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SEASONAL INCIDENCE OF TOMATO PINWORM, *Phthorimaea absoluta* (Meyrick) (LEPIDOPTERA: GELECHIIDAE) IN SOUTHERN DRY ZONE OF KARNATAKA

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ABSTRACT

The research on the seasonal incidence of the tomato pinworm, *Phthorimaea absoluta* (Meyrick) was conducted at the College of Agriculture, Karekere, Hassan, during *Late Kharif* 2023, *Rabi* 2023-24 and *Summer* 2024. *P. absoluta* was found to infest tomatoes from the nursery stage till to harvest. Infestation levels were lowest during the vegetative and grand growth stages, but increased significantly during the reproductive phase, leading to notable yield losses. The larval population, leaf and fruit damage varied with the season and crop stage. Peak larval incidence was recorded during the 42nd Standard Week (SW) of *Late Kharif*2023 (12.52), 3rd SW of *Rabi* 2023-24 (14.22) and 23rd SW of *Summer* 2024 (12.78). Similarly, fruit damage was highest during the 48th SW of *Late Kharif* 2023 (85.00%), 9th SW of *Rabi* 2023-24 (94.44%) and 27th SW of *Summer* 2024 (92.22%). Larval population, foliage, and fruit damage had a significant positive correlation with maximum while humidity showed a significant negative correlation.

Keywords **:** *Phthorimaea absoluta,* tomato pinworm*, Late Kharif, Summer, Rabi.*

Introduction

Phthorimaea absoluta (Meyrick) (Lepidoptera: Gelechiidae), commonly known as the tomato leaf miner or pinworm, is an invasive, oligophagous pest primarily affecting tomatoes but also other solanaceous crops. Globally, tomatoes are grown in 4.917 million hectares, producing 18.61 million metric tons. In India, tomatoes are grown in 843,000 hectares, with an annual production of 20.694 million metric tons (FAO, 2022), faces significant production challenges due to pests and diseases. *P. absoluta* has become a major pest in India, having been a dominant threat in South America since the 1960's (Garcia and Espul, 1982), and is native to this region (Urbaneja *et al*., 2013). The pest was first recorded in India in Maharashtra in October 2014 (Shashank *et al*., 2015) and later in Karnataka at ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Hessaraghatta, Bengaluru, during the 2014 *Rabi* season (Sridhar *et al*., 2014). *P. absoluta* causes severe yield and fruit quality reductions, with losses reaching up to 100% in both greenhouse and open-field conditions (Shashank *et al*., 2015; Daniel *et al*., 2017). The larvae damage various parts of the plant, including leaves, buds, stems, and fruits. Fruit rot often follows as secondary pathogens invade the damaged fruits (Daniel *et al*., 2017). Understanding the seasonal variation in foliage and fruit damage in relation to weather factors is crucial for developing effective Integrated Pest Management (IPM) strategies. Hence, this study aims to examine the seasonal incidence of *P. absoluta* and its correlation with weather conditions.

Materials and Methods

Experimental site and design : The present study was carried out under field conditions from September 2023 to July 2024 at the College of Agriculture, Karekere, Hassan, University of Agricultural Sciences, Bangalore (UASB), located at 12° 58' 18" North latitude and 76° 16' 13" East longitude. The meteorological data were recorded throughout the

study period at the Agro Meteorological Observatory of the College of Agriculture, Karekere. The locally grown hybrid variety Alankar was used for the experiments. 30 days old seedlings were transplanted in a 5 × 5 m² area with row-to-row and plant-to-plant spacing of 90 cm and 60 cm, respectively. The crop was managed according to the Package of Practices, excluding plant protection operations (Anon., 2017b).

Observations recorded: Observations were recorded weekly from 10 randomly selected, tagged plants, starting from 14 days after transplanting (DAT) across three seasons: *Late Kharif* 2023, *Rabi* 2023-24, and *Summer* 2024. The observed pest parameters (mines, larvae, leaf damage, fruit damage) were correlated with weather data to understand the impact of meteorological factors on pest incidence. Regression analysis was performed to determine the relationship between pest population and weather conditions.

