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The effect of abiotic parameters on the prevalence of pest population *Helicovepa armigera* on tomato in Rudrapur, Uttarakhand

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Abstract
The impact of the various abiotic parameters on the tomato fruit borer *Helicoverpa armigera* population was studied during September 2023- January 2024 in Lakhipur, Rudrapur. In this exploration, we examined the intricate relationship of abiotic parameters (like temperature, moisture, and rush) on the prevalence of pest populations. Our findings revealed that the population of *H. armigera* larva reached its peak 4.86 mean in 46th week when the maximum and minimum temperature was 28.5℃ and 12.7℃, respectively, relative humidity 84.7% and rainfall 0.0 mm was recorded. The larval population of *H. armigera* showed a negative correlation with evening humidity (r= -0.6222). At the same time, a non-significant positive relationship was set up between larval populations with minimal temperature and sun hours (r= 0.2752), (r= 0.5896), and (r = 0.7045), independently. A non-significant negative relationship was set up independently amid larval populations with morning RH and downfall (r= -0.547) and (r= 0.1838). These findings provide valuable insights into the relationship between abiotic parameters and the prevalence of the pest population, which can aid in developing effective pest management strategies.

Keywords: *Helicoverpa armigera*, correlation, abiotic parameters, tomato fruit borer, pest

Introduction

The highly destructive pest *Helicoverpa armigera*, commonly known as the cotton bollworm or maize earworm, is found worldwide but is most prevalent in temperate and subtropical regions. This minor bug can cause significant damage to tomatoes. *H. armigera* is one of the most prevalent nonentity pests in farming and accounts for half of all crop protection applications in India. The problem worsens because of this pest's multivoltine nature, rapid mobility, fecundity, a direct attack on regenerating structures, aggressive eating habits, lapped generations, etc. [11]. Moreover, integrated pest management may be enhanced after the seasonal cornucopia has been recognized since appropriate ecological data is a requirement[6]. Numerous environmental factors affect the populations of nonentity pests. The development and spread of nonentity pests depend heavily on abiotic factors. In Uttarakhand, a state in northern India with a diverse topography and climate, a variety of abiotic conditions can affect the existence and behavior of *Helicoverpa armigera*. This study is comprehensive in its approach, examining a wide range of abiotic factors and their impact on the seasonal prevalence of *Helicoverpa armigera*. Planning nonentity pest management strategies for *H. armigera* in Udham Singh Nagar will surely benefit from an understanding of the seasonality of tomato fruit borer. An attempt has been made to understand how different abiotic factors impact *Helicoverpa armigera* seasonal predominance,

Material and methods

The study area is located in Rudrapur, district Udham Singh Nagar. It is situated at an altitude range of 79.40°E, 28.98°N and an average elevation of 830 feet above sea level. The Radhakant village in Lakhipur served as the site of the field trial (Fig. 1). The tomato variety grown in Lakhipur is called M. Sona. Seedlings were planted in a randomized complete block design in a 5 x 4 m^2 experimental plot, with a 10 cm factory-to-plant distance and 30 cm row-to-row distance. All recommended agronomic practices were followed in the crop's production, except for factory protection measures, which let *H. armigera* (Fig. 2) grow in a fungicide-free area. The larval population was observed once a week on a single farm.

Data was collected between the first week of September 2023 till the second week of January 2024. The population of *H. armigera* larvae was recorded on ten randomly selected plants (Fig. 3). For the study and its conclusions, meteorological data were obtained from the meteorological department unit of Govind Ballabh Pant University of Agriculture and Technology. The meteorological parameters correlating with the incidence of tomato insect pests included relative humidity (morning and evening), maximum and minimum temperatures, daylight hours, rainfall, and sunshine hours.[8,12] The relationship between the frequency of pests and the meteorological data was analyzed using the correlation method.

Fig 1: Study site

Fig 2: *Helicoverpa armigera*

Fig 3: Infected tomato fruit

Results and discussion

The first incidence of the pest was seen on the 36th SW (0.40). The highest and lowest temperatures, morning-evening relative humidity (RH), amount of rainfall, and hours of sunlight were 34.3, 25.4, 88.4 (0712 am), 67.6 (1412 pm), 42.0 mm, and 5.6 hours, respectively, during that period. The maximum larva was observed on 46th SW (4.86), when the maximum-minimum temperature and morning-evening relative humidity (RH) were 22.8, 5.9, 93.6 (0712 am), and 47.0 (1412 am), respectively. At the beginning of the 51st SW, the larval population begins to decline (Table 1). The flowering and fruiting stages of the tomato correspond with the peak population of *H. armigera*, as demonstrated by Kamble *et al*. (2005)[4]. Furthermore, during the 21st SW, it was observed that the population of *H. armigera* was falling as the crop grew closer to maturity and had fewer larvae per plant. Similar results were noted by Chakraborty *et al.* (2012)[1], who noted that when the plant age reached the terminal stage, the larvae number began to decline. Similarly, Patel *et al.* (1998)[10] emphasized the emergence of a pest population that peaked in December and was observed from November to February. According to Singh *et al.* (2011)[13], the initial population of *Helicoverpa armigera* increased gradually. It was limited to vegetative development, but during the fruiting stage, it rapidly expanded and peaked in the 46th standard week, the second week of November; after that, fewer pests were observed.

