



Influence of Abiotic Factors on the Incidence of Two Spotted Spider Mite, *Tetranychus urticae* Koch on Brinjal in Coastal Areas of Cuddalore District, Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Brinjal, *Solanum melongena* L., is a native Indian vegetable belonging to the family Solanaceae. It was affected by various pests among which two spotted spider mite, *Tetranychus urticae* become a key pest. The influence of abiotic factors on the infestation of brinjal plant with mites was investigated during kharif-2022 (June to September) and rabi-2022-23 (November to March) seasons. *T. urticae* was found from the 24th to the 39th standard meteorological weeks (SMWs) in

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the kharif season and from the 47th to the 10th SMWs in the rabi season. The mite population increased gradually and reached to a peak in the second week of July with the population of 20.66 mites in kharif 2022 and second week of March with population of 21.80 mites in Rabi 2022 -23, respectively. The population of this pest started to be declined from the fourth week of July (10.13 mites /3 leaves) and also decreased to the level of 5.66 mites /3 leaves in the fourth week of August in kharif 2022. On the other hand, the population of mites started to be increased from the second week of February (15.06 mites /3 leaves) to the second week of March (21.80 mites/3 leaves) in rabi 2022-23. Generally, these results indicate that mites population gradually decreased with fall in the temperature during both seasons.

Keywords: Seasonal incidence; weather parameters; brinjal plant; *Tetranychus urticae* population.

1. INTRODUCTION

Brinjal, *Solanum melongena* L., is a native Indian vegetable belonging to the family Solanaceae. It reigns as the third most important vegetable crop grown in the most regions of India, contributing a remarkable 17.8% to the country's total vegetable production. On a global scale, India stands second to China in terms of vegetable production. It boasts 16.7% of the global vegetable-growing area and contributes a significant 15.4% to worldwide vegetable production [1]. Spider mites belonging to the Tetranychidae family represent major agricultural pests, causing significant damage to crops worldwide. Among them, the two-spotted spider mite (*Tetranychus urticae* Koch) stands out as the most economically impactful mite pest in the field [2]. It causes considerable economic loss, throughout the season. Even small populations of *T. urticae* can significantly impact crop yields and the severe infestations can completely kill plants [3]. No single factor is solely responsible for *T. urticae* outbreaks. Therefore, it's crucial to closely monitor mite populations to develop appropriate control strategies and prevent disastrous consequences. Due to the harmful effects of infestations by the two-spotted spider mites, understanding their seasonal occurrence on brinjal plants grown in protected environments across various seasons is urgent. This study was carried out to explore the influence of the seasonal changes and non-living factors (abiotic factors) on the incidence of the spider mite, *T. urticae* on brinjal plant.

2. MATERIALS AND METHODS

A field trial was conducted during kharif (2022) and rabi (2022-23) seasons to investigate the effect of weather factors on the prevalence of the mite, *Tetranychus urticae* in brinjal. The brinjal (variety - PLR. (BR)2) crop was raised from May,

2022 to September 2022 and mid - October 2022 to March 2023 by following recommended cultural and agronomical practices. Brinjal two spotted spider mite populations were monitored weekly interval throughout the experimental period. The experiment was set up at an infested brinjal field located at vallampadugai village near Annamalai University, Chidambaram (Tamil Nadu), India.

Five brinjal plants were selected randomly from each sector of the field to investigate the mite incidence. The mite population on three leaves / plant (Top, middle, and bottom) was recorded. Mites were counted within a 2 cm square area on each leaf by using a magnifying lens. The record of observations began when mites were first seen and continued weekly until the crop was harvested. Data on various weather parameters including maximum and minimum temperatures, morning and evening relative humidity, hours of bright sunshine and rainfall was gathered weekly from the Agro-Meteorology observatory at Annamalai University. These data were analyzed using simple correlation and linear regression techniques.