Larval Counts: Larval populations of *P. absoluta* were recorded by counting the number of mines with live larvae. Initially, the entire plant was examined, and later, three leaves from the bottom, middle, and top were observed for larvae.

Leaf Damage: The number of infested leaves was counted weekly and expressed as the percentage of leaf damage

$$\text{Leaf damage (\%)} = \frac{\text{No. of leaves infested per plant}}{\text{Total number of leaves per plant}} \times 100$$

Fruit Damage: Similarly, fruit damage was assessed by counting the number of damaged fruits weekly and expressing it as a percentage of fruit damage

$$\text{Fruit damage (\%)} = \frac{\text{No. of fruits infested per plant}}{\text{Total number of fruits per plant}} \times 100$$

The recorded observation was correlated with the weather parameters. Regression analysis between insect pest population and meteorological parameters was worked out

Results and Discussion

Incidence of *P. absoluta* during *Late Kharif* 2023 (August–November 2023)

During the *Late Kharif* season, leaf mines from *P. absoluta* appeared in the third week of August, peaking at 13.93 mines per plant in the second week of October. The average was 10.46 ± 2.37. Leaf damage ranged from 5.21% to 47.81%, with the highest damage (47.81%) and larvae count (12.52 larvae/plant) in October. The average damage was 22.08 ± 11.07% (Table 1), and larvae per plant averaged 7.1 ± 3.48. Fruit infestation was first recorded in the second week of September, ranging from 19.07% to 85%, with an average of 40.18 ± 29.89% (Table 2).

Leaf damage had a significant positive correlation with total rainfall (r = 0.517) and weaker correlations with temperature and humidity. Regression analysis explained 45% of the variation (R^2 = 0.45).Larvae per plant showed a significant positive correlation with rainfall (r = 0.589), with temperature and humidity also contributing. Regression analysis explained 45% of the variation (R^2 = 0.45).Number of mines had weak correlations with weather factors, with total rainfall showing a non-significant positive correlation (r = 0.403). Regression analysis explained 20% of the variation (R^2 = 0.20).Fruit infestation had a strong positive correlation with maximum temperature (r = 0.801) and weaker correlations with humidity and rainfall. Regression analysis explained 66.5% of the variation (R^2 = 0.665) (Table 3).

Incidence of *P. absoluta* during *Rabi 2023-24* (November 2023–February 2024)

During the Rabi season, leaf mines first appeared in the third week of November, with the number of mines per plant ranging from 7.13 to 21.72, peaking in the second week of December. The average was 10.92 ± 7.71 (Table 1). Leaf damage was first observed in late November, ranging from 5.77% to 44.70%, with the highest damage (44.70%) and larvae count (14.22 larvae/plant) recorded in the third week of January. The average leaf damage was 22.5 ± 15.16% (Table 1), and larvae per plant averaged 8.45 ± 3.55 (Table 2).Fruit infestation began in December, ranging from 21.91% to 94.44%, with an average of 46.68 ± 33.94% (Table 2).

Leaf damage showed weak positive correlations with rainfall, maximum, and minimum temperature but a non-significant negative correlation with relative humidity (Table 3). Multiple regression analysis explained 21% of the variation (R^2 = 0.21). Larvae per plant had significant positive correlations with maximum temperature (r = 0.564), relative humidity (r = 0.694), and minimum temperature (r = 0.618), with a non-significant positive correlation with rainfall (Table 3). Regression analysis explained 58% of the variation (R^2 = 0.58). Number of mines per plant showed weak correlations with rainfall and maximum temperature, and a significant negative correlation with relative humidity (r = -0.526) (Table 3). Regression analysis explained 35% of the variation (R^2 = 0.35). Fruit infestation had significant positive correlations with maximum temperature (r = 0.661) and negative correlations with minimum temperature (r = -0.669) (Table 3). Regression analysis explained 68.4% of the variation (R^2 = 0.684).

