contributing characteristics.

III. RESULTS AND DISCUSSION

Performance of six treatments was investigated and the findings of the present study have been discussed under different characters on infestation by insect pest. The result of the study showed marked variation in different characters and the variation of different characters are presented in the following Tables, Figures and Plates.

A. Incidence of Capsicum fruit borer

At the Vegetative stage of Capsicum

At the Vegetative stage of Capsicum, the consequence of different treatments on the number of healthy fruits/6 plant has been shown in **Table 1**. From this table it was revealed that, the highest number of healthy fruits/6 plant (21.75) was recorded from T₃ (Field sanitation + Spinosad (Tacer) @ 0.5ml/L of water at the 7 days intervals) which statistically different from all others treatment. In the same way, the lowest percent of infestation (1.14) were observed from T₃ (Field sanitation + Spinosad (Tacer) @ 0.5ml/L of water at the 7 days intervals) treatment. On the other hand, the highest percent of infestation (29.87) were observed from T₆ (Untreated control) which was closely followed by (12.16) in T₁ treatment. As a result, the order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at Vegetative stage of Capsicum is T₃ > T₅ > T₄ > T₂ > T₁ > T₆.

Table 1: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by number at Vegetative stage of Capsicum

Treatments	Healthy fruits (No.)	Infested fruits (No.)	% infestation	Infestation reduction over control (%)
T ₁	16.25 cd	2.25 b	12.16 b	59.28
T ₂	17.33 cd	1.67c	1.89 c	70.57
T ₃	21.75 a	0.25 e	1.14 f	96.20
T ₄	17.75 bc	1.25 d	6.58 d	77.97
T ₅	19.50 b	0.50 e	2.50 e	91.63
T ₆	13.50 e	7.75 a	29.87 a	--
LSD (0.05)	1.94	0.41	0.41	--
CV (%)	6.29	9.70	6.82	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Tacer) @ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

B. At the early reproductive stage of Capsicum

The highest number of healthy fruits/6 plant (27.25) was recorded from T₃treatment which statistically different from all others treatment. In case of number of infested fruits/6 plant at the early reproductive stage of Capsicum, the highest number of infested fruits/6 plant were collected from (10.75) T₆ (Untreated control) treatment. In the same way, the lowest percent of infestation (5.22) were observed from T₃treatment and infestation (38.28) were observed from T₆ (Untreated control) which was closely followed by (12.77) in T₁ treatment. the order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at early reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 2: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by number at early reproductive stage of Capsicum

Treatments	Number of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T ₁	22.75 cd	3.33 bc	12.77 b	66.65
T ₂	24.25 bc	3.25 bc	11.82 b	69.13
T ₃	27.25 a	1.50 e	5.22 e	86.37
T ₄	25.33 ab	2.75 cd	9.79 c	74.42
T ₅	26.25 ab	2.33 de	8.15 d	78.70
T ₆	17.33 e	10.75 a	38.28 a	--
LSD (0.05)	2.31	0.90	0.98	--
CV (%)	5.52	9.82	3.83	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Tacer)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

C. At the mid reproductive Stage of Capsicum

The highest number of healthy fruits/6 plant (42.25) was recorded from T₃ (which statistically different from all others treatment. whereas the lowest number of healthy fruits/6 plant (31.67) was recorded from T₆ (Untreated control) treatment. In case of number of infested fruits/6 plant at the mid reproductive stage of Capsicum, the highest number of infested fruits/6 plant were collected from (17.75) T₆ (Untreated control)., the lowest number of infested fruits/6 plant were collected from (3.33) T₃treatment. The order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at mid reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 3: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by number at mid reproductive stage of Capsicum

Treatments	Number of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T ₁	37.33 b	5.67 bc	13.19 b	63.29
T ₂	37.75 b	5.25 c	12.21 bc	66.01
T ₃	42.25 a	3.33 d	7.31 d	79.66
T ₄	38.25 b	4.75 c	11.05 c	69.24
T ₅	39.33 b	3.67 d	8.53 d	76.24
T ₆	31.67 c	17.75 a	35.92 a	--
LSD (0.05)	2.76	0.93	1.47	--
CV (%)	4.13	7.82	5.61	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Tacer)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

