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EFFECT OF ABIOTIC FACTORS ON THE SEASONAL INCIDENCE OF FRUIT BORER, *HELICOVERPA ARMIGERA* (HUB.) ON TOMATO WITH AND WITHOUT MARIGOLD AS A TRAP CROP

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ABSTRACT

A field experiment was conducted to study the seasonal incidence of tomato fruit borer, *Helicoverpa armigera* (Hub.) on tomato with and without marigold as a trap crop. The tomato fruit borer, *H. armigera* larvae were found to infest tomato crop throughout the growing season. The incidence of fruit borer on tomato without marigold as a trap crop was first noticed in the first week of February. The pest touched the peak with a mean of 4.40 larvae / five plants during third week of March. Similarly, the incidence of fruit borer on tomato with marigold as a trap crop was first noticed in the fourth week of January. The pest touched the peak with a mean of 1.20 larvae / five plants during third week of March. The correlation between fruit borer population and mean atmospheric temperature was positive and significant in with and without marigold; while, it exhibited non-significant negative correlation with relative humidity.

Key words: fruit borer, tomato, correlation, marigold, abiotic factor

INTRODUCTION

Tomato is an important vegetable grown worldwide and it is also an important ingredient in our daily cuisine, but to produce healthy and good tomatoes and make it available to the consumers is a difficult task, as it is infested by many pests. The tomato fruit borer, *Helicoverpa armigera* (Hub.) is a key pest as it infests fruits and makes them unfit for human consumption causing considerable (55%) crop loss (Selvanarayanan, 2000). It has been estimated that crops worth Rs.1000 crore are lost annually by this pest (Jayraj *et al.,* 1994). Over the years, the more common method for the control of this pest has been to have a film of a persistent effective insecticide over the foliage and fruiting bodies. However, the indiscriminate use of insecticides has eroded sustainability and resulted in buildup of pesticide residues, resistance to pesticides, resurgence and secondary outbreak of this pest (Fitt, 1989; Mehrotra, 1991). Therefore, switching from the use of insecticides alone to more bio-intensive methods of pest management such as the use of trap crops and farmscaping has become the trend. Trap cropping and planting of diversionary hosts have been widely applied and recommended in the past. Tomato fruit worm adults prefers marigold at flowering stage for oviposition as compared to tomato, which reduced *H. armigera* infestation of tomato (Srinivasan *et al*, 1994). So, to have clear proven idea on the incidence of fruit borer and to find the population build-up of this pest attacking tomatoes and their relation with abiotic factors like temperature, rainfall and relative humidity, the following experiment was conducted for further understanding of the role played by the abiotic factors in the incidence of fruit borer, which ultimately will help tomato growers in terms of yield as well as income generation.

MATERIAL AND METHODS

The investigation was carried out at the Horticulture Farm of Rajasthan College of Agriculture, MPUAT, Udaipur during *rabi* (October 2015 to April 2016). Geographically, Udaipur is located at 23.4°N longitude and 75°E latitude at an elevation of 579.5 MSL in the state of Rajasthan. The experiment was laid out to study the seasonal incidence of tomato fruit borer with and without marigold. A block of 8.2×10 m^2 was laid out in uniformly sized plots measuring 3.6 m x 3 m (10.8 m^2) with six plots for both experiments (with and without marigold). Tomato variety Samradhi was used for the experiment. Marigold was transplanted as the trap crop as per recommendation. The meteorological data on weather parameters *viz*, temperature, relative humidity and rainfall were collected from the meteorological observatory, Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur.

Five plants were randomly selected and tagged from each plot. The population of *H. armigera* larvae was estimated visually. At fruiting stage the population of fruit borer was counted on five randomly selected plants in each plot. The damage caused by fruit borers were estimated by the method described by Pradhan and Menon (1945). The percentage infestation was worked out on the basis of number of damaged fruits out of the total number of fruits at weekly interval. The weekly data thus obtained were correlated to the abiotic factors of the environment.