Table 1: Weekly meteorological data about larval population recorded during the crop growth period (2023-2024)

Std. week	M. Sona larva	Temp.		Rh%		Rainfall (mm) hour	Rainy days	Sunshine hour
		Max.	Min.	Morning 7:12 am	Evening 2:12 pm			
36	0.40	34.3	25.4	88.4	67.6	42.0	0.0	5.6
37	1.56	31.0	25.4	91.1	74.6	152.2	2.0	4.4
38	1.86	32.6	24.6	90.4	69.7	47.4	4.0	6.7
39	2.01	32.9	23.5	88.6	57.9	60.2	1.0	8.0
40	4.50	33.6	22.8	88.7	51.7	0.0	0.0	9.2
41	3.90	33.0	19.3	79.6	46.7	0.0	0.0	8.8
42	2.13	30.2	16.3	84.1	48.6	7.4	1.0	7.1
43	4.08	30.9	14.3	88.9	36.9	0.0	0.0	9.7
44	4.28	30.4	15.2	86.4	40.7	0.0	0.0	8.2
45	3.50	28.7	13.8	89.6	41.7	0.0	0.0	6.3
46	4.86	28.5	12.7	87.1	40.7	0.0	0.0	7.2
47	3.10	27.4	11.3	91.6	42.3	0.0	0.0	8.1
48	2.08	26.2	13.0	84.7	49.6	1.0	0.0	4.4
49	1.60	26.5	10.9	85.3	42.4	0.0	0.0	7.8
50	1.20	22.8	5.9	93.6	47.0	0.0	0.0	6.5
51	0.22	22.9	6.0	92.0	41.6	0.0	0.0	6.5
52	0.32	22.0	8.4	93.1	59.3	0.0	0.0	5.5
1	0.15	17.5	7.9	94.7	69.7	0.0	0.0	2.2
2	0.10	14.1	8.4	93.7	79.4	0.0	0.0	0.2

Table 2: Correlation coefficient on the incidence of *Helicoverpa armigera* larvae of tomato with weather parameters

Correlation coefficient (r)		
Season	**Weather parameter**	**Correlation coefficient**
September 2023- January 2024	Max. Temp	0.5896
	Min. Temp	0.2752
	Relative Humidity (7:12)	-0.547
	Relative Humidity (14:12)	-0.6222
	Rainfall	0.1838
	Sunshine hours	0.7045

Table 3: Descriptive statistics

	N	Min.	Max.	Mean	SEM	SD
STD	19	1.0	52.0	39.52	±3.26	14.22
M. Son	19	0.10	4.86	2.20	±0.37	1.61
Temp (max)	19	14.10	34.3	27.65	±1.28	5.60
Temp (min)	19	5.90	25.4	15.0	±1.53	6.68
Mor.	19	79.6	94.7	89.03	±0.88	3.87
Eve.	19	36.9	79.4	53.05	±3.03	13.23
Rain hour	19	0.00	152.2	16.32	±8.68	37.8
Rain day	19	0.00	4.0	0.42	±0.23	1.01
Sunshine	19	0.20	9.70	6.44	±0.54	2.37
Valid N	19					

Table 2 displays information regarding the impact of meteorological factors on the growth of the pest population. A noteworthy negative correlation (r = -0.6222) exists between the number of larvae and the relative moisture in the evening. On the other hand, a non-significant positive correlation with independent values of (r = 0.2752), (r = 0.5896), and (r = 0.7045) was established between the larval population and the minimum, maximum, and sun hours. The larval population showed a non-significant negative correlation with morning RH and rainfall of (r = -0.547) and (r = -0.1838), respectively. According to Kharpuse (2005)[5] and Mandal (2012)[9], *Helicoverpa armigera* is a significant tomato fruit borer pest that affects the crop during its whole reproductive cycle. Our data is consistent with Yadav *et al.'s* (1991)[16] findings, which state a substantial positive correlation between *H. armigera* with both maximum and minimum temperature and a negative correlation with relative humidity. According to Kakati *et al.* (2005)[3], the *H. armigera* population exhibited a substantial and positive correlation with minimum temperature (0.289) and maximum temperature (0.224). Additionally, there was a negative correlation (-0.086) with morning relative humidity. According to Chula *et al.* (2017)[2], the larval population exhibited a negative correlation (r = -0.830 and -0.369) with relative humidity but a positive correlation with lowest and maximum temperatures. These results are similar to the findings of Singh and Gupta (2017)[14] and Vikram *et al*. (2018)[15], who found that the population of *H. armigera* had a negative correlation with relative humidity (morning, evening), and favorably correlated with temperature (highest, minimum). However, the current results are inconsistent with those of Meena *et al*. (2014)[7], who found a negative and non-significant correlation between the minimum and maximum temperatures.

Conclusion

The present study's findings indicate that the tomato fruit borer, *Helicoverpa armigera*, began to appear in the first week of September and continued till the third week of January. This activity peaked in the third week of November. Therefore, it can be said that insecticide spraying should not be done during November to check the *Helicoverpa armigera* infestation on tomato crops.

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