Table 1: Seasonal incidence of tomato pinworm, *P. absoluta* during *Late kharif* 2023, *Rabi* 2023-24 and *Summer* 2024

MSW	Mean of ten plants *Late kharif* 2023		MSW	Mean of ten plants *Rabi* 2023-24		MSW	Mean of ten plants *Summer* 2024	
	Number of leaf mines/Plant	Per cent leaf infestation (%)		Number of leaf mines /Plant	Per cent leaf infestation (%)		Number of leaf mines /Plant	Per cent leaf infestation (%)
35	7.27	17.72	**47**	-	-	**15**	6.44	17.90
36	6.92	19.42	**48**	12.24	35.50	**16**	7.36	19.14
37	11.93	20.48	**49**	7.13	28.65	**17**	7.00	20.19
38	11.81	21.70	**50**	21.46	28.16	**18**	11.79	21.60
39	12.80	30.30	**51**	0.00	0.00	**19**	12.03	22.33
40	12.38	32.91	**52**	21.72	44.70	**20**	12.47	33.08
41	13.93	39.77	**01**	3.05	7.55	**21**	12.38	34.80
42	13.29	47.81	**02**	13.92	39.45	**22**	13.51	42.62
43	11.43	19.71	**03**	0.00	18.77	**23**	13.09	51.05
44	11.71	19.61	**04**	0.00	0.00	**24**	11.62	21.35
45	11.26	21.82	**05**	19.57	23.30	**25**	11.36	21.20
46	9.79	12.41	**06**	9.54	16.76	**26**	11.40	23.73
47	9.32	5.21	**07**	13.03	13.61	**27**	9.60	12.30
48	8.92	20.54	**08**	14.28	5.77	**28**	9.45	5.27
49	8.11	6.85	**09**	18.94	44.53	**29**	8.96	20.31
Mean ± SD	10.46 ± 2.37	22.08 ± 11.07		10.92 ± 7.71	22.5 ± 15.16		10.56±2.28	24.46±11.57

Incidence of *P. absoluta* During *Summer* 2024 (April 2024–June 2024)

During the Summer season, leaf mines first appeared in the second week of April, with the number of mines per plant ranging from 6.44 to 13.51, peaking in the fourth week of May. The average number of mines was 10.56 ± 2.28 (Table1). Leaf damage was first recorded in April, ranging from 5.27% to 51.05%, with the highest damage and larvae count (12.78 larvae/plant) observed in the first week of June. The average leaf damage was 24.46 ± 11.57%, and larvae per plant averaged 7.57 ± 3.22 (Table 7). Fruit infestation began in late April, ranging from 21.92% to 92.22%, with an average of 47.90 ± 35.09% (Table 2).

Leaf mines showed weak correlations with rainfall (r = 0.007), relative humidity (r = 0.141), and minimum temperature (r = 0.063), and a non-significant negative correlation with maximum temperature (r = -0.188) (Table 3). Multiple regression analysis explained 22% of the variation (R^2 = 0.22). Larvae per plant had significant positive correlations with maximum temperature (r = 0.473) and minimum temperature (r = 0.638), and significant negative correlation with total rainfall (r = -0.453), with a non-significant negative correlation with relative humidity (r = -0.248) (Table 3). Regression analysis explained 50% of the variation (R^2 = 0.50).Leaf damage showed significant negative correlations with both rainfall (r = -0.334) and relative humidity (r = -0.321), and weak positive correlations with maximum and minimum temperature (r = 0.160, 0.248) (Table 3). Multiple regression analysis explained 49.6% of the variation (R^2 = 0.496).Fruit infestation had significant positive correlations with rainfall (r = 0.510) and relative humidity (r = 0.563), and significant negative correlations with minimum (r = -0.748) and maximum temperature (r = -0.895) (Table 3). Multiple regression analysis explained 73.2% of the variation (R^2 = 0.732).

