Original Research Article

Seasonal Incidence of Thrips, *Thrips tabaci* (Lindeman) of Tomato (*Solanum lycopersicum* L) in Relation to Weather Parameters

Abstract

Field experiments were conducted during the *Rabi* seasons of 2021–2022 and 2022–2023 at the Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, to study the seasonal incidence of thrips (*Thrips tabaci*) in tomato and their relationship with meteorological parameters. The thrips population ranged from 0.08 to 6.67 per three leaves per plant in *Rabi* 2021–2022 and from 0.06 to 6.52 per three leaves per plant in *Rabi* 2022–2023, with peak infestations occurring in the 10th Standard Meteorological Week (SMW) in both years. Pooled data indicated a population range of 0.07 to 6.60 per three leaves per plant, with the peak consistently in the 10th SMW. Correlation analysis revealed significant negative relationships between thrips population and morning relative humidity (r = -0.621**) and evening relative humidity (r = -0.754**) in *Rabi* 2021–2022, and significant positive relationships with maximum temperature (r = 0.676**), evaporation (r = 0.925**), and wind speed (r = 0.885**). Similar trends were observed in *Rabi* 2022–2023, with additional positive correlations for bright sunshine hours (r = 0.525*). Weather parameters explained 98% and 95% of the variation in thrips population during *Rabi* 2021–2022 and 2022–2023, respectively, emphasizing their significant impact on thrips population dynamics in tomato crops.

Keywords: *Thrips tabaci*, Tomato, Seasonal incidence, correlation

Introduction

Tomato (*Solanum lycopersicum* L.) is a vital vegetable crop cultivated extensively across India. It occupies an area of 872.9 thousand hectares with a production of 21,238.1 thousand metric tons and a productivity rate of 24.33 metric tons per hectare (Anonymous, 2023). However, the production and quality of tomatoes are significantly affected by various pests, among which thrips play a major role. Thrips are small, fringe-winged insects belonging to the order *Thysanoptera*, with approximately 6,414 species documented globally. These species are classified into two suborders: Tubulifera, comprising 3,809 species, and Terebrantia, consisting of 2,593 species (Tyagi *et al*., 2024). Thrips exhibit diverse feeding behaviors, ranging from fungivorous to phytophagous, and are prevalent in tropical, subtropical, and temperate regions. While they contribute positively to pollination in some ecosystems, their role as agricultural pests and vectors of plant viruses poses significant challenges (Tyagi *et al*., 2024). In tomato crops, thrips directly damage plants by feeding on mesophyll and epidermal cells, leading to distorted growth, deformed flowers, and reduced fruit quality. This not only diminishes marketable yield but also affects the overall economic viability of tomato farming (Riley and Pappu, 2004). Furthermore, thrips act as vectors for tospoviruses, including the Tomato Spotted Wilt Virus (TSWV), which can cause severe yield losses. These viruses are acquired by thrips during their nymphal stages and transmitted throughout their lifespan, exacerbating the spread of diseases in tomato crops (Funderburk, 2022). The piercing-sucking mouthparts of thrips enable them to extract plant sap, resulting in visible symptoms such as stippling, silvering of leaves, premature leaf drop, and stunted plant growth (Childers and Achor, 1995). Thrips reproduce rapidly, with their life cycle ranging from 14 to 45 days, depending on environmental conditions, making their management particularly challenging (Funderburk, 2011). Environmental factors such as temperature, humidity, and rainfall significantly influence thrips population dynamics. For instance, higher temperatures tend to increase their population, while heavy rainfall and high humidity exert a suppressive effect (Subba and Ghosh, 2016; Timmanna *et al*., 2020). Additionally, thrips populations have been observed to increase approximately three weeks before the onset of diseases like TSWV, underscoring the need for timely monitoring and management (Riley *et al*., 2012). Given their economic importance as direct pests and vectors of plant pathogens, understanding the seasonal incidence of thrips in tomato crops is crucial for devising effective pest management strategies. This study aims to investigate the population dynamics of thrips in relation to environmental factors, providing insights to inform integrated pest management approaches.

