



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(7): 42-45
Received: 17-05-2026
Accepted: 21-06-2026

Parth Tanwar
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Neha Negi
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Vikas Chauhan
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Sonu Kumari
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Arushi Padiyal
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Riya Tyagi
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Mohit
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Ankit
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Corresponding Author:
Arushi Padiyal
Faculty of Agriculture, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India

Studies on Tomato (*Solanum lycopersicum* L.) major insect pests seasonal incidence and their correlation with weather parameters

Parth Tanwar, Neha Negi, Vikas Chauhan, Sonu Kumari, Arushi Padiyal, Riya Tyagi, Mohit and Ankit

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i7a.5889>

Abstract

Tomato (*Solanum lycopersicum* L.) is an economically important vegetable crop, but its productivity is often hampered by the infestation of several insect pests throughout the growing season. A field study was conducted during the 2025 tomato season at the Research Farm, Faculty of Agriculture, Maharishi Markandeshwar (Deemed to be University), Mullana, Haryana, to investigate the seasonal incidence of major insect pests and their relationship with prevailing weather parameters. Weekly observations were recorded on whitefly (*Bemisia tabaci*), serpentine leaf miner (*Liriomyza trifolii*), tomato fruit borer (*Helicoverpa armigera*) and leafhopper (*Amrasca devastans*) from transplanting to harvest. Whitefly, leaf miner and leafhopper populations first appeared during the 8th Standard Meteorological Week (SMW), whereas fruit borer infestation commenced during the 10th SMW. Whitefly, leaf miner and fruit borer reached their maximum populations during the 16th SMW with mean populations of 4.56 whiteflies per leaf, 4.85 leaf miner larvae per plant and 3.94 fruit borer larvae per plant, respectively. Leafhopper recorded the highest population of 8.60 insects per plant during the 14th SMW. Correlation analysis revealed that maximum temperature, minimum temperature and average relative humidity had significant positive effects on the population dynamics of all major insect pests. The findings indicate that weather conditions play a major role in influencing the abundance of insect pests in tomato and also highlight the importance of regular weather-based pest monitoring to help in the prediction of pest occurrences and enable the timely implementation of integrated pest management approaches for improved tomato production.

Keywords: Tomato, seasonal incidence, whitefly, leaf miner, weather parameters, population dynamics

1. Introduction

Tomato (*Solanum lycopersicum* L.), belonging to the family Solanaceae, is one of the major vegetable crops with high economic value grown across the world (Kumar *et al.*, 2020) [6]. It is grown under both open-field and protected cultivation systems for fresh consumption as well as for processing into products such as juice, paste, puree, sauces, soups and ketchup (Maurya *et al.*, 2025) [8]. Owing to its high nutritional and medicinal value, the tomato occupies a prominent place among vegetable crops and ranks second after the potato in India. The fruits are an excellent source of vitamins A, B-complex and C, minerals such as calcium, phosphorus and iron, and the antioxidant lycopene, which is known for its role in reducing the risk of several chronic diseases (Rasheed *et al.*, 2022) [15]. The crop is believed to have originated in South America, while its cultivated forms were developed in Mexico before spreading to different parts of the world (Knapp and Peralta, 2016) [5]. In India, tomato is widely cultivated as one of the main vegetable crops, contributing significantly to the national economy. It grows best under moderate climatic conditions with an optimum temperature range of 21-24°C. However, the changes in the climatic conditions affect its growth and make it easily susceptible to several insect pests (Deb and Bharpoda, 2017) [3]. Although advancements in agricultural technologies and the use of protected structures have enhanced production, insect pests remain the major constraints hampering tomato yield and quality. The major insect pests include tomato fruit borer (*Helicoverpa armigera*), whitefly (*Bemisia tabaci*), leafhopper (*Amrasca devastans*), thrips (*Scirtothrips dorsalis*) and serpentine leaf miner (*Liriomyza trifolii*) (Pratheek, 2023) [13], which attack tomato plants

throughout the growing season and cause severe quantitative and qualitative losses. Among these, the tomato fruit borer is known to cause the most damage to the crop, as the larvae feed on foliage, flowers and developing fruits. They even make fruits unmarketable once they start boring into the fruits. Yield losses due to *H. armigera* range from about 18 to 80 per cent depending upon pest intensity, crop stage and dominant climatic conditions (ul Haq and Ismail, 2026) ^[17]. Similarly, sucking pests including whiteflies, aphids, thrips and leafhoppers also cause direct damage by feeding on the sap and also act as vectors for the spread of viral diseases, reducing the in the crop productivity.

