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SEASONAL ABUNDANCE OF MAJOR INSECT PESTS OF SWEET ORANGE (*Citrus sinensis* L.) IN RELATION TO WEATHER PARAMETERS DURING *MRIG BAHAR* 2025

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ABSTRACT

Seasonal abundance of major insect pests of sweet orange (*Citrus sinensis* L. Osbeck) was investigated during *Mrig bahar* 2025 at the Central Nursery Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, to determine the occurrence of important insect pests and their relationship with prevailing weather parameters. Weekly observations were recorded from the 23rd to 52nd Standard Meteorological Week (SMW) on citrus leaf miner (*Phyllocnistis citrella* Stainton), citrus blackfly (*Aleurocanthus woglumi* Ashby), citrus psyllid (*Diaphorina citri* Kuwayama) and citrus whitefly (*Dialeurodes citri* Ashmead). Simultaneously, weather data including rainfall, maximum and minimum temperature and morning and evening relative humidity were recorded and correlated with pest incidence. Citrus leaf miner infestation remained active throughout the season and reached a maximum of 23.38 % during the 33rd SMW, while citrus blackfly attained the highest population of 25.50 blackflies/twig during the same week. Citrus psyllid population peaked at 24.25 psyllids/twig during the 36th SMW, whereas citrus whitefly recorded the highest population of 3.50 whiteflies/twig during the 48th SMW. Correlation analysis revealed that leaf miner infestation exhibited a highly significant positive association with rainfall and morning relative humidity and a highly significant negative association with maximum temperature. Citrus blackfly and citrus psyllid populations showed significant negative correlations with maximum temperature and positive correlations with morning relative humidity. Citrus whitefly population exhibited a significant negative correlation with minimum temperature. The investigation indicated that weather factors, particularly temperature and relative humidity, played a major role in regulating seasonal abundance of insect pests of sweet orange. The information generated through the present study will be useful for forecasting pest incidence and developing timely integrated pest management strategies in sweet orange orchards.

***Key words*:** Sweet orange, Seasonal abundance, Citrus leaf miner, Citrus psyllid, Weather parameters

Introduction

Sweet orange (*Citrus sinensis* L. Osbeck) is one of the most important fruit crops belonging to the family Rutaceae and is widely cultivated in tropical and subtropical regions of the world. The fruits are highly valued for their pleasant flavour, rich nutritional composition and abundance of vitamin C, minerals and antioxidants, making them an important component of the human diet. Besides fresh consumption, sweet orange is extensively utilized in the processing industry for the preparation of juices, concentrates, beverages and other value-added products (Swingle and Reece, 1967; Williams *et al*., 2021).

India is one of the leading producers of citrus fruits, where sweet orange occupies an important position among commercial fruit crops. According to the National

Horticulture Board, sweet orange is cultivated over about 5.8 lakh hectares with an annual production of approximately 62 lakh metric tonnes. Maharashtra is the leading sweet orange producing state, followed by Andhra Pradesh, Madhya Pradesh and Telangana, with major cultivation concentrated in the districts of Nagpur, Jalna, Aurangabad, Parbhani and Nanded (NHB, 2023; Qureshi *et al*., 2025).

Despite its economic importance, sweet orange production is seriously constrained by the incidence of several insect pests. Among them, citrus leaf miner (*Phyllocnistis citrella* Stainton), citrus blackfly (*Aleurocanthus woglumi* Ashby), citrus psyllid (*Diaphorina citri* Kuwayama) and citrus whitefly (*Dialeurodes citri* Ashmead) are considered the major pests causing considerable reduction in plant vigour, fruit yield and quality. Their infestation results in sap depletion, leaf mining, curling of tender leaves, development of sooty mould and transmission of citrus greening disease, leading to substantial economic losses if timely management practices are not adopted (Butani, 1979; Halbert and Manjunath, 2004; Bové, 2006). lthough several studies have been conducted on citrus pests in different agro-climatic regions, information on their seasonal incidence under the conditions of Parbhani is limited. Hence, the present investigation was undertaken to study the seasonal abundance of major insect pests of sweet orange in relation to weather parameters during *Mrig bahar*, 2025.