Material and methods

A field experiment was carried out at the Vegetable Improvement Scheme, CES, Wakawali, during the *Rabi* seasons of 2022–23 and 2023–24 to investigate the seasonal incidence of thrips on tomato. The tomato cultivar *Konkan Vijay* was grown in plots measuring 27.72 m^2 with a spacing of 60 × 60 cm.

Method of recording observations

Ten plants were selected randomly for observation. Population was counted on three leaves top, middle and bottom and expressed as number on three leaves. The observations of pests infesting tomato were recorded at weekly interval (SMW) in a crop season. All recommended cultivation practices was followed. At the same time a corresponding weekly record of meteorological data viz. minimum and maximum temperature, morning and evening percent relative humidity, wind speed, evaporation, bright sunshine were maintained.

The influences of different meteorological parameters on pest population were studied by graphical super imposition technique (Harshitha, 2019)

Statistical analysis

The data on thrips infestation in tomato crops were averaged, and correlation and regression analysis were conducted to examine the relationship between thrips populations and weather parameters. These analysis were performed using Microsoft Excel.

Result and discussion

Seasonal incidence of thrips infesting tomato

The data on seasonal incidence of thrips infesting tomato during *Rabi* `2022-23, *Rabi* 2023-24 and pooled data are presented in Table 1 and graphically depicted in Fig. 1.

The data revealed that, during *Rabi* 2022-23 the incidence of thrips population ranged from 0.08 to 6.67 /three leaves /plant. The pest incidence was first noticed in the 1st SMW (01st January to 07th January) *i.e.* 0.08 /three leaves /plant, then incidence increased continuously up to the 10th SMW (05th March to 11th March) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (6.67/three leaves /plant) was recorded in 10th SMW (05th March to 11th March) and minimum pest incidence (0.08/three leaves/plant) was recorded in 1st SMW (01st January to 07th January).

During *Rabi* 2023-24 the incidence of thrips population ranged from 0.06 to 6.52 /three leaves /plant. The pest incidence was first noticed in the 1st SMW (01st January to 07th January) *i.e.* 0.06 /three leaves/plant, then incidence increased continuously up to the 10th SMW (05th March to 11th March) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (6.52 /three leaves /plant) was recorded in 10th SMW (05th March to 11th March) and minimum pest incidence (0.06 /three leaves/plant) was recorded in 1st SMW (01st January to 07th January).

Table 1: Seasonal incidence of thrips, *T. tabaci* infesting tomato during *Rabi* 2022-23, *Rabi* 2023-24 and pooled data

SMW	Period	Mean no. of thrips /three leaves/plant		
		2022-23	2023-24	Pooled
49	03 Dec – 09 Dec	0.00	0.00	0.00
50	10 Dec – 16 Dec	0.00	0.00	0.00
51	17 Dec – 23 Dec	0.00	0.00	0.00
52	24 Dec – 31 Dec	0.00	0.00	0.00
1	01 Jan – 07 Jan	0.08	0.06	0.07
2	08 Jan – 14 Jan	0.91	0.67	0.79
3	15 Jan – 21 Jan	1.66	1.05	1.36
4	22 Jan – 28 Jan	1.66	1.28	1.47

5	29 Jan – 04 Feb	2.05	2.12	2.09
6	05 Feb – 11 Feb	3.32	3.67	3.50
7	12 Feb – 18 Feb	4.65	4.75	4.70
8	19 Feb – 25 Feb	4.41	4.20	4.31
9	26 Feb – 04 Mar	6.03	5.91	5.97
10	05 Mar – 11 Mar	6.67	6.52	6.60
11	12 Mar – 18 Mar	5.04	5.23	5.14
12	19 Mar – 25 Mar	5.87	5.43	5.65
13	26 Mar – 01 Apr	5.45	5.84	5.65
SD (±)		**2.48**	**2.52**	**2.50**
SMW- Standard Meteorological Week				

The pooled data of both the years revealed that, the incidence of thrips population was in the range of 0.07 to 6.60 /three leaves /plant. The pest incidence started from 1st SMW (01st January to 07th January) *i.e.* 0.07 /three leaves /plant, then incidence increased continuously up to the 10th SMW (05th March to 11th March) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (6.60/three leaves/plant) was recorded in 10th SMW (05th March to 11th March) and minimum pest incidence (0.07 /three leaves/plant) was recorded in 1st SMW (01st January to 07th January).

