Effect of temperature and BSFB population on the growth and yield of Brinjal

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Abstract - Brinjal shoot and fruit borer (BSFB) leucinodes orbonalis is very persist insect. The experiment on brinjal shoot and foot borer (BSFB) in brinjal was conducted from 5th July to 30th October in Bangabandhu Sheikh Mujibuer Rahman Agriculture university, Gazipur. The results indicated that the number of BSFB adult was higher in the vegetative stage than the reproductive stages, among the reproductive stages; late fruiting stage encountered the maximum mean number of BSFB adults (5). The population of BSFB adult is highly correlated with temperature. A correlation between the number of BSFB adults and the rate of infestation in shoots or fruits was found. This correlation indicated that for each individual adult caught BSFB 4.70% shoot and 4.123% fruit infestation by number and 6.4% fruit infestation by weight. Percent fruit infestation both by number and weight and the daily temperature are positively correlated, which is indicated by the correlation coefficient of 0.7030 by number and 0.56 by weight. Similar effects of higher temperature on the population increase and increased activity of many insect pests including BSFB have been reported.

Keywords - Vegetative stages, BSFB, infestation

I. INTRODUCTION

Brinjal (Solanum melongena L.) belonging to the family Solanaceae is a popular and economically important vegetable crop among small-scale farmers and low-income consumers of South Asia and this region accounts for nearly 60 percent and 53 percent of the world’s area and production, respectively [1]. Eggplant was introduced into Spain from India during the Moorish invasion from where it spread throughout Europe then into America. From India the domesticated non bitter types spread eastward into china by the fifth century BC [2]. Eggplant is a warm season crop requiring contentious long warm weather during growth and fruit maturation. The optimum growing temperature is 22°C-30°C and growth stops at a temperature below 17°C. According to [3] eggplant containing 92.70% water, 1.1% protein, 0.02% fat, 0.54% ash and 5.5% percent carbohydrate with calories of 130Ib having a source of vitamins A, B but poor in vitamin C. Brinjal is a source to produce antioxidants, vitamins, nutrients, dietary fiber, minerals, proteins and factors that build the body [4].

Eggplant is extensively cultivated in Bangladesh and is grown in kitchen and commercial gardens in both Rabi and Kharif season. It is an important vegetable occupying the second place in production following potato in Bangladesh [5]. The vegetables production in summer is scanty and eggplant plays an important role to cover this lean period.

The important vegetable is attacked by a dozens of insect pests among which the most serious and destructive one is the Brinjal shoot and fruit borer (BSFB), Leucinodes orbonalis Guenee [6, 7, 8, 9]. The incidence of the pest occurs either sporadically or in outbreak every through this country wherever eggplant is grown [10] as well as in the Indian sub-continent [11]. As a result of its attack, considerable damage can be observed every year affecting adversely the quality and yield of the crop. They are less active during February-April. This pest attack potato, tomato, peas [12] and other Solanaceous crops and wild Solanum species [13]. The damage by BSFB starts at seedling stage and continues till the last harvest of eggplant. The newly emerged larvae prefer tender shoot to bore. At early stage of plant growth, the larvae bore into petioles and mid ribs of large leaves and young shoots, close the entry points with their excreta, feed within [14] and cause drooping and withering of shoot[15]. At a later stage of plant growth, the larvae bore into the flower buds and fruits through calyx without...
leaving any holes through which the full grown larvae come outside the infested fruits for pupation. At this stage the pest damages both the shoots and fruits. Secondary infections by certain bacteria cause further deterioration of the fruits [16]. Incidence of BSFB in Brinjal could cause damage as high as 12-16% on shoots and 20-63% on fruits [17,18] estimated 9.7% and 20.7% loss of fruit by weight and number, respectively. The yield loss caused by this pest has been estimated up to 67% in Bangladesh [19] and up to 63% in Haryana, India [20]. Considering the seriousness of the pest a wide range of organophosphorous, carbamates and synthetic pyrethorides with various spray formulations have been advocated from time to time against this pest [21, 22, 23, 24,25,26,27,28]. The survey conducted under the present study also revealed the use of as many as 17 brands of organophosphate, carbamate and synthetic pyrethroid in as many as 15 combinations. The sample farmers applied different insecticides as many as 46 times, and the dose varied from 2 ml to 6 ml, which were either much below or much above the recommended dose but their efficacy was in terms of brinjal shoot and fruit infestation was very poor. But because of inefficacy of the chemical control measures in combating the pest, efforts are underway to find out better alternatives to chemicals as well as to sole reliance on any single method. Many of the sample farmers in the survey were also reported to have used sex pheromone traps, mechanical control measures and cultural methods either alone or in combinations but their effectiveness were also very poor in most of the instances. Most of the sample farmers used insecticides in addition to sex pheromone traps but without any basis and thus failed to get proper benefit. But some of the individual components selected based on survey results of the farmers’ practices (FPs) and evaluated on-station under supervised condition in the previous experiments under the present study provided satisfactory results, which if properly integrated, is expected to give very good Results [29].