At the late reproductive stage of

The highest number of healthy fruits/6 plant (58.67) was recorded from T₃ treatment. In case of number of infested fruits/6 plant at the late reproductive stage of Capsicum, the highest number of infested fruits/6 plant were collected from (25.67) T₆ (Untreated control). the lowest number of infested fruits/6 plant were collected from (3.33) T₃ treatment. In the same way, the lowest percent of infestation (5.37) were observed from T₃ treatment which was closely followed by (6.20) and (8.44) in T₅ and T₄ treatment respectively. the highest percent of infestation (37.79) were observed from T₆ (Untreated control) which was closely followed by (10.91) in T₁ treatment. As a result, the order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at late reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 4: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by number at late reproductive stage of Capsicum

Treatments	Number of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruits (No.)	Infested fruits (No.)		
T ₁	51.67 c	6.33 bc	10.91 bc	71.12
T ₂	52.33 bc	5.33 cd	9.24 cd	75.54
T ₃	58.67 a	3.33 f	5.37 e	85.79
T ₄	54.25 b	5.00 de	8.44 d	77.67
T ₅	56.75 a	3.75 ef	6.20 e	83.60
T ₆	42.25 d	25.67a	37.79 a	--
LSD (0.05)	2.12	1.29	1.79	--
CV (%)	2.28	9.05	7.86	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Tacer)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

D. Incidence of Capsicum fruit borer at weight basis

At the Vegetative stage of Capsicum

The highest weight of healthy fruits/6 plant (1.81 kg) was recorded from T₃ treatment. whereas the lowest weight of healthy fruits/6 plant (0.95 kg) was recorded from T₆ (Untreated control) treatment. In case of weight of infested fruits/6 plant at the Vegetative stage of Capsicum, the highest weight of infested fruits/6 plant were collected from (543

g) T₆ (Untreated control) and the lowest weight of infested fruits/6 plant were collected from (31 g) T₃ treatment. In the same way, the lowest percent of infestation on weight basis (1.68) were observed from T₃ treatment and the highest percent of infestation on weight basis (36.37) were observed from T₆ (Untreated control) which was closely followed by (8.82) in T₁ treatment. So, the order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at Vegetative stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 5: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by weight at Vegetative stage of Capsicum

Treatments	Weight of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (g)		
T ₁	1.55 b	150 b	8.82 b	75.74
T ₂	1.60 ab	115 c	6.71 c	81.56
T ₃	1.81 a	31 f	1.68 f	95.37
T ₄	1.65 ab	98 d	5.61 d	84.58
T ₅	1.71 ab	65 e	3.66 e	89.93
T ₆	0.95 c	543 a	36.37 a	--
LSD (0.05)	0.39	12.64	0.43	--
CV (%)	8.23	4.23	2.30	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

At the early reproductive stage of Capsicum

The highest weight of healthy fruits/6 plant (2.32 kg) was recorded from T₃ treatment, whereas the lowest weight of healthy fruits/6 plant (1.24 kg) was recorded from T₆ (Untreated control) treatment. In case of weight of infested fruits/6 plant at the early reproductive stage of Capsicum, the highest weight of infested fruits/6 plant were collected from (712 g) T₆ (Untreated control) and the other hand, the lowest weight of infested fruits/6 plant were collected from (128 g) T₃ treatment. In the same way, the lowest percent of infestation on weight basis (5.23) were observed from T₃ and the highest percent of infestation on weight basis (36.48) were observed from T₆ (Untreated control) which was closely followed by (14.85) in T₁ treatment. The order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at early reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 6: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by weight at early reproductive stage of Capsicum

Treatments	Weight of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (g)		
T ₁	1.87 cd	326 b	14.85 b	59.30
T ₂	1.95 b-d	302 c	13.41 b	63.23
T ₃	2.32 a	128 f	5.23 e	85.66
T ₄	2.02 bc	257 d	11.29 c	69.06
T ₅	2.11 b	209 e	9.01 d	75.29
T ₆	1.24 e	712 a	36.48 a	--
LSD (0.05)	2.11 b	209 e	9.01 d	--
CV (%)	1.24 e	712 a	36.48 a	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