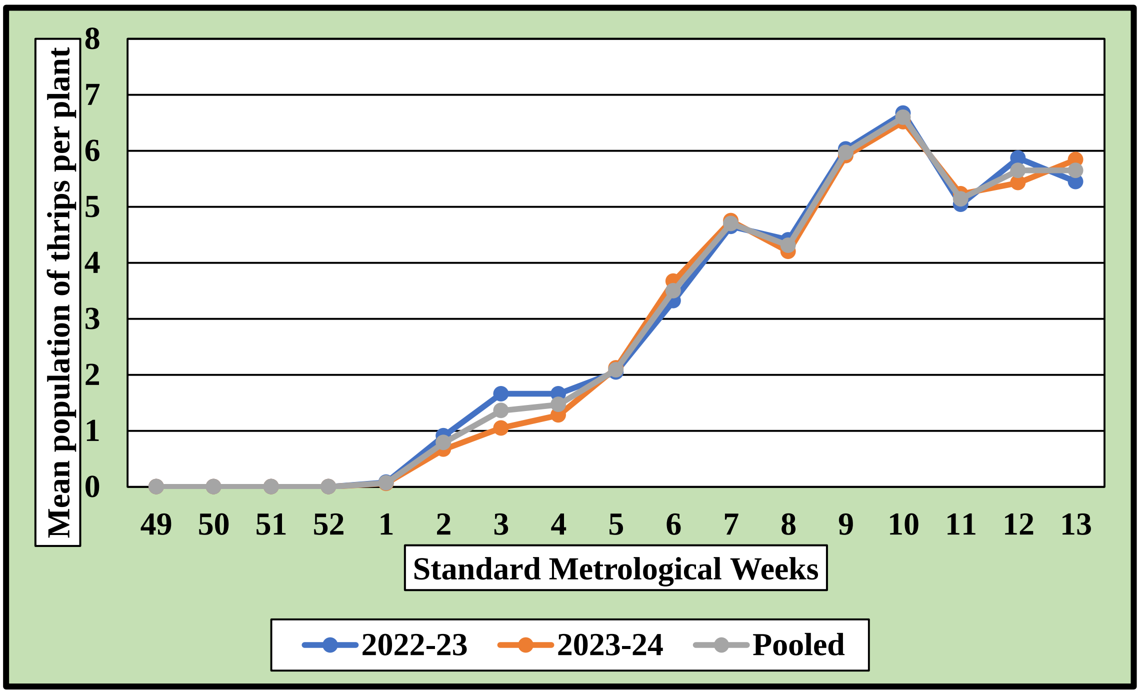

Fig. 1: Seasonal incidence of thrips infesting tomato during *Rabi* 2022-23, *Rabi* 2023-24 and pooled data

Correlation and regression between thrips population and weather parameters

Correlation studies

The data on correlation coefficient of mean population of thrips in relation to different weather parameters during *Rabi* 2022-23 and *Rabi* 2023-24 are shown in table 2.

During *Rabi* 2022-23, the mean population of thrips exhibited positive correlation with minimum temperature, bright sunshine hours. The maximum temperature (r= 0.676**), wind speed (r=0.885**) and evaporation (r=0.925**) recorded positive significant correlation, whereas morning (r=-0.621**) and evening relative humidity (r=-0.754**) had negative significant correlation with mean population of thrips. Other parameters were non-significantly correlated with thrips population.

