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Seasonal Incidence of Tomato Fruit Borer, *Helicoverpa armigera* (Hubner) and Its Correlation with Abiotic Factors: An Experimental Investigation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study on seasonal incidence of the tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato was conducted under field conditions at Vegetable Research Station, CSAUA&T, Kanpur during *Rabi* season 2021-2022. The incidence of fruit borer commenced in the 47th standard week (third week of November) with an average population of 0.2 larvae per m row length. The fruit borer population increased and gradually reached its peak level of 7.8 larvae per m row length in the 3rd standard week (January third week), after that, a declining trend was observed. As regards abiotic factors, rainfall (r=0.4727), maximum relative humidity (r=0.3306), minimum relative humidity (r=0.7544) and wind speed (r=0.6039) had a significant positive correlation with the fruit borer population. Maximum temperature (r=-0.7616) and minimum temperature (r=-0.6327) are negatively correlated with the fruit borer population.

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1. INTRODUCTION

"Tomato, *Lycopersicon esculentum* (Miller) belongs to the family Solanaceae. It is one of the most essential and remunerative vegetable crops with immense commercial and nutritional value. Tomato has a wide range of climatic adaptability. It is grown in tropical and subtropical regions worldwide for fresh fruits and processing purposes. It is the world's most consumed vegetable crop after potato and sweet potato. The tomato originated from Peru in South America" [1]. It spread from America to other parts of the world in the 16th century. Its transport was made in India by Vasco-De-Gama, a native of Portuguese. It was introduced into Europe by a Spanish explorer in the early sixteenth century. The leading tomato-growing countries in the world are China, India, Turkey, The United States of America, Egypt, Italy and Iran. The highest production of tomatoes in the world is from China (62.8 million tonnes), followed by India (20.3 million tonnes) (FAOSTAT 2021). India is the world's second-largest producer of vegetables, next to China. In India, tomato is cultivated in an 831-thousand-hectare area with an annual production of 20300 thousand tonnes. Andhra Pradesh, Madhya Pradesh, Karnataka, Gujrat and Odisha are our country's largest tomato producers [2].

Whereas, in Uttar Pradesh, the annual production of tomatoes is 902 thousand tonnes from a 20.88-thousand-hectare area [3]. "The tomato yield in India is considerably lower because of several factors of which the damage caused by insect pests is the most important. It is devasted by various pests like fruit borer, whitefly, pinworms, serpentine leaf miner, aphids, spider mites and tobacco caterpillar" [4]. "The prevalence of insect pests such as aphid, thrips, whitefly and leaf miner was also found in significant numbers" [5]. However, significant economic damage is caused by the fruit borer. Yield losses due to this pest are estimated at around 24 % to 73 % in India [6]. "Tomato fruit borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), is the most destructive insect pest causing average percent damage to fruits is 41.44 %, reducing the market value and quality of the fruit and found to cause a yield loss up to 35 % in general and up to 36 % in Uttar Pradesh" [7]. "The pest is highly polyphagous and is reported on nearly 181 host plants" [8]. **"**The monetary loss due to this pest in India has been estimated over rupees one thousand crore per year and yield losses ranged from 14-100 percent on different crops" [9]. "The problem of *Helicoverpa armigera* is magnified due to its direct attack on fruiting structure, voracious feeding habits, high mobility, fecundity and multivoltine overlapping generations" [10]. "Losses of millions of rupees solely due to this pest have been reported in crops like chickpea, cotton, pigeon pea, groundnut, tomato and other crops of economic importance" [11]. At the same time, adequate ecological data and knowledge on the seasonal incidence of tomato fruit borer will help formulate the insect pest management strategies for *H. armigera*. Hence, the present study was taken up to investigate the seasonal occurrence of *H. armigera* under Kanpur region conditions.

2. MATERIALS AND METHODS

The present investigation was conducted at the Vegetable Research Station of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, during *Rabi* 2021-2022. The site selected was uniform and cultivable with typically sandy loam soil having good drainage. Tomato variety Azad T-6 was transplanted on 30th October 2021, the seedlings of the one month. The seedlings were transplanted with a plant-to-plant and row-to-row spacing of 60×45 cm which was maintained between the seedlings. After ten days, gap filling was done to ensure a uniform plant population in each plot. The observations on the insect population were recorded weekly from the time of sowing to harvesting. Data recorded on insect pest and meteorological parameters were statistically analyzed. The simple correlation was computed between the population of pest and abiotic factors viz., rainfall, temperature, relative humidity and wind speed data obtained from the university's observatory. The data on the seasonal incidence of tomato fruit borer and the correlation between weather parameters are presented in Table 1.

