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POPULATION DYNAMICS OF WHITEFLY, *BEMISIA TABACI* AND THEIR CORRELATION WITH ABIOTIC FACTORS

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ABSTRACT

A field experiment was conducted during the *Kharif* seasons of 2023 and 2024 to study the population dynamics of whitefly, *B. tabaci* and their correlation with abiotic factors. The study was carried out at instructional farm, Department of Entomology, College of Agriculture, Bikaner (Rajasthan), India. The population of whitefly commenced on crop in the third week of August (34th SMW) with 1.79 and 1.75 mean whitefly population/six leaves (three week after transplanting), during *Kharif* 2023 and 2024, respectively. After 34th SMW the whitefly population increased gradually and reached to its peak with 10.23 and 11.24 whitefly /six leaves in the 39th SMW during *Kharif* 2023 and 2024, respectively. There after the whitefly, *B. tabaci* population started to decline gradually and reached to negligible level with 1.23 and 3.39 whitefly/six leaves in the 48th SMW during *Kharif*, 2023 and 2024, respectively. The maximum temperature showed significant positive correlation with the whitefly population during Kharif 2023 and 2024. The morning and evening relative humidity depicted a significant negative and significant positive correlation with the whitefly population during *Kharif* 2023 and 2024, respectively.

Key words : Whitefly, SMW, Tomato.

Introduction

Vegetables are essential part of human diet. It contains essential minerals, vitamins, bioactive compounds, antioxidants as well as phytochemicals. The estimated land under vegetable cultivation in India spans approximately 10.35 million hectares, yielding an impressive total production of 191.76 million tonnes with an average productivity of 18.52 tonnes per hectare (Anonymous, 2019-20). Tomato had an active acidity of 3.90-4.37 pH, contained 4.8-6.1% dry matter of which 811.9-847.8 mg/dm3 were amino acids (the share of essential amino acids is 32.5-34.1%), mono and disaccharides (3.48-6.50% FW), organic acids (13.01-16.55% DW) with a predominance of citric and tartaric acids, vitamins B1+ B2 (<1.0 mg/dm^3), B-6 (up to 1.2 mg/dm^3), PP (2.99-6.14 mg/dm^3), C (20.32-22.51 mg/dm^3) and phenolic compounds (212-254 mg/dm^3), flavonols and flavanones were identified in TS. The content of the anti-nutritional component – oxalic acid in TS is 24.46-42.38 mg/dm3 (Zharkova *et al*., 2025). In India, the area under tomato crop was 845 thousand hectares with the total production of 21181 thousand MT and productivity of 25.07 MT per hectare (Anonymous, 2022). The area of tomato in Rajasthan was 19.80 thousand hectares with production of 318115 MT and the productivity of 16.05 MT per hectare. The area of tomato in Bikaner was 13 hectares with annual production of 170 MT and productivity of 13.07 MT per hectare (Anonymous, 2024). In India, tomato crops are mainly grown in the states of Andhra Pradesh, Madhya Pradesh, Orissa, West Bengal, Karnataka, Bihar, Gujarat, Tamil Nadu, Uttar Pradesh, Haryana and Rajasthan etc. The major tomato producing districts of Rajasthan are Jaipur, Sirohi, Sikar, Tonk, Kota, Alwar and Dausa. Bikaner being a semi-arid region does not occupy much area under tomato cultivation but recently few farmers have taken as an initiative to start tomato production. Tomato crop, right from transplanting to harvesting is attacked by many insect pests *viz*., fruit borer [*Helicoverpa armigera* (Hub.)] and sucking insect pests *viz*., whitefly [*Bemesia tabaci* (Genn.)], Jassids [*Amrasca biguttulla biguttula* (Ishida)], thrips [*Thrips tabaci* (Lind)], Aphid [*Aphis gossypii* (Glover)] and serpentine leaf miner [*Liriomyza trifolii* (Burgess)]. The expansion of tomato area led to serge in pest populations, including the emergence of invasive species such as the South American tomato leaf miner, *Tuta absoluta* (Sridhar *et al*., 2014). Whitefly (*B. tabaci*) is one of the most important polyphagous pests of tomato having a white powdery wings and yellowish body. Adult whiteflies are usually found on the under sides of the tomato leaves. Where they feed and lay eggs. Tomato whitefly like other whiteflies suck the plant sap from the under surface of the leaves and secret sugary material called honey dew. This honey dew can then promote the growth of sooty mold on plants. During severe infestation the black fungal growth (sooty mold) can obstruct photosynthesis, leading to stunted plant growth. Additionally, it acts as a vector for the Tomato Leaf Curl Virus (TLCV), which severely affects tomato yield (Gupta *et al*., 2007). In recent decades, pest dynamics have shifted significantly due to climate variability and environmental changes. Abiotic factors such as temperature, humidity, wind velocity and precipitation play an important role in influencing insect behavior, population dynamics and migration patterns.