Table 2: Correlation coefficient of thrips, *T. tabaci* infesting tomato in relation to different weather parameters during *Rabi* 2022-23 and *Rabi* 2023-24

Weather parameters	Correlation coefficient (r)	
	2022-23	**2023-24**
Temp. Max.	0.676 **	0.843 **
Temp. Min.	0.170	0.087
RH-I	-0.621 **	-0.782**
RH-II	-0.754 **	-0.458
BSS	0.005	0.525*
WS	0.885 **	0.911**
EVP	0.925 **	0.950 **

* Correlation is Significant at the 0.05 level 'r' value = 0.482
** Correlation is significant at the 0.01 level 'r' value = 0.606

The mean population of thrips during *Rabi* 2023-24 showed positive correlation with minimum temperature, while negative correlation with evening relative humidity. The thrips population had positive significant correlation with maximum temperature (r= 0.843**), bright sunshine hours (r=0.525**) and wind speed (r=0.911**) and evaporation (r=0.950**) whereas negative significant correlation with morning relative humidity (r= -0.782**). Remaining parameters were non-significantly correlated with thrips population.

Multiple linear regression studies

The multiple regression was worked out between thrips population and weather parameters during *Rabi* 2022-23 and regression coefficient (b) and intercept (a) are presented in Table 3.

The regression equation of *Rabi* 2022-23 was worked out is as follows

$$\mathbf{Y= 6.809 + 0.028\ X_1 - 0.382\ X_2 - 0.078\ X_3 - 0.071\ X_4 - 0.732\ X_5 + 2.809\ X_6 + 0.824\ X_7}$$

The coefficient of determination (R^2) represents the proportion of common variation in the two variables. The investigation revealed that the weather parameters contributed for 98 per cent of total variation in the population of thrips on tomato.

Table 3: Multiple linear regression between thrips, *T. tabaci* and weather parameters during *Rabi* 2022-23

Sr. No.	Weather parameters	Regression coefficient (b)	S.E. (b)	't' values
(X_1)	**Temp. Max.**	0.028	0.234	0.123
(X_2)	**Temp. Min.**	-0.382	0.109	-3.520
(X_3)	**RH-I**	-0.078	0.043	-1.818
(X_4)	**RH-II**	-0.071	0.082	-0.877
(X_5)	**BSS**	-0.732	0.235	-3.094
(X_6)	**WS**	2.809	1.141	2.461
(X_7)	**EVP**	0.824	0.585	1.408
Intercept (a) = 6.809, N=15, F value = 51.436, R^2 = 0.98				

During *Rabi* 2023-24, the multiple regression was worked out between thrips population and weather parameters and regression coefficient (b) and intercept (a) are presented in Table 4.

The regression equation worked out of *Rabi* 2023-24 is as follows

$$Y= -16.854- 0.340\ X_{1}\ _{+}\ 0.051\ X_2 + 0.030\ X_3 -0.052\ X_4 - 0.008\ X_5 + 1.111\ X_6+ 1.105\ X_7$$

The coefficient of determination (R^2) represents the proportion of common variation in the two variables. The investigation revealed that the weather parameters contributed for 95 per cent of total variation in the population of thrips on tomato.

Table 4: Multiple linear regression between thrips, *T. tabaci* and weather parameters during *Rabi* 2023-24

Sr. No.	Weather parameters	Regression coefficient (b)	S.E. (b)	't' values
(X_1)	**Temp. Max.**	0.340	0.220	1.544
(X_2)	**Temp. Min.**	0.051	0.152	0.338
(X_3)	**RH-I**	0.030	0.121	0.255
(X_4)	**RH-II**	-0.052	0.045	-1.151
(X_5)	**BSS**	0.008	0.407	0.021
(X_6)	**WS**	1.111	0.817	1.360
(X_7)	**EVP**	1.105	0.716	1.541
Intercept (a) = -16.854, N=15, F value =23.600, R^2 = 0.95				