3. RESULTS AND DISCUSSION

The population of *H. armigera* in tomato crop along with meteorological observations during *Rabi* season 2021-2022 have been presented

Table 1. Occurrence of tomato fruit borer, *H. armigera* (Hubner) and weather parameters during *Rabi* season, 2021-2022

SMW	Dates of weeks	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Wind Speed (Km/hr)	No. of larvae/m row length
			Max.	Min.	Max.	Min.		
44	29.10.2021-04.11.2021	0	29.7	14.2	93	43	1.7	0
45	05.11.2021-11.11.2021	0	28.8	12.8	93	42	1.8	0
46	12.12.2021-19.11.2021	0	27.5	11.9	95	44	1.1	0
47	19.11.2021-25.11.2021	1.2	26.9	13.3	83	42	2.5	0.2
48	26.11.2021-02.12.2021	0	26.3	11.9	95	47	1.2	0.3
49	03.12.2021-09.12.2021	0	26	13.5	92	47	2.4	0.5
50	10.12.2021-16.12.2021	0	23.7	8.6	95	44	1.7	0.6
51	17.12.2021-23.12.2021	0	22.1	7.1	85	43	4.1	0.9
52	24.12.2021-31.12.2021	8.6	20.7	8.8	97	73	1.4	1.2
1	01.01.2022-07.01.2022	23.5	20.4	8.5	96	70	3	4.5
2	08.01.2022-14.01.2022	14.6	19.6	10.3	94	74	4.8	6.6
3	15.01.2022-21.01.2022	0	15.7	7.4	93	72	3.5	7.8
4	22.01.2022-28.01.2022	3	17.9	7.7	95	66	5.2	7.1
5	29.01.2022-04.02.2022	13	21.2	7.5	91	58	5.9	6.4
6	05.02.2022-11.02.2022	0	22.9	8.1	93	52	4.3	5.0
7	12.02.2022-18.02.2022	0	25	8.1	92.9	50	3.9	3.3
8	19.02.2022-25.02.2022	0	27.4	12.3	87	42	6.2	2.9
9	26.02.2022-04.03.2022	0	27.8	11.7	90	47	3.5	1.5
10	05.03.2022-11.03.2022	0	29.2	13.9	87	44	4.5	0.9
11	12.03.2022-18.03.2022	0	33.4	17.4	83	44	4.4	0.5
12	19.03.2022-25.03.2022	0	36.4	18.6	79	30	3.7	0.2
	r=	0.4727	-0.7616	-0.6327	0.3306	0.7544	0.6039	
	t=	2.3379	-5.1234	-3.5609	1.5267	5.0096	3.3023	