At the mid reproductive stage of Capsicum

The highest weight of healthy fruits/6 plant (3.58 kg) was recorded from T₃ which was closely followed by (3.42 kg) in T₅ and (3.19 kg) T₄ treatment, whereas the lowest weight of healthy fruits/6 plant (2.06 kg) was recorded from T₆ (Untreated control) treatment. In case of weight of infested fruits/6 plant at the mid reproductive stage of Capsicum, the highest weight of infested fruits/6 plant were collected from (1036 g) T₆ (Untreated control) and the lowest weight of infested fruits/6 plant were collected from (212 g) T₃. In the same way, the lowest percent of infestation on weight basis (5.59) were observed from T₃ treatment which was closely followed by (7.44) and (9.14) in T₅ and T₄ treatment respectively. The highest percent of infestation on weight basis (33.46) were observed from T₆ (Untreated control) which was closely followed by (12.05) in T₁ treatment. The order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at mid reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 7: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by weight at mid reproductive stage of Capsicum

Treatments	Weight of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (g)		
T ₁	3.03 de	415 bc	12.05 b	64.00
T ₂	3.11 cd	350 cd	10.12 c	69.77
T ₃	3.58 a	212 e	5.59 e	83.29
T ₄	3.19 c	321 d	9.14 c	72.68
T ₅	3.42 b	275 de	7.44 d	77.76
T ₆	2.06 f	1036 a	33.46 a	--
LSD (0.05)	0.13	80.60	1.56	--
CV (%)	2.36	10.32	6.71	--

[Treatment T1: Sanitation + Netting; T2: Field sanitation + Mulching of soil; T3: Field sanitation + Spinosad (Tacer)@ 0.5ml/L of water at the 7 days intervals; T4: Mulching + leaf extract of neem at the 7 days intervals; T5: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T6: Control]

At the late reproductive stage of Capsicum

The highest weight of healthy fruits/6 plant (5.25 kg) was recorded from T₃ which was closely followed by (4.93 kg) in T₅ and (4.72 kg) T₄ treatment, whereas the lowest weight of healthy fruits/6 plant (3.14 kg) was recorded from T₆ (Untreated control) treatment. In case of weight of infested fruits/6 plant at the late reproductive stage of Capsicum, the highest weight of infested fruits/6 plant were collected from (1832 g) T₆ (Untreated control). On the other hand, the lowest weight of infested fruits/6 plant were collected from (329 g) T₃ which was closely followed by T₅ and T₄ at the 7 days intervals treatment. The lowest percent of infestation on weight basis (5.90) were observed from T₃. On the other hand, the highest percent of infestation on weight basis (36.85) were observed from T₆ (Untreated control) which was closely followed by (10.71) in T₁ treatment. So, order of Incidence and Ecofriendly Management of Capsicum fruit borer terms of fruit infestation reduction at late reproductive stage of Capsicum is T₃> T₅> T₄> T₂> T₁> T₆.

Table 8: Incidence and Ecofriendly Management of Capsicum fruit borer on the basis of infested fruits and fruit infestation by weight at late reproductive stage of Capsicum

Treatments	Weight of fruits/6 plant		% infestation	Infestation reduction over control (%)
	Healthy fruit (kg)	Infested fruit (g)		
T ₁	4.11 bc	493 bc	10.71 b	70.93
T ₂	4.27 bc	469 c	9.90 b	73.14
T ₃	5.25 a	329 d	5.90 d	84.00
T ₄	4.72 a-c	422 cd	8.21 c	77.73
T ₅	4.93 ab	396 cd	7.44 c	79.82

T ₆	3.14 d	1832 a	36.85 a	--
LSD (0.05)	0.86	105.05	1.36	--
CV (%)	7.11	9.15	5.84	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the : Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days.

E. Effect of different treatments against Capsicum fruit borer and its impact on yield contributing characters of Capsicum

Number of leaves: The highest number of leaf plant⁻¹ (50.22) was recorded in T₃ which was statistically similar with 48.32 in T₅, 47.75 in T₄ and followed by 45.33 in T₂ treatment. On the other hand, the lowest number of leaf plant⁻¹ of Capsicum was 40.02 in T₆ (Untreated control), which was statistically different from 44.82 in T₁ treatment.

Total number of fruit plant⁻¹: The highest total number of fruit plant⁻¹ (14.82) was recorded in T₃ which was statistically similar with 14.02 in T₅, 13.58 in T₄ and followed by 13.33 in T₂ treatment and the lowest total number of fruit plant⁻¹ of Capsicum was 11.16 in T₆ (Untreated control), which was statistically different from 13.17 in T₁ treatment.

Fruit length (cm): The highest length of single healthy fruits (13.58 cm) was recorded in T₃ which was statistically similar with 13.35 cm in T₅, 13.29 cm in T₄ and followed by 13.13 cm in T₂ treatment and the lowest length of single fruit of Capsicum was 11.48 cm in T₆ (Untreated control), which was statistically different from 12.98 cm in T₁ treatment.