Materials and Methods

The present research experiments were conducted at Instructional farm of College of Agriculture, Bikaner (Rajasthan) on tomato crop under field conditions, during 2023 and 2024. Geographically, Bikaner is located at longitude of 73.22º East, latitude of 28.01º North and at an elevation of 234.70 meter from mean sea level (MSL) in Rajasthan. The region falls under agro-climatic zone I-C, (Hyper arid partially irrigated western plain zone) of Rajasthan. According to National Planning Commission Bikaner falls under agro-climatic zone XlV (Western dry region) of India. During summer, temperature may rise as high as 48°C, while in winter, it may fall as low as 0°C. The average annual rainfall of the locality is 250 mm. The relative humidity varies between 11 to 89 per cent. The transplanting of tomato variety Arka Vishaesh was done in the area 9 × 10 m^2 on last week of July 2023 and 2024, keeping row to row distance 60 cm. all agronomic practices were followed as per the recommendation of the package of zone I-C.

The population of whitefly was counted visually (absolute counting) in early morning hours (before 8 AM) of the day, when the whitefly remains less active. The observations were recorded on six leaves, *i.e*. two each from top, middle and bottom of 20 randomly selected and tagged plants from the whole the experimental plot. All the stages of nymphs and adults of these pests were taken into account while counting. The whitefly populations on upper surface of leaves were counted first and then on lower surface by gentle turning, taking all possible care not to disturb them.

The data recorded for the population dynamics of whitefly in relation to meteorological parameters were used for statistical analysis. Simple correlation was computed between the population of whitefly and meteorological parameters *viz*., maximum and minimum temperature, relative humidity along with total rainfall. The following formula was used for calculating correlation coefficient (Snedecor and Cochran, 1967)

$$r_{xy} = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\sqrt{\left[\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right]\left[\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right]}}$$

Where,

r_{xy} = simple correlation coefficient

x = variable i.e., abiotic component

y = variable i.e., mean number of insect pests

n = number of observations

Results and Discussion

The population of whitefly commenced on crop in the third week of August (34th SMW) and remained active through the cropping season *i.e*., fourth week of November (48th SMW) during *Kharif*, 2023 and 2024. The present result gets support from the result of Mishra *et al*. (2017) and Shamjibhai (2017), who reported incidence of whitefly, *B. tabaci* in the fourth week and third week of August, respectively. After 34th SMW the whitefly population increased gradually and reached to its peak with 10.23 and 11.24 whitefly /six leaves in the 39th SMW during *Kharif*, 2023 and 2024, respectively. The present results corroborate with the observations of Mishra *et al*. (2017) and Nissar *et al*. (2019), who depicted the peak population of whitefly, *B. tabaci* in the month of September. After reaching the peak, the population of whitefly, *B. tabaci* population started to decline gradually and reached to negligible level with 1.23 and 3.39 whitefly/six leaves in the 48th SMW during *Kharif*, 2023 and 2024, respectively.