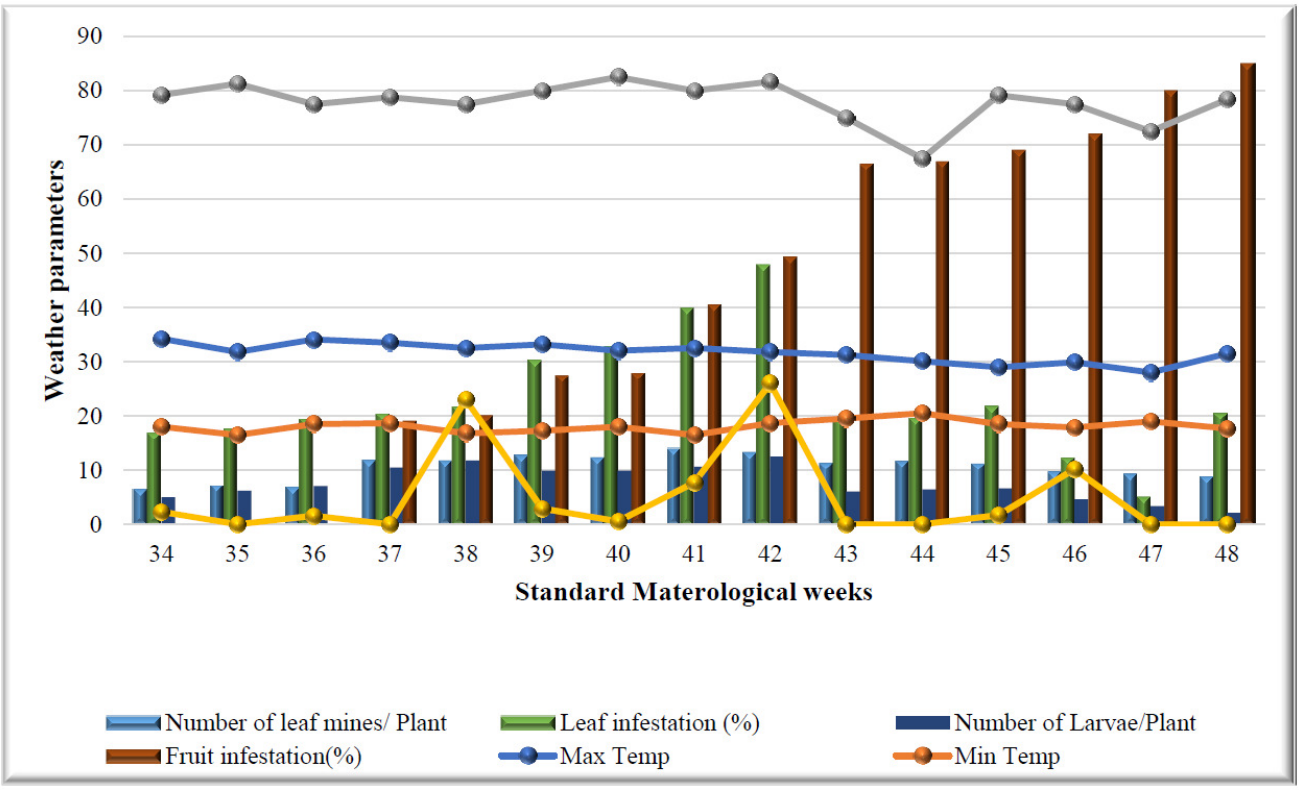

Fig. 1 : Incidence of tomato pinworm *P. absoluta* in relation to weather parameters, *Late Kharif* 2023

Table 2: Seasonal incidence of tomato pinworm, *P. absoluta* during *Late kharif* 2023, *Rabi* 2023-24 and *Summer* 2024.