Materials and Methods

The present investigation on the seasonal abundance of major insect pests of *sweet orange* (*Citrus sinensis* L. Osbeck) was conducted during the *Mrig bahar* season of 2025 at the Central Nursery Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, Maharashtra. The experimental site is situated at 19°15’ 33” N latitude and 76°46’ 59” E longitude, at an elevation of 408.50 m above mean sea level. The region falls under the Central Maharashtra Plateau Zone and is characterized by a semi-arid tropical climate. Field observations were recorded at regular intervals to assess the seasonal abundance of major insect pests of sweet orange and to study their relationship with the prevailing weather parameters.

Recording of observations

A healthy, untreated sweet orange trees were selected for recording seasonal incidence throughout the experimental period. Weekly observations were recorded from the 23rd to 52nd Standard Meteorological Week (SMW). Four tender terminal twigs (15 cm length) were selected randomly from four directions of the tree and observations were recorded on citrus leaf miner, citrus blackfly, citrus psyllid and citrus whitefly. Simultaneously, weekly meteorological data on rainfall, maximum temperature, minimum temperature, morning relative humidity and evening relative humidity were collected from the Agrometeorological Observatory, VNMKV, Parbhani and used for correlation analysis with pest incidence (Wagh, 2016).

Observation on citrus leaf miner

The incidence of citrus leaf miner (*Phyllocnistis citrella* Stainton) was recorded by counting the total number of leaves and the number of mined leaves present on each 15 cm tender twig. The per cent leaf infestation was calculated using the following formula

$$\frac{\text{Leaf minor infested leaves per 15 cm twig}}{\text{Total no. of leaves per 15 cm twig}} \times 100$$

Observation on citrus blackfly

The population of citrus blackfly (*Aleurocanthus woglumi* Ashby) was recorded by counting the number of nymphs and adults present on each selected 15 cm tender twig. The average number of blackflies per wig was worked out for each observation.

Observation on citrus psyllid

The population of citrus psyllid (*Diaphorina citri* Kuwayama) was recorded by counting the nymphs and adults present on newly emerged shoots and tender leaves of each selected twig. The mean number of psyllids per twig was calculated.

Observation on citrus whitefly

The population of citrus whitefly (*Dialeurodes citri* Ashmead) was recorded by examining the lower surface of leaves on each selected twig and counting the number of whiteflies present. The average population per twig was computed.

Statistical analysis

The weekly observations on pest incidence were subjected to correlation analysis to determine the relationship between seasonal abundance of major insect pests and weather parameters. Pearson’s correlation coefficient (r) was calculated between pest population and rainfall, maximum temperature, minimum temperature, morning relative humidity and evening relative humidity. The significance of correlation coefficients was tested at 5 and 1 per cent levels of probability.

Results and Discussion

Citrus leaf miner (*Phyllocnistis citrella* Stainton)

The seasonal incidence of citrus leaf miner during

Table 1: Seasonal incidence of major insect pests of sweet orange during *Mrig bahar* 2025.