A simple correlation was worked out between the population of *H. armigera* and abiotic environmental factors using the following formula.

$$r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n}\right]\left[\sum Y^2 - \frac{(\sum Y)^2}{n}\right]}}$$

Where,

r_{xy} = Simple correlation coefficient

X = Variable i.e. abiotic component. (Average temperature and relative humidity)

Y = Variable i.e. mean number of insect pests

n = Number of paired observations

Significance of correlation is tested by using following formula.

$$t = \frac{r}{\sqrt{1 - r^2}} \times \sqrt{n - 2} \sim t_{n-2} \text{ d.f.}$$

RESULT AND DISCUSSION

Seasonal incidence of *H. armigera* on tomato without marigold as a trap crop: The larval population of *H. armigera* was recorded at weekly intervals during entire crop season of tomato. The data presented in Table 1 and depicted in Fig.1 reveal that the incidence *H. armigera* on tomato initiated in the first week of February (5th SMW). Initial mean population of larvae was 0.40/plant. The population increased gradually and touched its peak with a mean of 4.40 larvae per plant during third week of March (12th SMW); thereafter, pest population declined gradually and reached 1.60 larvae per plant in the second week of April (15thSMW). The mean atmospheric temperature and relative humidity during the peak period of incidence were 24.90°C and 34.80 per cent respectively. The pest showed positive and significant correlation with maximum, minimum and mean atmospheric temperature (r = 0.670, 0.655 and 0.677, respectively). The damaged fruits recorded during first week of February (5th SMW) were 0.20 per plant. The maximum number of damaged fruits per (3.60/plant) was recorded during the third week of March (12thSMW) when the larval population was at its peak with a mean of 4.40 larvae/plant. The damaged fruits/plant showed a significant positive correlation with number of larvae/plant. Earlier, Sharma *et al.* (2006), Chakraborty *et al.* (2011), Sharma *et al.* (2013) and Mandloi *et al.* (2015) also studied the seasonal incidence of *H. armigera* on tomato and reported that the incidence of *H. armigera* initiated by first week of February with the peak in March. Sharma *et al.* (2013) reported that the tomato fruit borer population initiated in the 14th standard meteorological week (2.50 borers/plant) with a population peak of 13.70 borer/ plant during the 21st standard meteorological week. The borer population exhibited significant positive correlation with the temperature (maximum, minimum) (r=0.921, 0.626); whereas, it was positive and non-significant with sunshine hours (r =0.246). A significant negative correlation between borer population and maximum and minimum relative humidity (r =-0.700, -0.641) and non-significant negative correlation with rainfall (r =-0.420) was observed during the study. Mandloi *et al.* (2015) observed peak larval population of *H. armigera* from November 2012 to March 2013 with two distinct peaks on11th and 12th SMW (6.02 and 6.11 larvae/plant). The fruit borer had a significant positive correlation with number of rainy days (0.428).

Seasonal incidence of *H. armigera* on tomato with marigold as a trap crop: The larval population of *H. armigera* was recorded at weekly interval during entire crop season of tomato. The data presented in Table (2) and depicted in Fig.2 reveal that the incidence *H. armigera* on tomato initiated in the fourth week of January (4th SMW). Initial mean population of larvae was 0.20 per plant. The population increased gradually and touched its peak with a mean of 1.20 larvae per plant during third week of March (12th SMW); thereafter, pest population declined gradually and reached to the minimum of 0.80 larvae per plant in the second week of April. (15thSMW). The mean atmospheric temperature and relative humidity during the peak period of incidence were 24.90°C and 34.80 per cent respectively. The pest showed positive and significant correlation with maximum, minimum and mean atmospheric temperature (r = 0.628, 0.610 and 0.633, respectively). The infestation of fruits was recorded during fourth week of January (4thSMW) with 0.20 damaged fruits per plant. The maximum number of damaged fruits per plant (0.80/plant) was recorded during the third week of March (12thSMW) when the larval population was at its peak with a mean of 1.20 larvae/plant. The number of fruit borer larvae per plant was positively and significantly correlated with the damaged fruits. Earlier Moorthy *et al*. (2002), Karabhantanal *et al*. (2005), Hussain and Bilal (2007) and Kpassawah *et al* (2013), Jakhar and Suman (2015) also studied the seasonal