MSW	Mean of ten plants *Late kharif* 2023		MSW	Mean of ten plants *Rabi* 2023-24		MSW	Mean of ten plants *Summer* 2024	
	Number of Larvae /Plant	Per cent fruit infestation (%)		Number of Larvae /Plant	Per cent fruit infestation (%)		Number of Larvae /Plant	Per cent fruit infestation (%)
35	6.22	0.00	**47**	-	-	**15**	5.03	0.00
36	7.10	0.00	**48**	6.89	0.00	**16**	6.18	0.00
37	10.48	19.07	**49**	7.90	0.00	**17**	7.04	0.00
38	11.80	20.18	**50**	12.04	21.91	**18**	10.35	21.92
39	9.91	27.50	**51**	13.15	22.58	**19**	12.02	23.42
40	9.89	28.00	**52**	11.08	31.21	**20**	10.07	31.75
41	10.61	40.56	**01**	10.90	31.28	**21**	9.92	30.63
42	12.52	49.36	**02**	11.75	44.98	**22**	10.81	46.30
43	6.02	66.57	**03**	14.22	56.03	**23**	12.78	55.17
44	6.45	67.00	**04**	6.92	75.55	**24**	5.97	75.79
45	6.63	69.00	**05**	7.36	74.64	**25**	6.48	84.59
46	4.61	72.00	**06**	7.52	76.87	**26**	6.67	91.68
47	3.37	80.00	**07**	5.27	81.07	**27**	4.68	92.22
48	2.13	85.00	**08**	3.86	89.60	**28**	3.37	88.08
49	0.84	18.62	**09**	2.34	94.44	**29**	2.17	76.96
Mean ± SD	7.1 ± 3.48	40.18 ± 29.89		8.45±3.55	46.68 ± 33.94		7.57±3.22	47.90±35.09

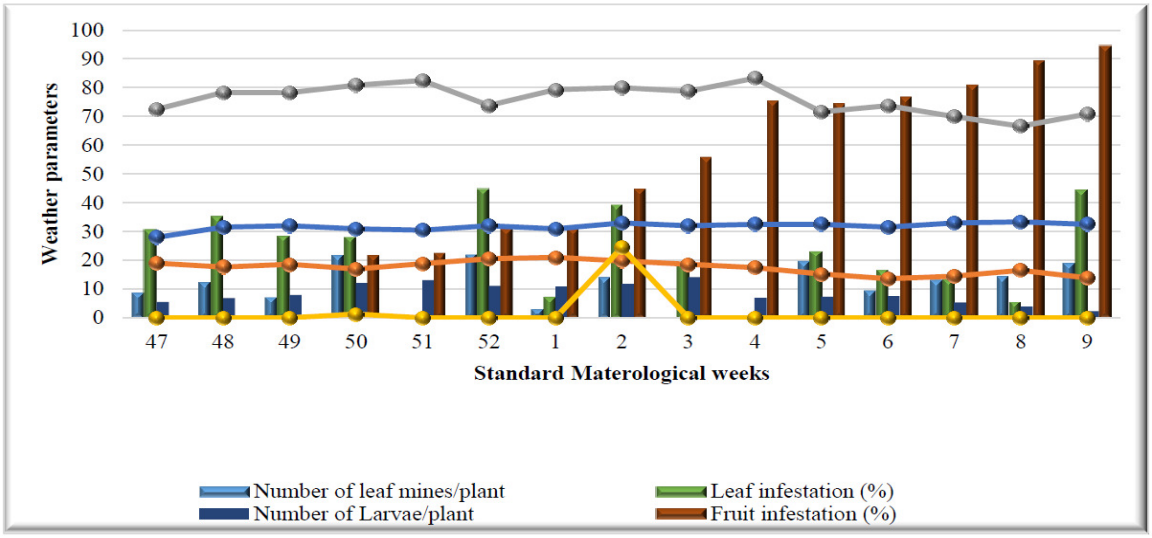

Fig. 2: Incidence of tomato pinworm *P. absoluta* in relation to weather parameters, *Rabi* 2023-24