SMW	Period	LMI	Blackfly /Twig	CP/T	Whitefly /twig	Rainfall (mm)	Temp. (°C)		RH	
							Max	Min	Morning	Evening
23	4–10 June	1.90	6.25	6.75	0.25	9.10	35.70	23.50	78.00	45.00
24	11–17 June	5.27	8.50	4.50	1.00	53.40	33.40	23.40	87.00	55.00
25	18–24 June	0.83	10.25	7.75	0.50	1.30	34.40	23.80	78.00	49.00
26	25 June–01 July	8.32	8.25	4.25	1.25	25.30	31.30	23.60	82.00	68.00
27	02–08 July	11.31	6.50	2.50	1.75	39.50	30.40	22.80	87.00	64.00
28	09–15 July	8.08	12.25	9.50	1.50	3.30	31.80	23.00	84.00	62.00
29	16–22 July	16.61	10.50	7.75	1.25	76.80	31.60	23.40	90.00	62.00
30	23–29 July	19.81	14.25	8.25	1.25	121.00	28.20	22.40	93.00	79.00
31	30 July–05 August	20.51	20.00	16.50	1.50	1.00	31.30	22.80	89.00	63.00
32	06–12 August	21.96	22.00	18.75	2.00	20.70	30.30	22.90	92.00	70.00
33	13–19 August	23.38	25.50	16.75	0.50	145.70	26.30	22.20	94.00	85.00
34	20–26 August	20.11	23.75	24.00	0.25	0.00	30.20	21.40	88.00	65.00
35	27 August–02 September	21.24	19.75	18.25	0.50	111.80	28.10	22.40	94.00	85.00
36	03–09 September	20.55	20.50	24.25	0.50	9.30	30.40	21.70	91.00	67.00
37	10–16 September	19.65	19.25	17.50	1.25	123.50	29.80	22.70	94.00	75.00
38	17–23 September	17.14	13.75	16.50	1.50	135.30	30.60	21.90	95.00	72.00
39	24–30 September	18.96	10.50	12.75	1.75	124.10	28.30	21.30	92.00	75.00
40	01–07 October	14.96	9.75	8.50	1.50	98.60	31.20	21.40	92.00	58.00
41	08–14 October	8.67	13.00	15.50	1.25	0.00	31.70	17.70	88.00	42.00
42	15–21 October	7.19	10.25	11.50	0.75	0.00	32.80	20.10	88.00	44.00
43	22–28 October	10.97	8.00	3.25	2.00	6.10	31.40	21.40	92.00	55.00
44	29 October–04 November	13.38	5.75	1.25	2.75	38.00	30.80	21.60	92.00	63.00
45	05–11 November	8.65	10.50	7.00	1.75	0.00	30.80	13.20	86.00	30.00
46	12–18 November	10.22	12.50	9.25	2.50	0.00	28.70	8.70	85.00	28.00
47	19–25 November	10.37	15.75	8.50	2.75	0.00	30.70	11.10	87.00	31.00
48	26 November–02 December	11.81	19.50	11.75	3.50	0.00	28.70	10.80	89.00	32.00
49	03–09 December	12.72	23.75	12.25	2.25	0.00	28.60	8.80	90.00	26.00
50	10–16 December	14.05	22.25	14.25	1.75	0.00	28.30	6.40	89.00	23.00
51	17–24 December	14.20	24.75	15.75	0.50	0.00	28.10	6.40	89.00	27.00
52	24–31 December	14.06	23.75	17.25	1.50	0.00	27.70	7.00	90.00	28.00

*SMW- Standard Meteorological Week; LMI: Leaf miner infestation(%); CP/T: Citrus psyllid / twig; RH: Relative Humidity (%)

Mrig bahar, 2025 is presented in Table 1 and Fig. 1. The pest remained active throughout the observation period (23rd–52nd SMW). The infestation varied from 0.83 to 23.38%. The lowest infestation (0.83%) was recorded during the 25th SMW, whereas the highest infestation (23.38%) was observed during the 33rd SMW. Thereafter, the infestation gradually declined and persisted at moderate levels until the end of the season. The higher infestation recorded during August may be attributed to the availability of tender vegetative flushes coupled with favourable weather conditions.

The present findings are in agreement with Bhut *et al.*, (2013), who reported higher leaf miner activity during July and August. Similar observations were also made by Alexander *et al.*, (2014), who observed peak infestation during August to September. Prabhudev *et al.*, (2021) also reported that citrus leaf miner remained active throughout the year with maximum infestation during the rainy season. The present investigation confirms that the monsoon period favours the development and multiplication of citrus leaf miner.