3. RESULTS AND DISCUSSION

The incidence of spider mite was recorded from 24th and 25th Standard Meteorological Week (SMW) during kharif 2022 in brinjal plant with 16.53 and 18.73 mites, respectively. The peak population of *T.urticae* (20.66 mites) was observed in 28th SMW (Table 1). *T. urticae* were found on brinjal crops during kharif season in June 2022. The first observation on mite population was showed in the 24th week (June) with an average of 16.53 mites. The record of results was continued until September (39th week) to monitor mite activity throughout the season.

Table 1. Influence of weather parameters on the incidence of *T. urticae* during kharif season, 2022

SMW	Period (2022)	Mean no. of mites	Temperature (°C)		Relative Humidity (%)	HBSS (Hrs)	Rainfall (mm)	Wind speed (Kmph)
			Max.	Min.				
24	11 Jun – 17 Jun	16.53	37.8	24.6	67	7.5	028.0	5.0
25	18 Jun – 24 Jun	18.73	35.2	24.5	68	5.0	000.0	3.8
26	25 Jun – 01 Jul	17.60	37.2	25.0	69	6.3	005.8	5.0
27	02 Jul – 08 Jul	14.47	35.6	24.7	66	3.7	023.6	5.3
28	09 Jul – 15 Jul	20.66	35.5	25.2	65	4.3	001.0	7.9
29	16 Jul – 22 Jul	18.40	36.0	24.4	70	7.2	022.4	4.2
30	23 Jul – 29 Jul	10.13	34.4	23.3	73	6.4	050.5	3.4
31	30 Jul – 05 Aug	13.47	33.2	24.3	78	3.3	013.0	2.6
32	06 Aug – 12 Aug	13.80	34.3	24.0	67	6.1	000.0	6.5
33	13 Aug – 19 Aug	9.06	36.2	23.9	69	7.5	047.4	4.2
34	20 Aug – 26 Aug	5.66	33.9	24.7	76	4.5	038.6	3.7
35	27 Aug – 02 Sep	7.20	32.3	23.6	81	4.1	027.0	1.9
36	03 Sep – 09 Sep	14.67	33.5	23.7	74	5.0	001.2	2.9
37	10 Sep – 16 Sep	16.86	34.9	23.9	70	6.2	002.0	6.1
38	17 Sep – 23 Sep	15.93	35.3	24.3	68	6.4	000.0	4.5
39	24 Sep – 30 Sep	11.67	35.4	26.2	73	5.5	048.6	3.2

*SMW- Standard Meteorological Week, *Max. – Maximum, *Min. – Minimum, *HBSS - Hours of Bright Sun Shine

The mite population start to decline after the 29th SMW of 2022, and this decreasing continued until the 39th SMW, 11.67 represent an average of mites during this period. The highest mite population was observed on the 28th SMW (20.66 mites), while the lowest population was recorded on the 34th SMW with an average of 5.66 mites per 3 leaves (Table 1). The peak population of mites occurred during the third week of July, 28th (SMW) of the kharif season. Then this population steadily declined until the 30th SMW, reaching a minimum level of two-spotted spider mites. Tabasum and Buhroo [4] were aligning with our current results. Anber et al. [5] found that the population exhibited a gradual rise, reaching a peak in late June that persisted through the third week of July.

During the kharif season, the population of the *T. urticae* was positively linked to weather conditions. Specifically, a strong positive correlation was found between the maximum temperature and the mite population (correlation coefficient of +0.510). However, the minimum temperature showed a weaker, non-significant positive correlation (correlation coefficient of +0.265). Moreover, the analysis revealed significant correlations between environmental factors and the population of the two-spotted spider mite. Relative humidity exhibited a negative correlation ($r = -0.678$), while rainfall displayed an even stronger negative correlation ($r = -0.694$). Conversely, wind velocity demonstrated a significant positive correlation ($r = 0.585$) with the mite population. Kumar et al. [6] showed that the different stages of mites were found significantly positively correlated with maximum temperature and non-significantly positively correlated with minimum temperature. The morning relative humidity was non-significantly negatively correlated with the population of eggs and significantly negatively correlated with active stages.