Table 1. Effect of abiotic factors on the seasonal incidence of fruit borer larvae on tomato without marigold during *rabi* 2015-16

SMW	Dates of Observation	Abiotic factors						Damaged fruits/plant	Fruit borer larvae/plant
		Temperature (°C)			Relative Humidity (%)				
		Maximum	Minimum	Mean	Maximum	Minimum	Mean		
4	26-01-2016	25.9	6.0	15.95	80.1	22.1	51.10	0	0
5	02-02-2016	27.7	10.0	18.85	78.0	19.6	48.80	0.20	0.40
6	09-02-2016	26.6	7.3	16.95	78.0	19.6	48.80	0.80	1.60
7	16-02-2016	26.0	12.2	19.10	68.1	27.3	47.70	0.60	1.80
8	23-02-2016	30.5	11.9	21.20	67.0	18.0	42.50	1.20	2.60
9	01-03-2016	31.6	11.6	21.60	67.5	21.0	44.25	1.40	2.80
10	08-03-2016	31.7	14.1	22.90	67.6	28.7	48.15	1.20	2.40
11	15-03-2016	30.9	15.7	23.30	70.0	32.1	51.05	2.40	3.20
12	22-03-2016	34.1	15.7	24.90	51.7	17.9	34.80	3.60	4.40
13	29-03-2016	35.9	17.9	26.90	52.9	19.7	36.30	3.20	3.60
14	05-04-2016	36.6	19.5	28.05	39.7	16.9	28.30	1.80	3.20
15	12-04-2016	36.33	19.46	27.89	39.71	16.86	28.29	0.60	1.60
Seasonal Mean		30.27	12.49	21.38	67.33	23.07	45.20	1.42	2.30
Coefficient of correlation (r) for population and Maximum Temperature					0.621*	0.670*			
Coefficient of correlation (r) for population and Minimum Temperature					0.579*	0.655*			
Coefficient of correlation (r) for population and Mean Temperature 0.613*					0.677*				
Coefficient of correlation (r) for population and Maximum Relative Humidity					-0.471	-0.562			
Coefficient of correlation (r) for population and Minimum Relative Humidity					-0.024	-0.016			
Coefficient of correlation (r) for population and Mean Relative Humidity					-0.399	-0.472			
Coefficient of correlation (r) for population of fruit borer and fruit damage					0.929*				

SMW- Standard meteorological week, * Value of 't'- significant at 5% level of significance.

Table 2. Effect of abiotic factors on the seasonal incidence of fruit borer larvae on tomato with marigold during *rabi* 2015-16