Citrus blackfly (*Aleurocanthus woglumi* Ashby)

The seasonal incidence of citrus blackfly during *Mrig bahar*, 2025 is presented in Table 1 and Fig. 1. The pest was observed throughout the cropping season, with the population ranging from 5.75 to 25.50 blackflies/twig. The lowest population (5.75 blackflies/twig) was recorded during the 44th SMW, while the highest population (25.50 blackflies/twig) was observed during the 33rd SMW. The population increased gradually during the monsoon period, declined from September to early November and again showed a gradual increase during November and December.

The present findings are in accordance with Aruna

Table 2: Correlation between pests of sweet orange with weather parameter.

Weather parameters	Correlation coefficient value(r)			
	LM	BT	CT	WT
Rainfall(mm)	0.530**	-0.030	0.077	-0.188
Max. Temp. (⁰C)	-0.685**	-0.663**	-0.410*	-0.232
Min. Temp. (⁰C)	0.106	-0.449*	-0.123	-0.410*
Morning RH	0.817**	0.396*	0.391*	0.155
Evening RH	0.547**	-0.094	0.151	-0.355

LM: Leaf miner (% infestation); BT: Blackfly/twig; CT: Citrus psyllid/twig; WT: Whitefly/twig
** Significance at 1% and *Significance at 5%

et al., (2017), who reported higher blackfly incidence during the rainy season and winter months. Similar observations were made by Kumar *et al.*, (2021), who recorded peak blackfly population during August followed by a gradual decline after the rainy season. Nath and Sikha (2019) also reported major population peaks during August and November. The present study indicated that favourable weather conditions prevailing during the monsoon season promoted the multiplication of citrus blackfly.

Citrus psyllid (*Diaphorina citri* Kuwayama)

The seasonal incidence of citrus psyllid during *Mrig bahar*, 2025 is presented in Table. 1 and Fig.1. The psyllid population remained active throughout the observation period and varied from 1.25 to 24.25 psyllids/twig. The minimum population (1.25 psyllids/twig) was recorded during the 44th SMW, whereas the maximum population (24.25 psyllids/twig) was observed during the 36th SMW. The population increased from late July, reached its peak during early September and thereafter declined gradually before increasing again towards the end of the season.

The present findings are in conformity with Patel and Patel (2006), who reported maximum psyllid activity during August. Similar results were obtained by Wankhade *et al.*, (2015) and Singh *et al.*, (2023), who observed higher psyllid populations during the rainy season owing to the availability of tender flushes. The present investigation also indicated that citrus psyllid remained active throughout the cropping period, with peak incidence during early September.

Citrus whitefly (*Dialeurodes citri* Ashmead)

The seasonal incidence of citrus whitefly during *Mrig bahar*, 2025 is presented in Table 1 and Fig. 1. The whitefly population remained comparatively low throughout the study period and ranged from 0.25 to 3.50 whiteflies per twig. The lowest population (0.25 whiteflies/ twig) was recorded during the 23rd and 34th SMWs, whereas the highest population (3.50 whiteflies/twig) was observed during the 48th SMW. The population remained low from June to October, increased gradually during November and declined towards the end of December.

The present findings are in agreement with Lekurwale and Kadam (2017), who reported comparatively higher whitefly populations during October to December. Similar observations were made by Priyadarshini *et al.*, (2018) and Jivrag *et al.*, (2022), who reported maximum whitefly activity during the later part of the cropping season. The present results indicate that whitefly incidence was comparatively low during the rainy season and increased during the winter months.

Correlation between citrus leaf miner infestation and weather parameters

The correlation coefficients between citrus leaf miner infestation and weather parameters are presented in Table 2. Leaf miner infestation exhibited a highly significant positive correlation with rainfall (r = 0.530**) and morning relative humidity (r = 0.817**), while a highly significant negative correlation was observed with maximum temperature (r = –0.685**). The relationships with minimum temperature (r = 0.106NS) were positive but non-significant, whereas evening relative humidity showed a significant positive correlation (r = 0.547**). These results indicate that rainfall and higher relative humidity favoured leaf miner infestation, whereas higher maximum temperature adversely affected its incidence.

