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Insect pests scenario and management of fruit borer (*Helicoverpa armigera* Hubner) on tomato crop (*Lycopersicon esculentum*) in Malwa Region, Madhya Pradesh

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Abstract
A field experiment entitled "Studies on Insect Pests Scenario and Management of Fruit Borer (*Helicoverpa armigera* Hubner) on Tomato Crop (*Lycopersicon esculentum*) in Malwa Region, Madhya Pradesh" was conducted at Agritech Viransh, Malwa Region, Indore (M.P.) during Rabi 2022-23 and Kharif 2023-24. The objective was to study the seasonal incidence and correlation of major insect pests of tomato with key abiotic factors. Four major insect pests were recorded: whitefly (*Bemisia tabaci*), jassid (*Amrasca biguttula biguttula*), serpentine leaf miner (*Liriomyza trifolii*), and tomato fruit borer (*Helicoverpa armigera*). The results indicated that pest population dynamics were significantly influenced by temperature and relative humidity. The whitefly infestation began in the 45th SMW and peaked during the 2nd SMW with 7.01 whiteflies per three leaves. Similar trends were observed for other pests. Correlation analysis revealed a significant negative correlation between pest population and temperature, while relative humidity showed a positive association.

Keywords: *Helicoverpa armigera*, tomato crop, *Lycopersicon esculentum*

Introduction
Tomatoes (*Lycopersicon esculentum.* Mill) are a popular and important vegetable grown in all over the world during the *Rabi*, *Kharif* and *Zaid* season, as well as in many other nations. It is a member of the *Solanaceae* family. Tomato (*Lycopersicon esculentum* Mill), is a popular vegetable occupying the daily menu of people all over the world. Having its origin in Mexico tomato was taken to Europe in 1600 A.D. Later, it reached India along with traders to add tang to our curries.

Tomato is a nutritious and tasty vegetable that is used in salads and soups, as well as processed into stable goods such as ketchup, sauce, marmalade, chutney, juice paste, powder, and other items. It offers great beneficial effects to human health through its high content in potassium and antioxidants such as ascorbic acid, vitamin A, vitamin C, lycopene, essential amino acids and tocopherols that may contribute to fight against carcinogenic substance. Tomatoes contain lycopene, a potent antioxidant that lowers the risk of prostate cancer.

In India majority of the population are vegetarian and vegetables play an important role in their diet. India is the second largest producer of vegetables next to China. Tomato is most widely grown vegetable crop '· in India. Tomato yields in Bangladesh are inadequate in contrast to those in other tomato-growing countries across the world. Tomato production now covers 73151.55 acres area with yield 442299.60 metric ton (BBS 2021-2022).

The fruit borer, *Helicoverpa armigera* (Hubner) is the most destructive pest of tomato in India, which is commonly known as gram pod borer, American bollworm and fruit borer (Meena and Raju).

As a result, chemical insecticides are thought to be the most effective way to combat this pest. Chemical pesticides are the only commonly used approach in Bangladesh to combat tomato fruit borer. Because of their quick action, ease of application, and availability, insecticides have become indispensable in enhancing vegetable crop output. Generally, Bangladeshi farmers control this bug by using chemical insecticides, as this is seen to be the most effective method of combating this pest. In general, pesticides are highly effective, have a quick cure time, and are quite inexpensive. A vast range of bio-pesticides containing chemicals have recently been described as effective insect pest control measures in tomato. As a result, a study was carried out to see if various bio-pesticides.

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crops grown throughout India for its nutritional and economic value. However, its production is constrained by several insect pests that cause considerable yield losses. Among them, the fruit borer (*Helicoverpa armigera* Hubner) is the most destructive, feeding on floral buds and fruits, leading to qualitative and quantitative losses. Understanding the seasonal incidence and correlation between pest populations and abiotic factors is essential for developing an effective Integrated Pest Management (IPM) strategy. Therefore, this study was undertaken to investigate the seasonal occurrence of major insect pests of tomato and their relationship with environmental conditions in the Malwa region of Madhya Pradesh.

Materials and Methods

Experimental Site

The experiment was carried out at Agritech Viransh Farm, Malwa Region, Indore (M.P.) during Rabi season 2022-23 and Kharif season 2023-24. The region lies at an altitude of 553 meters above mean sea level with subtropical climatic conditions.

Observation of Insect Pests

Observations on pest population were recorded at weekly intervals from 45th Standard Meteorological Week (SMW) onwards. Three leaves per plant were selected from top, middle, and bottom canopy levels to count the number of whiteflies and jassid. For leaf miner and fruit borer, the number of mines and larvae per plant were recorded.

Weather Parameters

Meteorological data including minimum and maximum temperature (°C), relative humidity (%), rainfall (mm), wind speed (km/hr), and sunshine hours (hrs) were obtained from the nearby Meteorological Observatory, Indore.