MATERIALS AND METHODS

The present study on the Brinjal shoot and fruit borer (BSFB) was carried out in summer season during 5th July to 30th October 2008 at the experimental farm Bangabandhu Skeikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur, Bangladesh. The materials and methods adopted in the study are discussed in the following sub-headings:

Location
The study areas are situated at 24.9º N latitude and 90.26 º E longitude with an elevation of 8.4 meter from the sea level in BSMRAU, Gazipur.

Climate
The experimental farm is characterized by heavy tropical rainfall during the month of May to September and scattered rainfall during the rest of the year. Daily maximum and minimum temperature, relative humidity and total rainfall is recorded in the study period at BSMRAU, Gazipur.

Soil
The soil of the experimental plots belongs to the gray terrace soils (AEZ-28), Gazipur.

Land preparation
Fertilizer was applied as recommended by Rashid (1999) for brinjal cultivation @ 15 tons of cowdung and 250, 150 and 125 kg of Urea, TSP and MP respectively. Total amount of cow dung and half amount of TSP were applied in the pit at the time of transplanting. The rest dose of urea and the rest of MP were applied as top dressing. The first top dressing of Urea (one third) was made at 15days after transplanting. One third of Urea and one third of MP at the time of flower initiation and rest of Urea and MP and MP at the time of fruit initiation were applied to keep the plants at normal growth and production.

Raising of seedlings and transplanting
Brinjal seeds (BARI-8) were collected from Horticulture Research Center (HRC), Joydevpur, Gazipur. Seeds were sown directly on special tray for seedling rising at Entomology department of BSMRAU, Joydevpur, Gazipur. The plots were lightly irrigated regularly for ensuring proper growth and development of the seedlings. Fifty two days old healthy seedlings (3/4 leaf stage) were transplanted in the experimental plots.

Cultural operations
Dead and damaged seedlings were replaced immediately by new ones from the stock. Propping of each plant using Bamboo sticks (1meter height) was done for providing extra support to avoid lodging of the plants.
Weeding, mulching, and other necessary cultural operations were done whenever necessary. The MP and Urea were top dressed in 3 splits as described earlier.

**Pheromone trap:**
Three pheromone traps were used for the experiment, first pheromone trap was placed in the monitoring plot at the same day of transplanting of seedlings for monitoring and another three pheromone traps were placed in the plot covering the total plot area just from the day of flowering. Traps were placed in the plot at the plant canopy and height of pheromone traps were adjusted time to time for maintaining the canopy height.

**Data collection**
The following parameters were considered the incidence of BSFB infestation on brinjal field.

**BSFB adult number**
Number of BSFB adult was counted from one pheromone trap placed at the plant canopy in each morning from (16.07.2008) onward and another three pheromone traps were placed in rest of the plot covering the whole plot just from the flowering stage (11.08.2008), after collecting the adults they were destroyed and some of the insects (adult BSFB) were preserved in the glass vial with 40% ethanol for further identification. The height of the pheromone traps were adjusted time to time with the increasing height of brinjal plant, when required.