The present findings are in agreement with Alexander *et al.*, (2014), Kumbhar *et al.*, (2021) and Dewangan *et al.*, (2022), who also reported a positive association of citrus leaf miner with rainfall and relative humidity and a negative association with maximum temperature.

Correlation between citrus blackfly population and weather parameters

The correlation analysis revealed that citrus blackfly population had a highly significant negative correlation with maximum temperature (r = –0.663**) and a

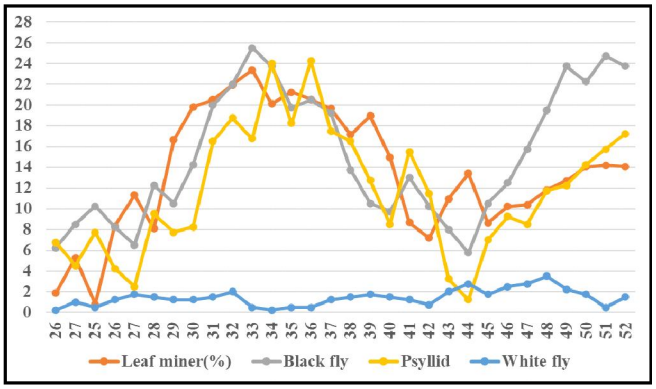


Fig. 1: Seasonal incidence of major insect pests of sweet orange during *Mrig bahar* 2025.

significant negative correlation with minimum temperature (r = –0.449*). Morning relative humidity showed a significant positive correlation (r = 0.396*), whereas rainfall (r = –0.030NS) and evening relative humidity (r = –0.094NS) exhibited non-significant relationships. These findings indicate that lower temperatures and higher morning relative humidity favoured the build-up of citrus blackfly population. Similar observations were reported by Jivrag *et al.,* (2022), Daniele *et al.,* (2014) and da Silva *et al.,* (2024).

Correlation between citrus psyllid population and weather parameters

The citrus psyllid population exhibited a significant negative correlation with maximum temperature (r = –0.410*) and a significant positive correlation with morning relative humidity (r = 0.391*). Rainfall (r = 0.077), minimum temperature (r = –0.123) and evening relative humidity (r = 0.151) showed non-significant correlations with psyllid population. The results suggest that moderate temperature and higher morning relative humidity favoured the development of citrus psyllid. The present findings corroborate those of Poovizhiraja *et al.,* (2019), Tandel *et al.,* (2020) and Zorzenon *et al.,* (2021), who also reported a negative influence of maximum temperature and a positive influence of relative humidity on citrus psyllid abundance.

Correlation between citrus whitefly population and weather parameters

The correlation coefficients revealed that citrus whitefly population had a significant negative correlation with minimum temperature (r = –0.410*). Rainfall (r = –0.188), maximum temperature (r = –0.232), morning relative humidity (r = 0.155) and evening relative humidity (r = –0.355) exhibited non-significant correlations with whitefly population. The results indicated that minimum temperature had a greater influence on whitefly incidence than other weather parameters. These findings are in partial agreement with Lekurwale and Kadam (2017), Jivrag *et al.,* (2022) and Mahmoudi *et al.,* (2024), who reported that temperature and relative humidity play an important role in regulating citrus whitefly population.

Conclusion

The present investigation revealed that citrus leaf miner, citrus blackfly, citrus psyllid and citrus whitefly remained active throughout the *Mrig bahar* season, with peak populations occurring during different Standard Meteorological Weeks. Citrus leaf miner and blackfly attained maximum incidence during the 33rd SMW, while citrus psyllid and whitefly reached their peak during the 36th and 48th SMWs, respectively. Correlation analysis indicated that rainfall and relative humidity favoured the incidence of leaf miner, whereas maximum temperature showed a negative influence on most of the insect pests. The study demonstrated that weather parameters play a significant role in regulating the seasonal abundance of major insect pests of sweet orange. The information generated from the present investigation will be useful for forecasting pest incidence and implementing timely integrated pest management practices in sweet orange orchards.

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