Table 9. Effect of different treatments against Capsicum fruit borer and its impact on yield contributing characters of Capsicum

Treatments	Number of leaf's	Total number of fruit/ plants	Fruit length (cm)	Fruit diameter (cm)
T ₁	44.82 cd	13.17 b	12.98 ab	4.63 a
T ₂	45.33 b-d	13.33 b	13.13 ab	4.66 a
T ₃	50.22 a	14.82 a	13.58 a	4.82 a
T ₄	47.75 a-c	13.58 b	13.29 a	4.70 a
T ₅	48.32 ab	14.02 ab	13.35 a	13.35 a
T ₆	40.02 e	11.16 c	11.48 b	4.36 a
LSD (0.05)	3.04	1.23	1.79	0.74
CV (%)	3.74	5.21	7.76	8.92

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

F. Effect of different treatments against Capsicum fruit borer of Capsicum on the basis of yield/ha during total cropping season

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

That the highest yield of healthy fruits (27.68 t/ha) was observed in T₃ treatment which was closely followed by (26.87 t/ha) in T₅ and (26.33 t/ha) in T₄ treatment, whereas the lowest yield of healthy fruits (18.92 t/ha) was observed in untreated control (T₆) treatment which was followed by (25.12 t/ha) in T₅ and in T₁ treatments respectively.

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

that the lowest yield of infested fruits (0.75 t/ha) was observed in T₃ treatment which was closely followed by (0.93 t/ha) in T₅ and (1.06 t/ha) in T₄ treatment, whereas the highest yield of infested fruits (5.62 t/ha) was observed in untreated control (T₆) treatment which was followed (1.52 t/ha) in T₁ treatments respectively.

Table 10. Effect of different treatments against Capsicum fruit borer of Capsicum 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	25.12 bc	32.77	1.52 b	72.95
T ₂	25.71 a-c	35.89	1.36 bc	75.80
T ₃	27.68 a	46.30	0.75 d	86.65
T ₄	26.33 a-c	39.16	1.06 cd	81.14
T ₅	26.87 ab	30.18	0.93 cd	83.45
T ₆	18.92 c	--	5.62 a	--
LSD (0.05)	2.14	--	0.43	--
CV (%)	4.74	--	10.03	--

[Treatment T₁: Sanitation + Netting; T₂: Field sanitation + Mulching of soil; T₃: Field sanitation + Spinosad (Taccor)@ 0.5ml/L of water at the 7 days intervals; T₄: Mulching + leaf extract of neem at the 7 days intervals; T₅: Field sanitation + Neem oil @ 2.0 ml/L of water with detergent at the 7 days intervals; T₆: Control]

G. Relationship between yield contributing character and total yield of capsicum at farmer field

Relationship between total number of fruit/ plants and total yield of capsicum

A significant relationship was found between the total number of fruit/ plants and total yield of capsicum when correlation was made between these two parameters.

The highly significant ($p < 0.05$), very strong ($R^2 = 0.9523$) and negative ($y = -1.0557x + 30.178$) correlation was found between total number of fruit/ plants and total yield of capsicum, i.e. total yield of capsicum increased with the total number of fruit/ plants increased.

