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Effect of weather parameters on incidence of key pest, *Helicoverpa armigera* (Hubner) on tomato

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Abstract
A field experiment was conducted at Central Research Farm, SHIATS, Naini, Allahabad during *Rabi*, 2014-15 to study the effect of weather parameters on incidence of *Helicoverpa armigera* (Hubner) on tomato during *Rabi*, 2014-15. The incidence of *H. armigera* started in 8th standard meteorological week (third week of February) with an average population of 2.0 larvae per plant thereafter, larval population increased gradually and reached to its peak level (6.0 larvae per plant) in 12th standard meteorological week (third week of March). Weather parameters, temperature [maximum (r = 0.625) and minimum (r = 0.668)], wind velocity (r=0.527) and sunshine hours (r=0.722) showed significant positive correlation with larval population. Relative humidity [morning (r=-0.160) and evening (r=-0.388)] had non-significant negative correlation while, rainfall had non-significant positive correlation (r=0.091) with larval population.

Keywords: tomato, incidence, weather, population

1. Introduction
Tomato (*Lycopersicon esculentum* Mill) is an important vegetable crop grown worldwide after potato. India rank second in the area as well as in the production of tomato (Anonymous, 2011) [1]. Tomato is a very good source of minerals, vitamins and dietary fibers. It is an important ingredient of over daily cuisine because it is generally used to prepare soup, juice, ketchup and pickles etc. Tomato crop is infested by different insect pests; about sixteen pest species cause damage to tomato crop in India (Butani, 1977) [2]. The tomato fruit borer, *Helicopera armigera* (Hubner) is a key pest and cause upto 40-50 per cent damage to the tomato crop (Pareek and Bhargava 2003) [7]. This pest is a nocturnal and polyphagous in nature, distributed throughout the Indian subcontinent (Singh and Narang 1990) [13]. The larval stage of this pest infest fruits and makes it unfit for human consumption. The young larval stage feed on the foliage and later instars bore inside the fruits. Incidence of fruit borer is dependent on weather parameters; therefore the present study was carried out to see the effect of weather parameters on incidence of tomato fruit borer.

2. Material and Methods
The investigation was carried out at Central Research Farm, SHIATS, Naini, Allahabad during *Rabi*, 2014-15. The tomato cultivar, Selection-22 was sown in plot size of 9 x 5 m. with row to row and plant to plant distance of 60x45 cm. The weekly observations were recorded during morning hours on five randomly selected and tagged plants from the whole experimental plot. The meteorological data on weather parameters *viz.*, atmospheric temperature (maximum and minimum), relative humidity (morning and evening), rainfall, wind velocity and sunshine hours were collected from the meteorological section, SHIATS, Naini, Allahabad and presented in Table 1. Correlation coefficient was worked out between fruit borer population and weather parameters by using the following formula.

$$rX_1Y_1 = \frac{\sum X1Y1 - \frac{\sum X1 \sum Y1}{n}}{\sqrt{\left[\sum X_1^2 \frac{\left(\sum X_1\right)^2}{n}\right] \left[\sum Y_1^2 - \frac{\left(\sum Y_1\right)^2}{n}\right]}}$$

Where,
rX_1Y_1= Simple correlation coefficient
X_1=Independent variable *i.e.* abiotic component
Y_1= Dependent variable *i.e.* pest
n= Number of observations

3. Results and Discussion

3.1 Seasonal incidence of *H. armigera*

The data presented in Table 1 and depicted in Figure 1 revealed that the larval population of *H. armigera* was first recorded in the 8th standard meteorological week (third week of February). Initial mean population of larvae on tomato variety selection-22 was 2.0 per plants. Kharpuse and Bajpai (2006) [5] also recorded fruit borer population in third week of February during *Rabi*, 2004-05. Choudhary *et al.* (2017) [4] recorded incidence of fruit borer in third week of February with an average population of 2.2 larvae per plant on tomato which is also in agreement with the present study. The larval population increased gradually and reached to its peak (6.0 larvae per plant) during 12th standard meteorological week (third week of March), when temperature (maximum and minimum), relative humidity (morning and evening), rainfall, wind velocity and sunshine hours were 34.31 ^{0}C, 16.45 ^{0}C, 87.57%, 45.71%, 0.0 mm, 2.66 km h^{-1} and 13.25 hours, respectively. Choudhary *et al.* (2017), Pandey *et al.* (2012) and Reddy *et al.* (2009) [4, 6, 10] also observed peak population of fruit borer in the month of March which in agreement of the present findings. Thereafter, larval population declined gradually and reached to its minimum level of 1.5 larvae per plants in the 15th standard meteorological week (second week of April) and completely disappeared after 15th standard meteorological week.