SMW	Dates of Observation	Abiotic factors						Damaged fruits/plant	Fruit borer larvae/plant
		Temperature (°C)			Relative Humidity (%)				
		Maximum	Minimum	Mean	Maximum	Minimum	Mean		
4	26-01-2016	25.9	6.0	15.95	80.1	22.1	51.10	0.20	0.20
5	02-02-2016	27.7	10.0	18.85	78.0	19.6	48.80	0.20	0.40
6	09-02-2016	26.6	7.3	16.95	78.0	19.6	48.80	0.60	0.60
7	16-02-2016	26.0	12.2	19.10	68.1	27.3	47.70	0.20	0.40
8	23-02-2016	30.5	11.9	21.20	67.0	18.0	42.50	0.20	0.20
9	01-03-2016	31.6	11.6	21.60	67.5	21.0	44.25	0.40	0.40
10	08-03-2016	31.7	14.1	22.90	67.6	28.7	48.15	0.60	0.60
11	15-03-2016	30.9	15.7	23.30	70.0	32.1	51.05	0.40	0.60
12	22-03-2016	34.1	15.7	24.90	51.7	17.9	34.80	0.80	1.20
13	29-03-2016	35.9	17.9	26.90	52.9	19.7	36.30	0.60	0.80
14	05-04-2016	36.6	19.5	28.05	39.7	16.9	28.30	0.60	0.60
15	12-04-2016	36.33	19.46	27.89	39.71	16.86	28.29	0.80	0.80
Seasonal Mean		30.27	12.49	21.38	67.33	23.07	45.20	0.47	0.57
Coefficient of correlation (r) for population and Maximum Temperature					0.728*	0.628*			
Coefficient of correlation (r) for population and Minimum Temperature					0.626*	0.610*			
Coefficient of correlation (r) for population and Mean Temperature 0.690*					0.633*				
Coefficient of correlation (r) for population and Maximum Relative Humidity					-0.701	-0.612			
Coefficient of correlation (r) for population and Minimum Relative Humidity					-0.301	-0.187			
Coefficient of correlation (r) for population and Mean Relative Humidity					-0.672	-0.565			
Coefficient of correlation (r) for population of fruit borer and fruit damage					0.878*				

SMW- Standard meteorological week, * Value of 't'- significant at 5% level of significance.

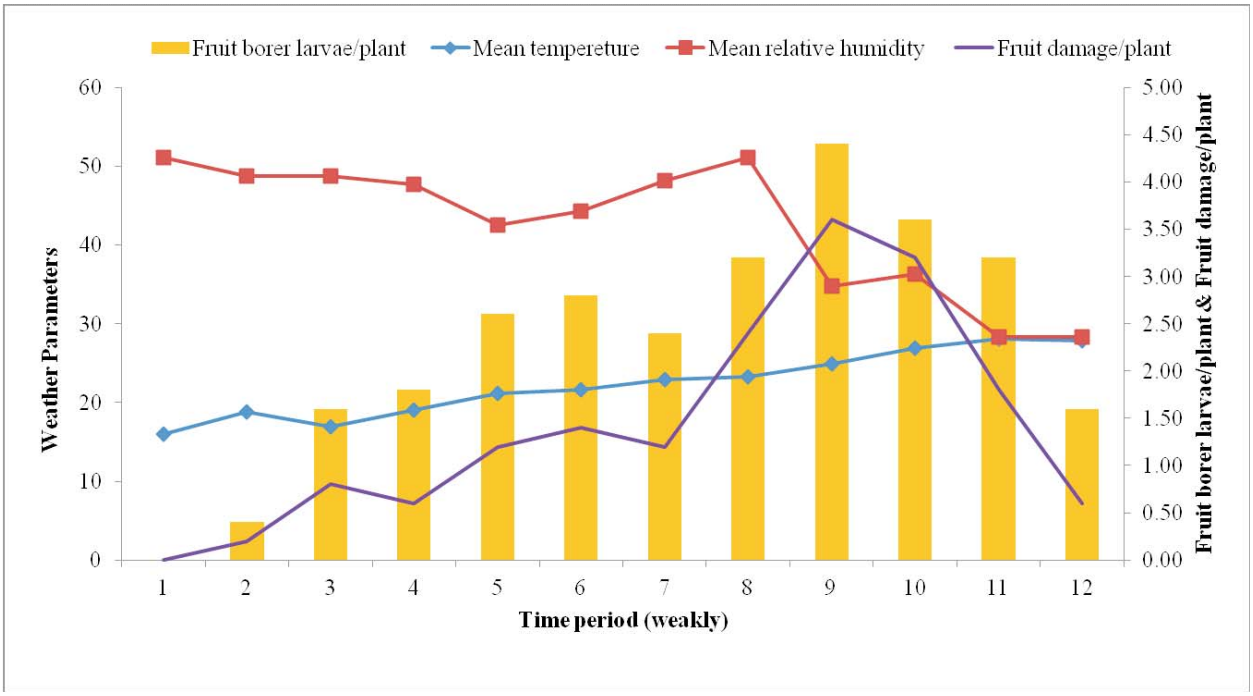


Fig.1: Seasonal incidence of fruit borer, *H. armigera* on tomato without marigold