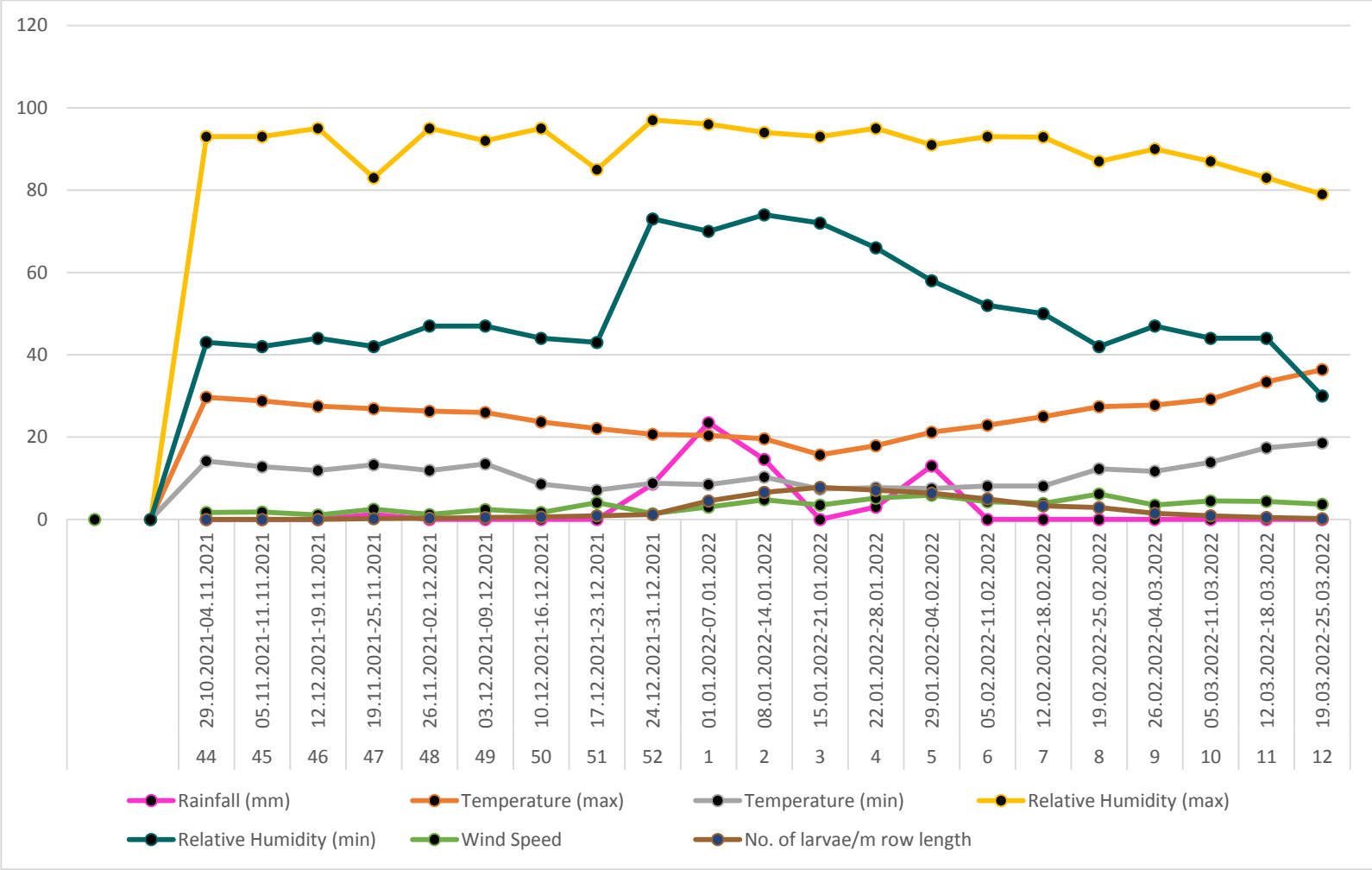

Fig. 1. Effect of abiotic factors on the incidence of tomato fruit borer, *Helicoverpa armigera* during *Rabi* season, 2021-2022

in Table 1 and Fig. 1. The data reveals that the population of *H. armigera* first appeared in the 3rd week of November i.e., the 47th standard meteorological week (SMW). The pest population was recorded as the number of larvae per meter row length varied from 0.2 to 7.8. The larval population was low during November and mid-December, ranging from 0.2 to 0.9 larvae per meter row length. The pest population increased from the last week of December and reached its peak, i.e., 7.8 larvae per meter row length during the 3rd SMW i.e., the third week of January. In January, there was considerable rainfall in the first two weeks. During this period the weather parameters like maximum and minimum temperature ranged from 15.7 °C to 7.4 °C and the relative humidity (maximum and minimum), 93 % and 72 %, respectively, were recorded. The pest population started to decline from 4th SMW to 12th SMW which varied from 7.1 to 0.2 larvae per meter row length, respectively. The correlation coefficient (r) between the incidence of fruit borer larvae and prevailing weather parameters revealed that rainfall (r=0.4727), maximum relative humidity (r=0.3306), minimum relative humidity (r=0.7544) and wind speed (r=0.6039) showed a significant positive impact on fruit borer larvae population while maximum temperature (r= -0.7616) and minimum temperature (r= -0.6327) had a negative impact on fruit borer population. The above-cited results on the seasonal incidence of *H. armigera* in tomato crop are as per the work done by different researchers as [12] reported that the fruit borer (*Helicoverpa armigera*) is a major pest of the tomato crop confirming our findings. The population of *Helicoverpa armigera* contributes significantly to the yield losses [13]. "There was a negative correlation between the percentage of plants attacked by insect pests and yield. The population build-up of the tomato fruit borer pest had a significant negative correlation with minimum temperature and a non-significant correlation with maximum temperature" [14]. The population of *H. armigera* started during 35th SMW (0.5 larvae per plant), after that, the population reached 2.8 larvae per plant in the 47th SMW and the highest population was recorded during the fruiting stage of the crop in the range of 4.2 larvae per plant [7]. "A significant positive correlation between both minimum and maximum temperature and pest incidence was observed. Rainfall is considered the most important factor regulating the insect population. The correlation coefficient indicated a negative relationship between the larval population and rainfall" [15]. "Weather parameters, temperature (maximum and minimum), humidity maximum, wind velocity and sunshine hours had a significant positive correlation with the larval population" [16]. The population of fruit borer exhibited highly significantly positively correlated with temperature, maximum (r= 0.741) and minimum (r= 0.667) while relative humidity (RH) was found to be highly significantly negatively correlated with morning RH (r = - 0.798) and evening RH (r=-688) [17].

4. CONCLUSION

The incidence of fruit borer, *H. armigera,* commenced in the 3rd week of November i.e., the 47th SMW (0.2 larvae per m row length). The pest population increased and peaked i.e., 7.8 larvae per m row length during the 3rd SMW i.e., the third week of January. Afterward, the pest population declined continuously. Rainfall, maximum relative humidity, minimum relative humidity and wind speed are positively correlated, while maximum and minimum temperatures had a negative correlation with the fruit borer population. The results will help us to schedule its management strategies in the tomato crop against tomato fruit borer.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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