The maximum and minimum temperatures showed

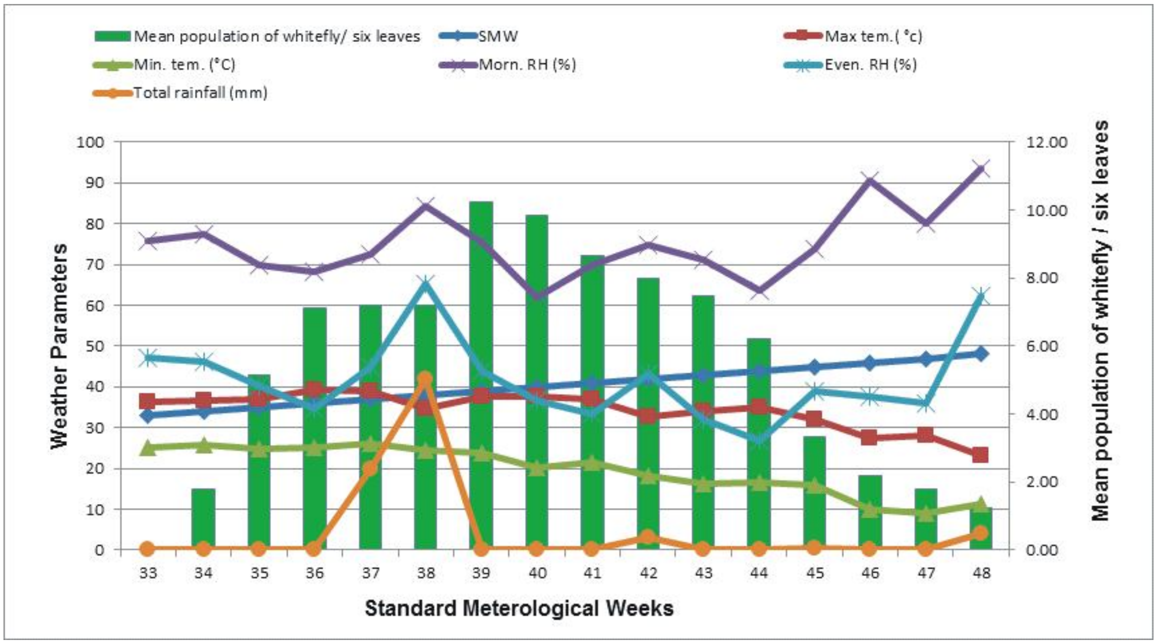

Fig. 1 : Population dynamics of *B. tabaci* on tomato in relation to weather parameters during *Kharif*, 2023.

significant positive and non-significant positive correlation with the whitefly population, respectively during Kharif, 2023 and 2024. The present result fully akin with the results of Shahnaz *et al*. (2006), Dhaka and Pareek (2008), Chavan *et al*. (2013), Sharma *et al*. (2013), Indirakumar *et al*. (2016), Nissar *et al*. (2019), Ingole *et al*. (2024) and Srinivas and Kumar (2025), who also observed significant positive correlation between whitefly population and maximum temperature. Contrary to present result of Kaushik (2012), Chavan *et al*. (2013) and Sidar *et al*. (2019), who reported significant negative correlation between maximum temperature and whitefly population do not support the present finding.

Similar to present investigation Ashfaq *et al*. (2010), Saini *et al*. (2017), Khokhar *et al*. (2019), Wade *et al*. (2020) and Nikki *et al*. (2025), who also recorded non-significant positive correlation between minimum temperature and whitefly population confirm the present result. The present finding is not in accordance with the result of Jha and Kumar (2017), Subba *et al*. (2017), who reported non-significant negative correlation between minimum temperature and whitefly population.

In present result maximum relative humidity showed significant negative correlation (r= -0.571) with whitefly population during *Kharif*, 2023. The present results are in conformity with those of Subba *et al*. (2017) and Ingole *et al*. (2024), who also registered significant negative correlation with morning relative humidity and whitefly population. The observations of Nissar *et al*. (2019) support the present result, who also reported non-significant negative correlation with whitefly population and evening relative humidity. Present result does not get support from the result of Chavan *et al*. (2013) and Srinivas and Kumar (2025), who registered significant positive correlation between whitefly population and maximum relative humidity.

In present investigation minimum relative humidity showed non-significant negative correlation (r= -0.243) during *Kharif*, 2023. The present result does not akin with the result of Wade *et al*. (2020), who exhibited non-significant positive correlation between whitefly population and minimum relative humidity.

The whitefly population exhibited a positive significant correlation in case of evening relative humidity (r= 0.595) However, it revealed a non-significant positive correlation (r= 0.058) with morning relative humidity, respectively during *Kharif*, 2024. The present result does not get support from the result of Chavan *et al*. (2013), who found significant negative correlation between minimum relative humidity and whitefly population. The present result is not in accordance with the result of Subba *et al*. (2017), who registered non-significant negative correlation between whitefly population and morning relative humidity.

The rainfall depicted non-significant positive correlation with whitefly population during *Kharif*, 2023. The present result corroborates with the results of Saini *et al*. (2017), Harshita *et al*. (2019), Khokhar *et al*. (2019) and Mondal *et al*. (2019), who also registered non-significant positive correlation between whitefly population and rainfall. During *Kharif*, 2024 rainfall

Table 1 : Population dynamics of *B. tabaci* on tomato in relation to weather parameters during *Kharif*, 2023.