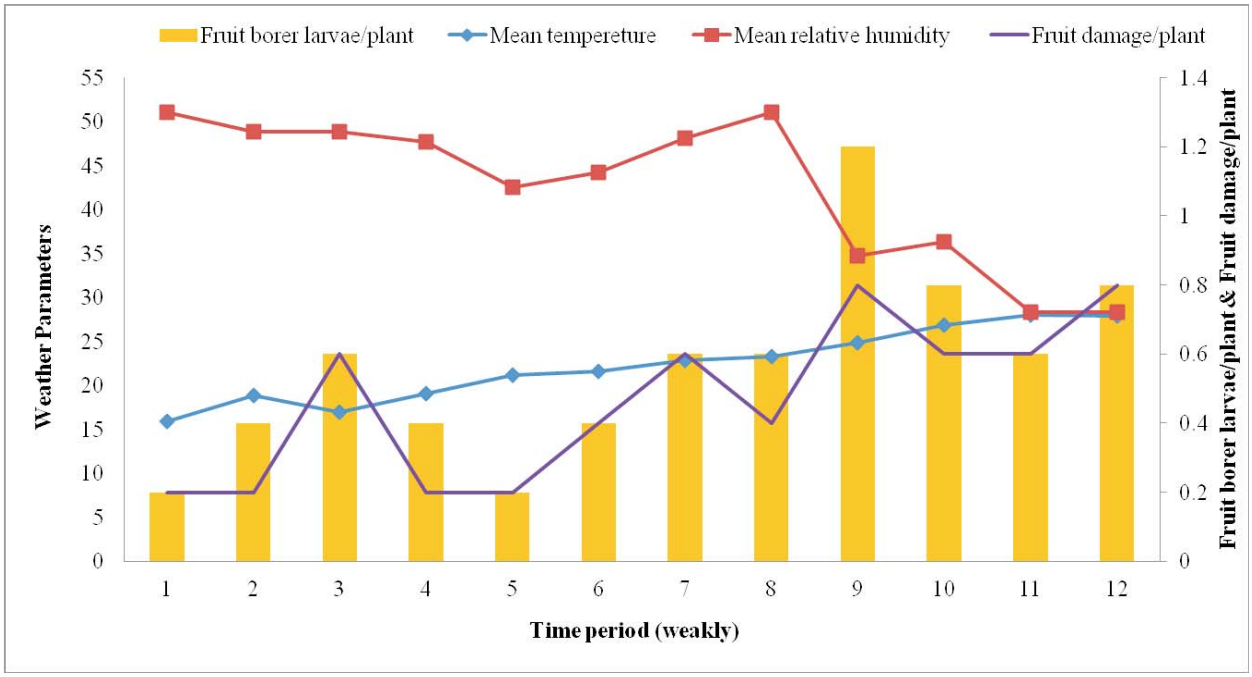


Fig.2: Seasonal incidence of fruit borer, *H. armigera* on tomato with marigold as a trap crop

incidence of *H. armigera* on tomato. In relation to abiotic factors of climate and marigold as a trap crop on tomato crop which reduced the larval population compared to without marigold the population of *H. armigera* to initiated by fourth week of January with the peak in March. Karabhantanal *et al*. (2005) revealed that the IPM module consisting of trap crop (15 rows of tomato: 1 row marigold) + *Trichogramma pretiosum* (45 000/ha) was significantly superior over the rest of the modules tested in restricting the larval population (100% after the fourth spray). The stacked tomato cultivated with marigold was more effective against the tomato fruit borer infestation (Kpassawah *et al.,* 2013).

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