Discussion

Similar result has been recorded by Subba *et al*. (2015) revealed that the minimum number of thrips (0.42-53 per leaves) was recorded during 38th to 44th standard metrological week and maximum level of population was observed during 45th to 2nd (1.05-1.89 per leaf) and again during 6th to 20th standard metrological week (1.00-2.22 per leaf). Correlation coefficient values worked out for thrips incidence and weather parameters revealed that temperature difference had significant positive influence on thrips while significant negative correlation with temperature, relative humidity. Present findings are in accordance with those of Mandloi (2013) reported that thrips population had significant positive correlation with relative humidity evening (r= 0.456) in tomato. Vinutha *et al.* (2024) reported a significant positive correlation between maximum temperature (r = 0.663*), indicating that pest activity increased with rising temperatures. Conversely, relative humidity showed a significant negative correlation (r = -0.609*), suggesting higher humidity suppressed pest activity in onion. Jamuna *et al.* (2019) reported that the multiple linerar regression showed a R^2 value of 0.803 indicating 80 per cent influence of weather parameter on thrips incidence in tomato

Conclusion

The seasonal incidence of thrips in tomato crops is characterized by a clear pattern of emergence, peak infestation, and subsequent decline, heavily influenced by environmental conditions. Effective management strategies must consider these seasonal trends and environmental factors to mitigate the impact of thrips on tomato production. Understanding these dynamics is essential for developing integrated pest management approaches that can help sustain tomato yields against thrips infestations.

References

Anonymous, (2023). State-wise area, production and productivity of tomato in India. www.indiastat.com.

Harshitha, M. (2019). *Screening of cultivars, seasonal incidence and management of pests infesting tomato.* MSc. Thesis, Dr,BSKKV, Dapoli.

Riley, D. G., & Pappu, H. R. (2004). Tactics for management of thrips (Thysanoptera: Thripidae) and tomato spotted wilt virus in tomato. *Journal of economic entomology*, *97*(5), 1648-1658.

Childers, C. C., & Achor, D. S. (1995). Thrips feeding and oviposition injuries to economic plants, subsequent damage and host responses to infestation. *Thrips biology and management*, 31-51.

Tyagi Kaomud., Abhishek Patidar., Devkant, Singha., Vikas, Kumar. (2024). Arthropoda; Insecta: Thysanoptera. doi: 10.26515/fauna/1/2023/arthropoda:insecta:thysanoptera

Subba, B., Ghosh, S. K., & Tamang, S. (2015). Population dynamics of Thrips (Thrips tabaci L.) Infesting tomato (Lycopersicon esculentum L.) and their sustainable management. *International Journal of Economic Plants*, *2*(2), 54-58.

Timmanna., Mohan, I, Naik., A, K, Chakravarty., R, Ashokan., V, Sridhar. (2020). Weather based prediction models for thrips and bud necrosis virus disease in tomato. *Indian journal of entomology*, 82(2):228.

David, G., Riley., Shimat, V., Joseph., Rajagopalbabu, Srinivasan. (2012). Temporal Relationship of Thrips Populations to Tomato Spotted Wilt Incidence in Tomato in the Field. *Journal of Entomological Science*, 47(1):65-75.

Funderburk, J., Reitz, S., Olson, S., Stansly, P., Smith, H,, McAvoy, G., Demirozer, O., Snodgrass, C., PARET, M., AND Leppla, N. (2011). Managing thrips and tospoviruses in tomato. Univ. Florida, Coop. Ext. Serv. ENY 859, Gainesville, FL

Mandloi R. (2013). Study on seasonal incidence of insect pest complex of tomato (*Solanum lycopersicum* L.) and their management with phyto-extracts. M.Sc (Ag) Thesis. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur.

Jamuna, B., Bheemanna, M., Hosamani, A. C., Ghante, V. N., Govindappa, M. R., Kavitha, K., & Kisan, B. (2019). Population dynamics of thrips and bud necrosis virus disease on tomato. *Int. J. Curr. Microbiol. Appl. Sci*, **8**(5): 24-34.

Vinutha, R., Hegde, M., Hiremath, S., Guruprasad, G., Hulihalli, U., Shivakumara, K., & Rachana. (2024). Occurrence and seasonal abundance of *Thrips tabaci* Lindeman on onion in the north transition zone of Karnataka, India. *Pest Management in Horticultural Ecosystems*, **30**(01): 93-100