3.2 Correlation between *H. armigera* and weather parameters

Studies on correlation revealed that temperature [maximum (r=0.625) and minimum (r=0.668)], wind velocity (r=0.527) and sunshine hours (r=0.722) had a significant positive correlation with larval population (Table 1). The present results get support from the work of Chakraborty *et al.* (2011), Choudhary *et al.* (2017), Pandey *et al.* (2012), Reddy and Kumar (2004), Reddy *et al.* (2009), Sharma *et al.* (2013) and Sharma *et al.* (2006) [3, 4, 6, 9-12] who obtained positive significant correlation with maximum temperature. Reddy and Kumar (2004), Reddy *et al.* (2009) and Sharma *et al.* (2013) [9-11] also recorded significant positive correlation with minimum temperature. Choudhary *et al.* (2017) [4] also obtained significant positive correlation between wind velocity and larval population of fruit borer on tomato which supports present findings.

Relative humidity [morning (r=-0.160) and evening (r=-0.388)] had non-significant negative correlation, while rainfall had non-significant positive correlation (r=0.091) with larval population. Pandey *et al.* (2012), Sharma *et al.* (2013) and Umbarkar *et al.* (2010) [6, 11, 14] reported a significant negative correlation between relative humidity and fruit borer population which partially supports present findings. Choudhary *et al.* (2017) [4] also recorded non-significant negative correlation between relative humidity (morning and evening) and larval population of *H. armigera*. The present results corroborates with the findings of Prasad *et al.* (2006) and Reddy *et al.* (2009) [8, 10] who reported non-significant positive correlation with rainfall and fruit borer population.

Table 1: Incidence of fruit borer, *H. armigera* on tomato during *Rabi*, 2014-15

Standard Meteorological week	Number of larvae/plant	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Wind velocity (km/ hr)	Sunshine hours (hr/day)
		Maximum	Minimum	Morning	Evening			
47th	0.00	30.02	11.88	82.71	44.57	0.00	0.64	7.8
48th	0.00	31.05	11.62	82.71	41.85	0.00	0.52	8.44
49th	0.00	29.54	10.37	84.28	45.14	0.00	0.69	8.28
50th	0.00	27.51	9.54	87.00	56.42	1.20	0.73	6.22
51st	0.00	22.25	7.84	91.28	58.57	0.00	1.77	3.51
52nd	0.00	17.20	8.2	93.42	62.57	0.00	0.83	1.10
1st	0.00	20.65	12.74	92.28	56.42	4.71	1.46	0.00
2nd	0.00	19.71	9.65	91.28	68.57	0.00	1.40	0.00
3rd	0.00	15.71	7.92	94.57	67.14	0.00	1.29	0.00
4th	0.00	18.62	11.64	93.42	69.14	3.28	1.25	0.00
5th	0.00	23.62	12.90	92.28	51.57	1.51	1.43	2.65
6th	0.00	27.08	11.17	91.28	54.42	0.74	2.10	3.08
7th	0.00	28.20	11.94	94.57	48.14	0.00	0.79	6.45
8th	2.0	30.85	13.34	93.42	49.42	0.00	1.68	15.68
9th	4.4	29.58	14.71	89.57	60.57	9.62	2.16	13.35
10th	4.9	33.20	15.11	89.85	50.42	0.00	1.73	12.20
11th	5.4	33.37	15.02	86.71	45.14	0.02	1.78	11.25
12th	6.0	34.31	16.45	87.57	45.71	0.00	2.66	13.25
13th	5.2	34.14	18.37	91.14	44.14	1.20	3.09	10.32
14th	3.8	38.76	20.24	89.00	40.23	0.00	5.23	9.73
15th	1.5	39.25	21.00	87.00	38.74	0.00	4.02	9.32
Correlation coefficient (r)		0.625**	0.668**	-0.160	-0.388	0.091	0.527*	0.722**