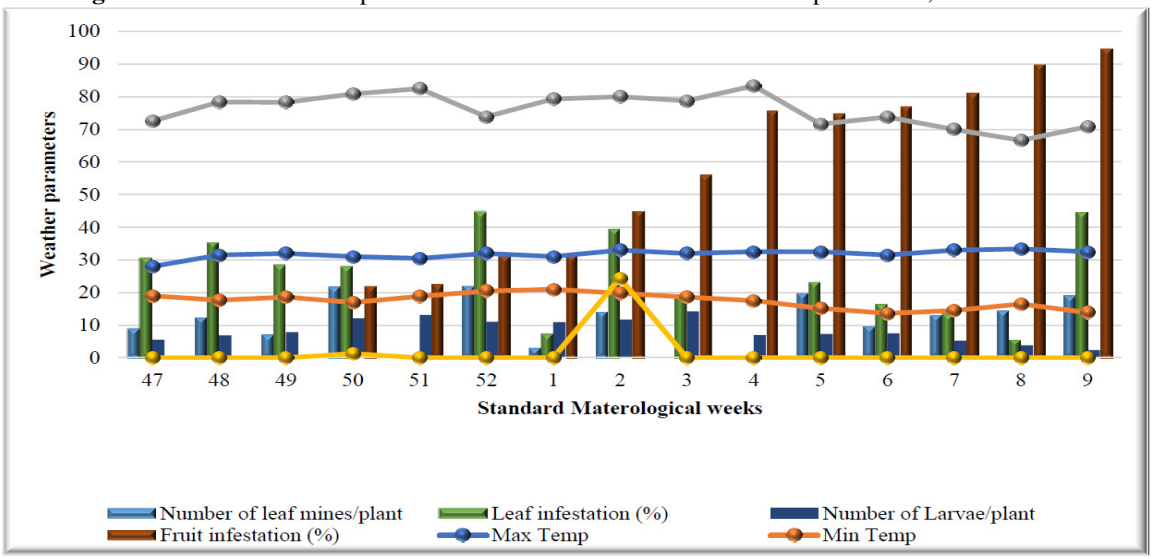

Fig. 3 : Incidence of tomato pinworm *P. absoluta* in relation to weather parameters, *Summer* 2024

Table 3: Correlation coefficient (r) and coefficient of determination (R^2) between weather parameters and incidence of tomato pinworm, *P. absoluta*during *Late Kharif* 2023, *Rabi* 2023-24 and *Summer* 2024

Particulars	*Late Kharif*2023					*Rabi* 2023-24					*Summer* 2024				
	Correlation co-efficient (r)					Correlation co-efficient (r)					Correlation co-efficient (r)				
	Max Temp (°C)	Min Temp (°C)	Relative Humidity (%)	Rainfall (mm)	Coefficient of determination (R^2)	Max Temp (°C)	Min Temp (°C)	Relative Humidity (%)	Rainfall (mm)	Coefficient of determination (R^2)	Max Temp (°C)	Min Temp (°C)	Relative Humidity (%)	Rainfall (mm)	Coefficient of determination (R^2)
Number of leaf mines /Plant	-0.119	0.008	0.061	0.403	0.201	0.241	-0.317	-0.526*	0.127	0.352	-0.188	0.063	0.141	0.007	0.221
Leaf infestation (%)	0.312	-0.254	0.488	0.517*	0.451	0.032	0.046	-0.19	0.315	0.215	0.160	0.248	-0.321*	-0.334*	0.496
Number of Larvae/plant	0.362	-0.265	0.349	0.589*	0.455	0.564*	0.618*	0.694*	0.272	0.577	0.473*	0.639**	-0.248	-0.453*	0.500
Fruit infestation (%)	0.801**	0.404	-0.459	-0.012	0.665	0.661*	-0.669*	-0.485	-0.024	0.684	-0.895**	-0.748**	0.563**	0.510**	0.732

Nayana *et al*. (2018) reported that the incidence of *T. absoluta* had the positive correlation with the maximum temperature. Likewise, Chavan et al. (2021) reported a positively correlation with maximum temperature and sunshine hours and similar results were also observed in present study. The results of the present investigations are in close conformity with Manjula et al. (2020) who reported the incidence was relatively low in the early stages of the crop however its population escalated as the crop season progressed.

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