**Shoot infestation**
The total number of shoots and the number of shoots infested by the BSFB was recorded at every alternative day from five plants of each plot for each treatment during the period of 5th July to 30th October and percent shoot infestation and its reduction over control were calculated for all the treatments in every alternative day. In case of mechanical control, the infested shoots were clipped, removed and destroyed after counting.

\[
\% \text{Shoots infestation} = \frac{\text{Number of infested shoots}}{\text{Number of total shoots}} \times 100
\]

\[
\% \text{Reduction in shoot infestation} = \frac{\% \text{shoot infestation in control} - \% \text{shoot infestation in treatment}}{\% \text{shoot infestation in control}} \times 100
\]

**Number of fruits per plant**
Data were collected on the basis of harvested fruits per plant in each treatment. The marketable fruits were harvested at 7 days interval at early, mid and late fruiting stage.

**Number of healthy and infested fruits**
Data was recorded on the basis of the number of healthy fruits (HF) and infested fruits (IF) harvested early, mid and late fruiting stages of the plant. There was 3, 3 and 4 harvest at early, mid and late fruiting stage, respectively. In total, ten (10) harvests were done throughout the fruiting period. Infestation rate (by number and weight) of brinjal fruits caused by BSFB at early, mid and late fruiting stage in different treatments and its reduction over control were calculated.

**Weight of healthy and infested fruit**
The weight of healthy and infested fruits at early, mid and late fruiting stage of egg plants was taken separately per plot from each treatment.

**Fruit infestation percent**
The overall percent fruit infestation and those at three different fruiting stages were calculated using the formula.

\[
\% \text{Fruit infestation by number} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100
\]

\[
\% \text{Fruit infestation reduction by number} = \frac{\% \text{infestation of untreated control} - \% \text{infestation of treatment}}{\% \text{infestation of untreated control}} \times 100
\]
% Fruit infestation by weight = \frac{\text{Weight of infested fruits}}{\text{Total weight of fruits}} \times 100

\%	ext{ fruit infestation reduction by weight}=\frac{\%\text{ infestation of untreated control} - \%\text{ infestation of treatment}}{\%\text{ infestation of untreated control}} \times 100

The stage wise percent fruit infestation was calculated on the basis of the infestation occurred at each fruiting stage of the brinjal. The overall or accumulated infestation rate (both by number and weight) was derived from early, mid and late fruiting stages for different treatments and its reduction over control were also calculated.

Yield/hectare
The healthy and total yield of brinjal for each treatment was calculated in tons from the cumulative fruit production in a plot. Effective of different treatments on the increase and decrease of brinjal yield over control was also calculated.

Data analysis
The data were analysed by correlation method for important parameter like percent shoot and fruit infestation, healthy and infested yield; extend of damage, fruit bearing capabilities, intensity of attack, etc.

RESULTS AND DISCUSSIONS

Mean number of BSFB adult caught by pheromone trap:
The number of the adult BSFB trapped in the trap set at the plant canopy in middle of the Brinjal plots during 5th July to August, 2008 is shown in Figure 1. The catch of BSFB adult started from the first day and continued up to the last day with the maximum mean number (11 BSFB adult per trap) caught on the July 30 and the lowest mean number (1 BSFB adults per trap) on the first and last day including several other dates in between. The second highest number (7 BSFB adults per trap) was caught on the July 25 while the mean number of BSFB adult catch at most of the times during vegetative period ranged from 1 to 11, during early fruiting period ranged from 1 to 3, during mid fruiting stage ranged from 1 to 4 and late fruiting stage ranged from 1 to 5. These demonstrate that the number of BSFB adult was higher in the vegetative stage than the reproductive stages, Among the reproductive stages, late fruiting stage encountered the maximum mean number of BSFB adults (5).