SMW	Period of observations		Abiotic factors					Mean whitefly / six leaves
			Temperature (^{0}C)		Relative humidity (%)		Total rainfall (mm)	
	From	To	Max.	Min.	Morning	Evening		
33	13 Aug to	19-Aug	36.4	25.3	75.6	47.1	0.0	0.00
34	20 Aug to	26-Aug	36.6	25.8	77.4	46.3	0.0	1.79
35	27 Aug to	02-Sep	37.1	24.8	69.7	40.1	0.0	5.16
36	03 Sep to	09-Sep	39.2	25.3	68.1	34.6	0.0	7.10
37	10 Sep to	16-Sep	38.9	26.0	72.6	44.7	20.0	7.19
38	17 Sep to	23-Sep	34.7	24.5	84.3	65.3	41.8	7.21
39	24 Sep to	30-Sep	37.5	23.9	75.3	44.0	0.0	10.23
40	01 Oct to	07-Oct	37.6	20.2	62.0	36.7	0.0	9.86
41	08 Oct to	14-Oct	37.0	21.6	69.9	33.4	0.0	8.65
42	15 Oct to	21-Oct	32.6	18.1	74.9	43.1	3.0	8.00
43	22 Oct to	28-Oct	33.9	16.4	71.0	32.0	0.0	7.49
44	29 Oct to	04-Nov	35.0	16.5	63.7	26.9	0.0	6.21
45	05 Nov to	11-Nov	32.0	15.9	73.9	38.9	0.4	3.33
46	12 Nov to	18-Nov	27.4	10.1	90.4	37.6	0.0	2.19
47	19 Nov to	25-Nov	28.1	9.2	80.1	35.9	0.0	1.81
48	26 Nov to	02-Dec	23.2	11.2	93.4	62.3	4.2	1.23
Correlation coefficient between insect pests of tomato and abiotic factors								
							Temperature (^{0}C) maximum	0.566*
							Temperature (^{0}C) minimum	0.353
							Relative humidity (%) morning	-0.571*
							Relative humidity (%) evening	-0.243
							Rainfall (mm)	0.174

* Significant at 5 % level, SMW = Standard meteorological weeks.