The prevalent weather conditions, including temperature, relative humidity, rainfall, photoperiod and crop phenology, largely influence the occurrence and abundance of insect pests on tomato. For the prediction of pest outbreaks and the development of effective integrated pest management (IPM) strategies, a thorough understanding of the seasonal incidence and population dynamics of these pests is important (Mengasha *et al.*, 2025) ^[9]. Regular monitoring of pest populations in the prevailing weather conditions is necessary for determining the proper time for carrying out management practices and reducing the usage of pesticides. The overuse of synthetic insecticides has led to severe damage to the environment, humans and animals, including destruction of natural enemies, development of insecticide resistance and presence of pesticide residues in fruits (Barathi *et al.*, 2024) ^[1]. Therefore, there is an urgent need for the adoption of sustainable and scientifically built pest management methods based on monitoring of pest incidence rather than repetitive pesticide applications. In light of this need, studies on seasonal incidence help farmers to identify peak activity periods of economically important pests for the timely application of control measures, especially at the most vulnerable stages of pest development (Mrosso *et al.*, 2023) ^[10]. Moreover, such information plays a crucial role under changing climatic conditions, where the variations in temperature and humidity alter the pest behaviour, their survival and distribution. Despite being of great economic importance, complete information on the seasonal incidence of major insect pests of tomato under different agro-climatic conditions still remains limited. Therefore, the present investigation was undertaken to study the seasonal incidence of major insect pests of tomato and to determine their relationship with prevailing weather parameters. The findings of the study will contribute to a better understanding of pest population dynamics and provide a scientific basis for developing timely, economical and environmentally sustainable pest management strategies for tomato cultivation.

2. Materials and Methods

2.1 Experimental Site

The field experiment was conducted during the tomato cropping season of 2025 (February to June) at the Research Farm, Faculty of Agriculture, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana.

2.2 Procurement of seed

The seeds of the tomato variety Heemasohna were procured from Bhatia Seeds and Pesticides store, Shahabad.

2.3 Experimental details

The experiment was laid out in a Randomized Block Design (RBD) comprising ten treatments (Table 1; Fig 1) with three replications. Tomato variety Heemasohna was transplanted in February 2025 at a spacing of 60 × 45 cm on raised beds. All recommended agronomic practices were followed uniformly

except for plant protection measures.

2.4 Observations recorded

Observations on the seasonal incidence of major insect pests, namely tomato fruit borer (*Helicoverpa armigera*), whitefly (*Bemisia tabaci*), leafhopper (*Amrasca devastans*) and serpentine leaf miner (*Liriomyza trifolii*), were recorded at weekly intervals from transplanting to final harvest by randomly selecting and tagging five plants. The population of each pest was recorded using standard sampling methods and the observations were correlated with prevailing weather parameters to study their seasonal incidence and population dynamics.

2.5 Data Analysis

The experimental data were subjected to correlation using OPSTAT software.

3. Results

3.1 Seasonal incidence of major insect pests

3.1.1 Whitefly (*Bemisia tabaci*)

The population of whitefly first appeared during the 8th SMW with a mean population of 0.13 whiteflies per leaf (Table 1; Fig 1). Thereafter, the population increased gradually with the advancement of the crop growth stage and favourable weather conditions. The whitefly population reached its maximum of 4.56 whiteflies per leaf during the 16th SMW when the maximum and minimum temperatures were 40.29 °C and 24.14 °C, respectively, with an average relative humidity of 50.36%. Subsequently, the population declined gradually to 3.75 and 3.21 whiteflies per leaf during the 17th and 18th SMW, respectively.

3.1.2 Serpentine leaf miner (*Liriomyza trifolii*)

The incidence of serpentine leaf miner was first recorded during the 8th SMW with a mean population of 0.87 larvae per plant (Table 1; Fig 1). The pest population increased progressively throughout the crop season and attained its peak population of 4.85 larvae per plant during the 16th SMW under prevailing weather conditions of 40.29 °C maximum temperature, 24.14°C minimum temperature and 50.36% average relative humidity. Thereafter, the population declined to 3.98 larvae per plant during the 17th SMW and further decreased to 2.81 larvae per plant during the 18th SMW.

3.1.3 Tomato fruit borer (*Helicoverpa armigera*)

The fruit borer (*Helicoverpa armigera*) was absent up to the 9th SMW and its first appearance was observed during the 10th SMW with a mean population of 0.89 larvae per plant (Table 1; Fig 1). The larval population increased steadily from 1.12 larvae per plant during the 11th SMW to 3.76 larvae per plant during the 15th SMW. The highest population, 3.94 larvae per plant, was recorded during the 16th SMW under high-temperature conditions. Thereafter, the population declined gradually to 3.62 and 3.38 larvae per plant during the 17th and 18th SMW, respectively.