Statistical Analysis

Correlation coefficients were computed between the mean pest population and weather parameters using standard statistical methods (Panse and Sukhatme, 1985) [6].

Results and Discussion

Seasonal Incidence of Major Insect Pests

Four major pests were recorded during the study period—whitefly (B. *tabaci*), jassid (A. *biguttula biguttula*), leaf miner (L. *trifolii*), and fruit borer (H. *armigera*).

Whitefly (*Bemisia tabaci*)

The first appearance of whitefly was recorded at 45th SMW (0.68 whiteflies per 3 leaves). The population gradually increased and reached its peak during the 2nd SMW (7.01 whiteflies per 3 leaves) when the minimum and maximum temperatures were 7.5°C and 16.7°C, respectively, with 77.4% relative humidity, zero rainfall, 2.8 km/hr wind speed, and 3.7 hours of sunshine. Thereafter, the population declined and reached the lowest (0.48 whiteflies/3 leaves) during the 10th SMW.

These results agree with those of Kumar and Singh (2022) [1], who observed maximum whitefly population during the 1st SMW. Kumar *et al*. (2016) [2] reported peak incidence during the 2nd week of January, while Waluniba and Ao (2014) [3] found highest incidence during 4th-9th SMW at different planting dates. Similarly, Madhushree (2019) [4] and Kotak *et al*. (2019) [5] recorded peak whitefly populations during January.

Correlation between Weather Parameters and Major Insect Pests (Rabi 2023-24)

Table 1: Seasonal incidence of major insect pests of tomato in relation to weather parameters during Rabi season, 2023-24.

SMW	Temp (°C)	RH (%)	Rain (mm)	Wind (km/hr)	Sunshine (hrs)	Whitefly/3 leaves	Jassid/3 leaves	Leaf miner/plant	Fruit borer/plant
45	15.5-29.6	71.8	0.00	1.40	5.60	0.68	0.18	0.60	0.00
46	14.1-28.7	70.4	0.00	1.10	6.50	0.90	1.48	1.90	0.00
47	12.6-27.5	70.5	0.00	1.50	6.50	1.63	2.72	1.60	0.00
48	12.6-26.3	71.8	2.40	1.20	6.00	1.35	2.58	2.80	0.10
49	14.2-25.9	71.8	2.00	1.90	3.60	1.59	3.47	3.70	0.40
50	7.0-23.9	69.7	0.00	2.80	7.90	3.18	5.43	4.80	0.70
51	6.0-23.2	71.3	0.00	1.80	7.00	4.38	6.73	5.70	1.20
52	9.6-20.7	75.8	0.00	1.80	5.30	5.63	7.42	6.90	2.10
1	9.7-18.2	79.5	5.00	1.60	1.90	5.50	7.23	6.10	2.70
2	7.5-16.7	77.4	0.00	2.80	3.70	**7.01**	6.27	5.70	2.90
3	6.5-13.2	79.3	0.00	2.30	0.80	6.23	5.15	4.90	3.10
4	5.3-15.2	74.5	0.00	2.10	3.70	5.90	4.28	3.30	3.40
5	8.0-22.0	73.9	0.00	3.00	5.80	5.56	3.44	2.20	3.60
6	7.4-20.5	74.0	0.00	3.90	5.40	3.64	2.86	1.50	2.40
7	10.7-24.7	72.9	2.40	3.50	7.10	2.76	1.56	1.10	1.20
8	10.8-26.2	70.0	3.80	3.70	7.80	1.33	1.28	0.90	0.50
9	9.6-30.3	69.5	0.00	4.10	8.10	0.48	0.10	0.20	0.00

Correlation between Abiotic Factors and Major Pests

Table 2: Correlation coefficients between abiotic factors and pest population on tomato (Rabi 2023-24)

Insect	Temperature (°C)	Relative Humidity (%)	Rainfall (mm)	Wind (km/h)	Sunshine (hrs)
	Min	Max			
Whitefly	-0.757	-0.920	0.825	-0.286	-0.160
Jassid	-0.585	-0.710	0.645	-0.198	-0.291
Leaf miner	-0.468	-0.646	0.625	-0.202	-0.386
Fruit Borer	-0.732	-0.903	0.809	-0.203	-0.644

(Significant at $P \leq 0.05$, Significant at $P \leq 0.01$)

The results indicated that minimum and maximum temperatures were negatively correlated with pest population, whereas relative humidity and rainfall showed a significant positive relationship. These findings confirm that cooler and humid conditions favored pest build-up, whereas higher temperatures reduced infestation levels.

Conclusion

The study revealed that whitefly, jassid, leaf miner, and fruit borer are the major insect pests infesting tomato in the Malwa region. Their incidence varied significantly with weather parameters. The peak incidence of whitefly was recorded at the 2nd SMW under favorable temperature and humidity. Correlation studies confirmed that pest population increases with higher relative humidity and decreases with higher temperatures. These findings can help in predicting pest occurrence and planning timely management strategies in tomato cultivation.

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