The trap catch of BSFB adults provides a relatives estimate of the population fluctuation of the pest throughout the cropping season. Accordingly, the population of BSFB adults was higher sometimes during the early
summer that coincides with the vegetative stages of the crop and more or less at an average high level during the late summer, which coincides with the fruiting stages. Most interestingly, the catch of BSFB adult continued throughout the whole cropping season starting at the transplantation and ending at the maturity stage of the crop. This indicates the presence of the BSFB throughout the crop as a pest in all stages of brinjal. This finding is inconformity with many researchers [30, 31,32] They reported BSFB as a pest that infest all stages of the crop.

**BSFB Adult Number Vs Shoot Infestation:**
The relationship between the number of BSFB adults and percent shoots infestation caused by them in untreated plots throughout the crop period is presented in Figure 2.

\[
\frac{\% \text{ infestation of untreated control} - \% \text{ infestation of treatment}}{\% \text{ infestation of untreated control}} \times 100
\]

**Figure 2. Relationship between mean number of BSFB adult caught and percent (%) shoot infestation in untreated plots**

It is revealed from the figure that there is a strong positive relationship between the mean number of BSFB adults caught by the pheromone trap and the percent shoot infestation as indicated by a positive high value of correlation coefficient (r=0.4696), this provides an estimate that for an increase of 1 individual BSFB adult there is an increase of 4.69% shoot infestation.

**BSFB Adult Number Vs Fruit infestation:**
The relationship between the number of BSFB adults and percent fruits infestation by number caused by them in untreated plots throughout the crop period is presented in Figure 3.
The figure reveals that similar to the shoot, there is a strong positive relationship between the mean number of BSFB adults caught by the pheromone trap and the percent fruit infestation by number as indicated by a positive high value of correlation coefficient \( r=0.4123 \). This provides an estimate that for an increase of 1 individual BSFB adult there is an increase of 4.123\% fruit infestation by number.

**Trend of fruit infestation throughout the crop season:**

The rate of fruit infestation by BSFB is not uniform throughout the crop season as presented in Figure 4. As revealed from the Figure, there is an increasing trend of fruit infestation both by number and weight with the advancement of the crop stage, the fruit infestation attaining the highest at the mid-stage and then gradually decreasing reaching minimum at the last harvest, the trend of fruit infestation is more or less consistent with the mean number of BSFB adult caught by the pheromone trap (Figure 1). Fruit infestation was recorded 22.53\% by number and 17.53\% by weight at the first harvest on early fruiting stage, which reached the highest (40.03\% by number and 34.03\% by weight) at 7\textsuperscript{th} harvest on late fruiting stage that coincided with the highest number of adult BSFB (5) caught by the pheromone trap at the 7\textsuperscript{th} week while the fruit infestation fell to the lowest (20.05\% by number and 17.53\% by weight) when the mean number of adult BSFB catch by pheromone decreased to one 1.
Figure 4. Percent (5%) fruit infestation (by number and weight) at different harvests and stages of Brinjal in untreated plot

Figure 6. Relationship between percent (%) fruit infestation by number and temperature in untreated plot
The most possible reason for the increase in number of BSFB adults and the percent (%) fruit infestation is the temperature as shown in the Figure 5 & 6. It is revealed from the figure that the percent fruit infestation both by number and weight and the daily temperature are positively correlated, which is indicated by the correlation coefficient of 0.7030 by number and 0.56 by weight). Similar effects of higher temperature on the population increase and increased activity of many insect pests including BSFB have been reported by several researchers [33].

I. CONCLUSIONS

The incidence of BSFB adult was high in early summer which favourable for the growth and development of BSFB and spread throughout the cropping season thus the farmers should be more cautious for this pest from July onwards and practices the management strategies of BSFB in the brinjal field.

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REFERENCES