3.1.4 Leafhopper (*Amrasca devastans*)

The leafhopper population first appeared during the 8th SMW with a mean population of 3.20 leafhoppers per plant (Table 1; Fig 1). The population increased continuously during the succeeding weeks and reached a peak of 8.60 leafhoppers per plant during the 14th SMW, when the maximum temperature was 36.86°C, the minimum temperature was 21.86°C and the average relative humidity was 44.57%. Thereafter, the population gradually declined to 7.80, 6.70, 6.10 and 5.30 leafhoppers per plant during

the 15th, 16th, 17th and 18th SMW, respectively.

Table 1: Seasonal incidence of major insect pests of tomato

SMW	Temperature (°C)	Max	Temperature (°C)	Min	Avg RH (%)	White fly/Leaf	Leaf miner/Plant	<i>Helicoverpa armigera</i> /Plant	Leaf hopper/Plant
6	23.7		5.5		68.5	0	0	0	0
7	25.5		7.9		62.5	0	0	0	0
8	24.7		8.9		71	0.13	0.87	0	3.2
9	26.6		15.5		71	1.18	1.54	0	4.7
10	29.14		15.57		62.43	1.56	1.97	0.89	6.1
11	32.29		17.29		62.43	1.87	2.31	1.12	7.4
12	33.71		17.86		53.14	2.34	2.79	1.87	7.9
13	37.86		16.71		47.86	3.32	3.34	2.34	8.3
14	36.86		21.86		44.57	3.88	3.89	3.09	8.6
15	39		22.57		50.29	4.43	4.38	3.76	7.8
16	40.29		24.14		50.36	4.56	4.85	3.94	6.7
17	39.29		24.71		42.79	3.75	3.98	3.62	6.1
18	39.57		25.43		55	3.21	2.81	3.38	5.3

Seasonal Incidence of Insect Pests

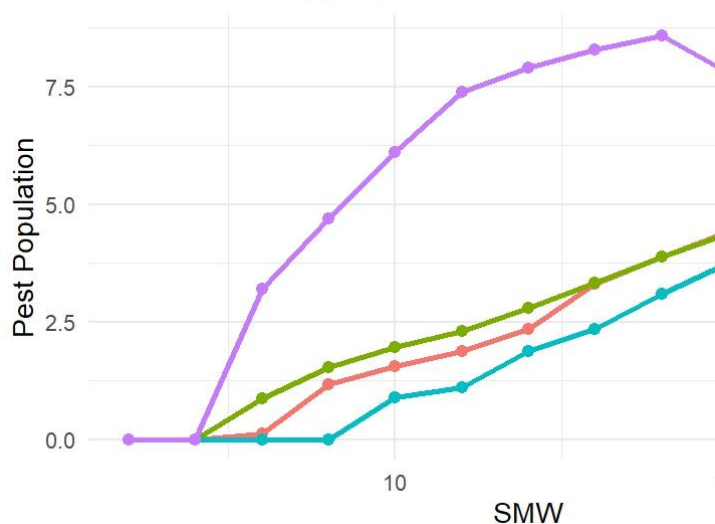


Fig 1: This Picture shows Seasonal incidence of major insect pests in relation to standard meteorological weeks (SMW)

3.2 Correlation of major insect pests of tomato with weather parameters

The correlation analysis indicated that the population of major insect pests of tomato was positively influenced by the prevailing weather parameters (Table 2; Fig 2). Whitefly exhibited a highly significant positive correlation with maximum temperature, minimum temperature and average relative humidity, with correlation coefficients of 0.918, 0.968 and 0.923, respectively. Similarly, the population of serpentine leaf miner showed highly significant positive correlations with maximum temperature, minimum temperature and average relative humidity, recording

correlation coefficients of 0.887, 0.938 and 0.911, respectively. Tomato fruit borer also exhibited a highly significant positive association with all the weather parameters, with correlation coefficients of 0.942 for maximum temperature, 0.964 for minimum temperature and 0.890 for average relative humidity. Leafhopper population showed a significant positive correlation with maximum temperature, recording a correlation coefficient of 0.676, while it exhibited highly significant positive correlations with minimum temperature and average relative humidity, with correlation coefficients of 0.752 and 0.756, respectively. These findings indicate that increasing temperature and favourable relative humidity played an important role in the multiplication and seasonal abundance of major insect pests of tomato and may be useful for forecasting pest outbreaks and planning timely pest management strategies.