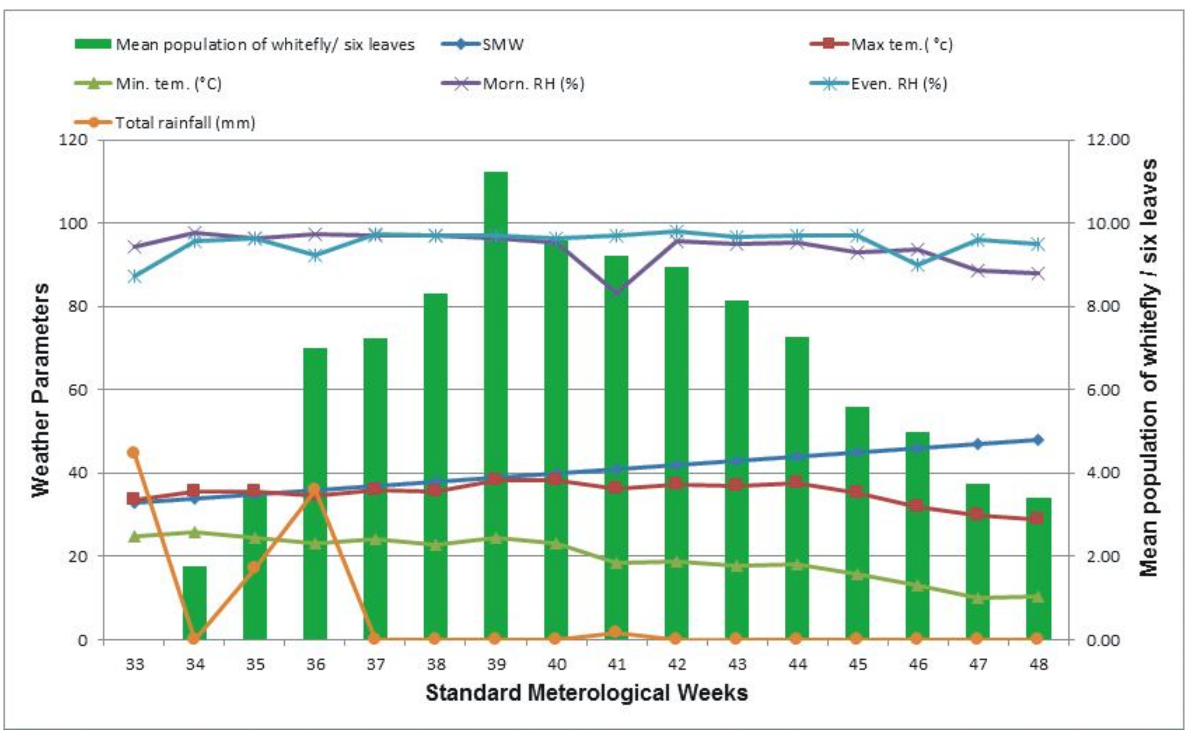

Fig. 2 : Population dynamics of *B. tabaci* on tomato in relation to weather parameters during *Kharif*, 2024.

Table 2 : Population dynamics of *B. tabaci* on tomato in relation to weather parameters during *Kharif*, 2024.

SMW	Period of observations		Abiotic factors					Mean whitefly / six leaves
			Temperature (^{0}C)		Relative humidity (%)		Total rainfall (mm)	
	From	To	Max.	Min.	Morning	Evening		
33	13 Aug to	19-Aug	33.6	24.9	94.3	87.4	44.6	0.00
34	20 Aug to	26-Aug	35.7	25.7	97.6	95.6	0	1.75
35	27 Aug to	02-Sep	35.6	24.5	96.3	96.4	17.2	3.46
36	03 Sep to	09-Sep	34.7	23	97.4	92.4	35.8	6.99
37	10 Sep to	16-Sep	35.8	24	96.9	97.3	0	7.25
38	17 Sep to	23-Sep	35.7	22.9	96.9	97	0	8.32
39	24 Sep to	30-Sep	38.2	24.5	96.3	97	0	11.24
40	01 Oct to	07-Oct	38.2	23	95.4	96.3	0	9.57
41	08 Oct to	14-Oct	36.2	18.4	83.4	97	1.8	9.21
42	15 Oct to	21-Oct	37.4	18.8	95.6	98.1	0	8.96
43	22 Oct to	28-Oct	36.9	17.8	95.1	96.6	0	8.13
44	29 Oct to	04-Nov	37.6	18	95.3	97.1	0	7.27
45	05 Nov to	11-Nov	35.4	15.8	93	97	0	5.60
46	12 Nov to	18-Nov	31.8	13	93.7	90	0	4.99
47	19 Nov to	25-Nov	29.9	10.1	88.7	96	0	3.75
48	26 Nov to	02-Dec	28.9	10.4	88	94.9	0	3.39
Correlation coefficient between insect pests of tomato and abiotic factors								
							Temperature (^{0}C) maximum	0.637*
							Temperature (^{0}C) minimum	0.104
							Relative humidity (%) morning	0.058
							Relative humidity (%) evening	0.595*
							Rainfall (mm)	-0.448

* Significant at 5 % level, SMW = Standard meteorological weeks.

depicted a non-significant negative correlation with whitefly population in present research. Similar to present result Shahnaz *et al.* (2006), Dhaka and Pareek (2008) Indirakumar *et al.* (2016) Mishra *et al.* (2017) and Subba *et al.* (2017), who also reported non-significant negative correlation with whitefly population, akin the present result.

Conclusion

The study of seasonal incidence of insect-pests and their correlation with weather parameters is important to know the most susceptible stage of insect pests at which suitable control measures should be adopted to manage the pests. It is also helpful in knowing the period of the most suitable stages of insect pests, period of initiation, peak and down fall of population, which helps in devising suitable pest management measures to be adopted at appropriate time in changing cropping pattern.

The whitefly, *B. tabaci* infesting tomato crop during the two consecutive seasons. The population of whitefly started in the third week of August (34th SMW) and reached to its peak in the 39th SMW during *Kharif* 2023 and 2024. The maximum temperature showed significant positive correlation with the whitefly population during *Kharif* 2023-24. The morning and evening relative humidity depicted a significant negative and significant positive correlation with the whitefly population during *Kharif* 2023 and 2024, respectively.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Disclaimer (Artificial Intelligence)

Author (s) hereby declare that No generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing of editing of this manuscript.

Competing interests

Authors have declared that no competing interests exist.

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