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05 level

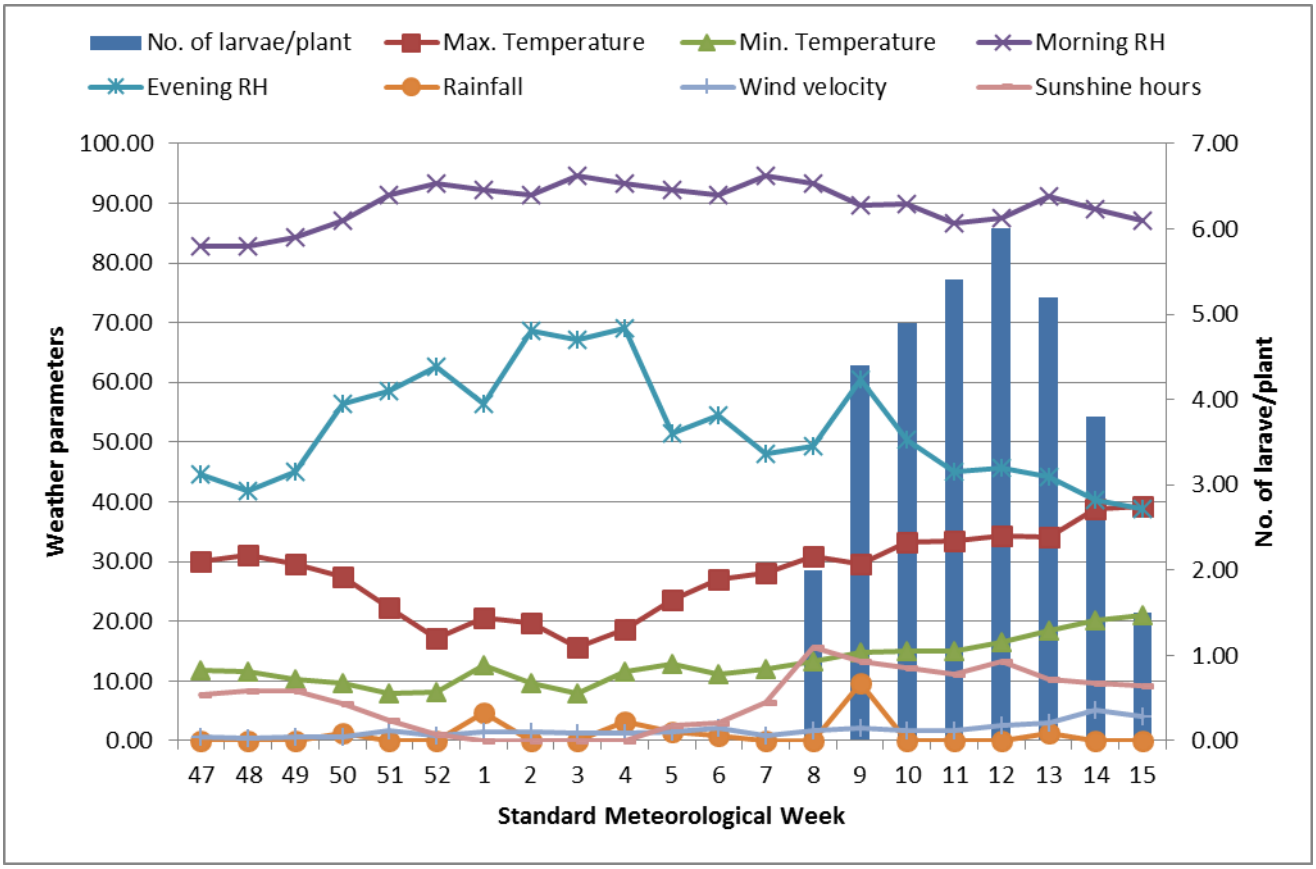

Fig 1: Incidence of fruit borer, *H. armigera* on tomato during *Rabi*, 2014-15

4. Conclusion

Thus the present study revealed that the incidence *H. armigera* was started in 8th standard meteorological week (third week of February) thereafter, larval population increased gradually and reached to its peak in 12th standard meteorological week (third week of March). Weather parameters, temperature (maximum and minimum), wind velocity and sunshine hours had significant positive correlation with larval population.

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