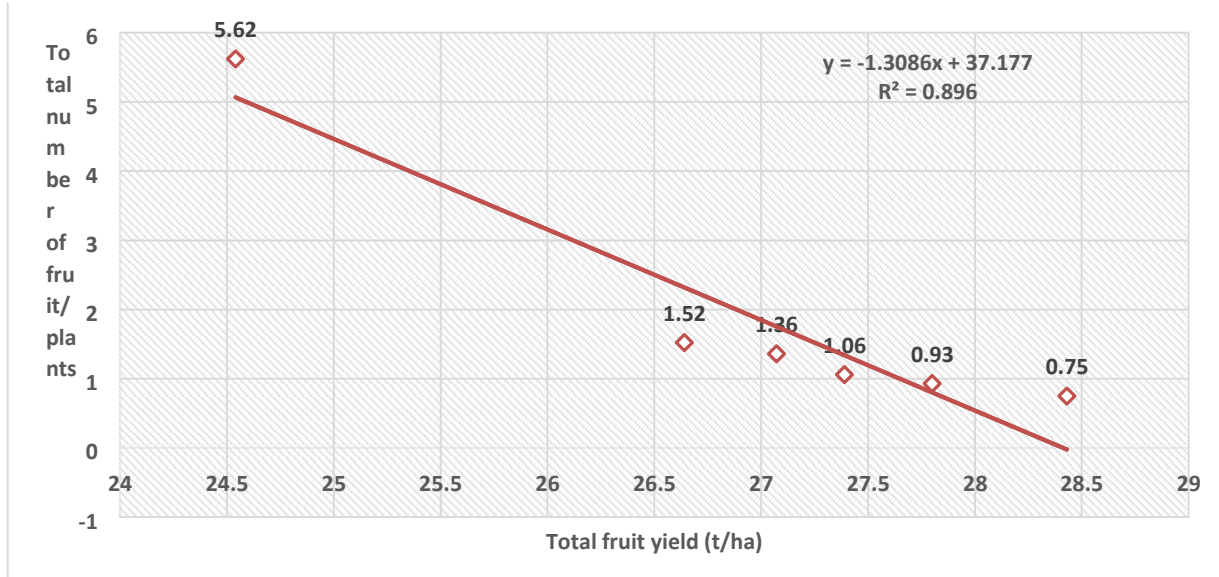


Figure 1. Relationship between total number of fruit/ plants and total yield of capsicum

Relationship between infested fruit yield (t/ha) and total yield of capsicum

A significant relationship was found between infested fruit yield (t/ha) and total yield of capsicum when correlation was made between these two parameters. The highly significant ($p < 0.05$), very strong ($R^2 = 0.9535$) and negative ($y = 0.7036x - 5.5191$) correlation was found between infested fruit yield (t/ha) and total yield of capsicum, i.e. total yield of capsicum increased with the infested fruit yield (t/ha) decreased.

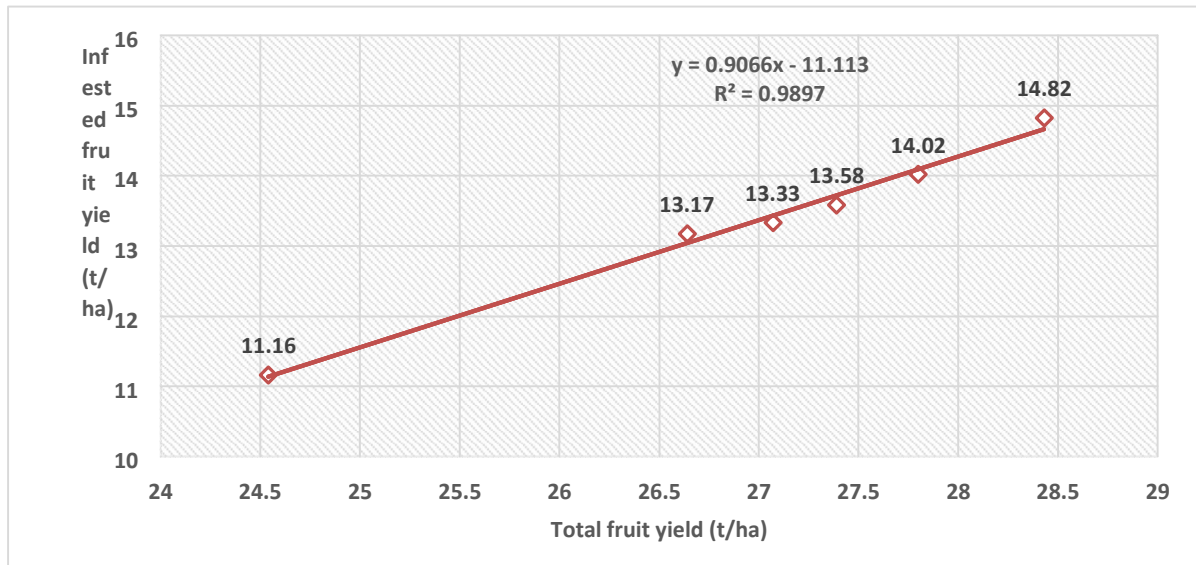


Figure 2. Relationship between infested fruit yield (t/ha) and total yield of capsicum

IV. CONCLUSION

The experiment was conducted in the experimental field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Among seven treatments, it was observed that treatment T₃ (Field sanitation + Spinosad (Tacer)@ 0.5ml/L of water at the 7 days intervals) was the most effective treatment for reducing insect pest's infestation at total growing stages.

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