Table 2: Correlation of major insect pests with weather parameters

	White fly	Leaf Miner	Fruit Borer	Leaf Hopper
Temperature (Max.) °C	0.918**	0.887**	0.942**	0.676*
Temperature (Min.) °C	0.968**	0.938**	0.964**	0.752**
Average RH (%)	0.923**	0.911**	0.890**	0.756**

Correlation Between Weather Parameters and

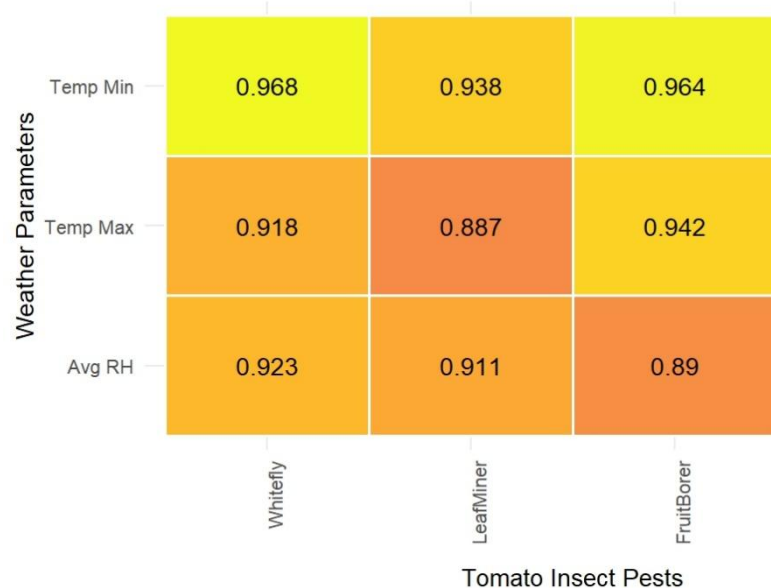


Fig 2: This picture depicts the correlation between weather parameters and major tomato pests during cropping season (Feb to June) of 2025

4. Discussion

The present investigation revealed that the seasonal incidence of major insect pests of tomato was greatly influenced by prevailing weather conditions and crop growth stage. Whitefly, leaf miner and leafhopper first appeared during the 8th SMW, whereas fruit borer infestation commenced during the 10th SMW. The populations of all pests increased gradually and reached their peak during the 14th to 16th SMW before declining towards crop maturity. Whitefly and leaf miner attained their highest populations during the 16th SMW, while leafhopper reached its highest population during the 14th SMW and fruit borer during the 16th SMW. Similar findings for whitefly were reported by Padhi *et al.* (2017) [10] and Radhika *et al.* (2018) [14]. The seasonal incidence of leaf miner observed in the present study is in agreement with the findings of Dibbad *et al.* (2020) [4]. The present observations on fruit borer are in conformity with the

reports of Chakraborty *et al.* (2012) ^[2], who also observed peak infestation during the middle reproductive stage of the crop. The correlation analysis indicated that the population of major insect pests was significantly influenced by weather parameters. Whitefly, leaf miner and fruit borer exhibited highly significant positive correlations with maximum temperature, minimum temperature and average relative humidity, whereas leaf hopper showed a significant positive association with maximum temperature and highly significant positive correlations with minimum temperature and average relative humidity. These findings suggest that increasing temperature, coupled with favourable relative humidity, created suitable conditions for pest multiplication and seasonal abundance. Similar findings were reported by Sharma *et al.* (2017) ^[16], who observed a positive relationship between temperature and the population dynamics of major tomato insect pests. Moreover, whitefly multiplication is found to be favoured by higher temperatures and a significant positive association between temperature and whitefly incidence has also been reported (Latif and Akhter, 2013; Pavan, 2021) ^[7, 12]. Similarly, an increase has also been observed in *Helicoverpa armigera*. These findings indicate the significance of weather parameters, particularly temperature and relative humidity, in influencing the seasonal pest occurrence and their utilization in forecasting pest outbreaks and the timely implementation of integrated pest management practices in tomato cultivation.

5. Conclusion

The study showcased the close association of the incidence and abundance of major insect pests in tomato with predominant environmental conditions and crop growth stage. Among the pests observed, the highest populations of whitefly, leaf miner and fruit borer were recorded during the 16th SMW and that of leafhopper during the 14th SMW. Weather parameters, mainly the maximum and minimum temperatures and average relative humidity, showed a significant positive influence on pest population dynamics. These findings, thus, underscore the importance of predicting pest outbreaks and the adoption of timely, effective and sustainable pest management strategies in tomato cultivation via continuous pest surveillance and weather-based monitoring.

References

- Barathi S, Sabapathi N, Kandasamy S, Lee J. Present status of insecticide impacts and eco-friendly approaches for remediation: A review. *Environ Res.* 2024;240:117432.
- Chakraborty K, Santosh R, Chakravarthy AK. Incidence and abundance of tomato fruit borer, *Helicoverpa armigera* (Hubner) in relation to the time of cultivation in the northern parts of West Bengal, India. *Curr Biotica.* 2011;5(1):91-97.
- Deb S, Bharpoda TM. Impact of meteorological factors on population of major insect pests in tomato, *Lycopersicon esculentum* Mill. under middle Gujarat condition. *J Agrometeorol.* 2017;19(3):251-254.
- Dibbad SH, Hanumantharaya L, Hanumanthappa M, Srinivasa V, MH SK. Studies on population dynamics of major insect pests of tomato. *J Entomol Zool Stud.* 2020;8(6):1245-1248.
- Knapp S, Peralta IE. The tomato (*Solanum lycopersicum* L., Solanaceae) and its botanical relatives. In: Causse M, Giovannoni J, Bouzayen M, Zouine M, editors. *The tomato genome*. Berlin, Heidelberg: Springer; 2016. p. 7-21.
- Kumar A, Kumar V, Gull A, Nayik GA. Tomato (*Solanum lycopersicum*). In: Nayik GA, Gull A, editors. *Antioxidants in vegetables and nuts: Properties and health benefits*. Singapore: Springer; 2020. p. 191-207.
- Latif MA, Akhter N. Population dynamics of whitefly in cultivated crops and its management. *Int J Bio-resource Stress Manag.* 2013;4(4):576-581.
- Maurya HK, Lata R, Sundar S, Mitra D, Singh H, Yadav G. Scientific advances in tomato (*Solanum lycopersicum* L.) cultivation, agronomic innovation and genetic improvement: A comprehensive review. *J Adv Biol Biotechnol.* 2025;28(10):781-803.
- Mengasha GG, Salo KS, Kassaye A, Terefe H, Fentahun Z, Suure MT, *et al.* Spatiotemporal dynamics and drivers of *Phthorimaea absoluta* infestation in tomatoes: Inferences for identifying measures to enhance components of integrated pest management strategies. *Crop Prot.* 2025;107531.
- Mrosso SE, Ndakidemi PA, Mbega ER. Farmers' knowledge on whitefly populouness among tomato insect pests and their management options in tomato in Tanzania. *Horticulturae.* 2023;9(2):253.
- Padhi GK, Maity L, Chattopadhyay A, Samanta A. Population dynamics of whitefly (*Bemisia tabaci* Genn.) in chilli and screening of genotypes against chilli leaf curl virus. *J Entomol Zool Stud.* 2017;5(5):104-107.
- Pavan T. Infestation of whitefly (*Bemisia tabaci* G.) on tomato crop (*Solanum lycopersicum* L.) and its management. In: *Proceedings of the 9th International Conference on Agriculture and Rural Development (ICARD-2021)*; 2021. p. 9.
- Pratheek GN. Studies on population dynamics and management of sucking pest complex in tomato, *Solanum lycopersicum* L. Bangalore: University of Agricultural Sciences, GKVK; 2023.
- Radhika M, Reddy CN, Anitha V, Vidhyasagar B. Seasonal incidence of sucking pest complex in black gram during rabi 2017-18. *J Entomol Zool Stud.* 2018;6(4):901-903.
- Rasheed H, Javed A, Haroon A, Ameen S. Bioactive compounds in tomatoes and their effects on human health: A comprehensive review. *Int J Cell Sci Biotechnol.* 2022;11(1):15-26.
- Sharma D, Maqbool A, Jamwal VVS, Srivastava K, Sharma A. Seasonal dynamics and management of whitefly (*Bemisia tabaci* Genn.) in tomato (*Solanum esculentum* Mill.). *Braz Arch Biol Technol.* 2017;60:17160456.
- ul Haq R, Ismail M. Infestation level of *Helicoverpa armigera* (Hubner) in different tomato varieties in selected districts of Khyber Pakhtunkhwa, Pakistan. *Int J Agric Sustain Dev.* 2026;8(1):51-62.