The two-spotted spider mite population on brinjal was initiated at 11.33 and 7.47 mites in the 47th and 48th standard meteorological weeks (SMW) during rabi (2022-23), respectively. The population peaked at 21.80 mites in the 10th SMW (Table 3). During the rabi season in November 2022, the mites population on brinjal crop was observed. The first signs of the *T. urticae* population were seen in the 47th week of 2022, with an average of 11.33 mites. The mite population start to increase from week 5 to week 10 in 2023, averaging 21.80 mites. The highest mite population (21.80 mites) occurred in week 10 of 2023, while the lowest population (5.06 mites) was recorded in week 49 of 2022. Khatak et al. [7] found that the population of *T. urticae* mites gradually decreased in November and reported low to negligible mite populations during the months of December, January, and February. Tamilnayagan et al. [8] and Sonika et al. [9] observed a statistically significant peak in mite density during the last week of March, compared to other observation periods. Moreover, a steady rise in the population of *T. urticae* was observed from January to March, coinciding with increasing temperatures and decreasing humidity. Patel et al. [10] reported that the population of two-spotted spider mite is fluctuating during the 5th SMW of January.

During rabi season of 2022-23, maximum temperature was associated with a significant increase in the mite population, as indicated by a positive correlation coefficient of 0.653. Conversely, minimum temperature was linked to a significant decrease in mite numbers, as shown by a negative correlation coefficient of -0.576. Relative humidity and rainfall were associated with higher population of two-spotted spider mites with correlation coefficient of -0.728 and -0.729. The strength of these associations was statistically significant. Wind speed also had a negative association with mite population,

Table 2. Correlation factors between the incidence of *T. urticae* and weather parameters during kharif season, 2022

Weather parameters	Correlation coefficient
Maximum temperature	0.510**
Minimum temperature	0.265 ^{NS}
Relative humidity	-0.678*
Hours of Bright Sun Shine (HBSS)	0.151 ^{NS}
Rainfall	-0.694*
Wind velocity	0.585**

(* = Highly Significant at 1%; ** = Significant at 5%; NS= Non- Significant)

Table 3. Influence of weather parameters on the incidence of *T. urticae* during rabi season, 2022-23

SMW	Period (2022-23)	Mean no. of mites	Temperature (^o C)		Relative Humidity (%)	HBSS (Hrs)	Rainfall (mm)	Wind speed (Kmph)
			Max.	Min.				
47	19 Nov – 25 Nov	11.33	30.9	21.1	74	3.7	000.0	3.0
48	26 Nov – 02 Dec	7.47	31.0	21.5	90	5.7	070.8	2.1
49	03 Dec – 09 Dec	5.06	29.0	21.3	91	2.8	076.2	4.4
50	10 Dec – 16 Dec	7.26	28.5	20.7	91	3.3	049.4	2.6
51	17 Dec – 23 Dec	10.33	29.0	20.5	87	4.1	000.0	4.7
52	24 Dec – 31 Dec	18.13	31.7	21.0	89	7.1	014.9	3.1
1	01 Jan – 07 Jan	15.73	30.3	19.5	74	7.2	001.0	2.7
2	08 Jan – 14 Jan	17.86	29.4	18.0	72	7.3	017.0	3.3
3	15 Jan – 21 Jan	14.40	29.1	17.4	73	7.9	000.0	2.8
4	22 Jan – 28 Jan	11.47	29.2	19.3	74	6.4	000.0	3.4
5	29 Jan – 04 Feb	6.80	28.2	20.9	82	2.7	044.4	4.8
6	05 Feb – 11 Feb	15.06	29.8	18.2	73	8.6	000.0	2.4
7	12 Feb – 18 Feb	18.33	30.5	16.8	69	8.7	000.0	1.9
8	19 Feb – 25 Feb	20.73	31.0	17.6	70	9.1	000.0	2.3
9	26 Feb – 04 Mar	21.47	30.9	19.5	71	7.6	000.5	3.3
10	05 Mar – 11 Mar	21.80	31.4	20.3	71	7.0	000.0	3.4

*SMW- Standard Meteorological Week, *Max. – Maximum, *Min. – Minimum, *HBSS - Hours of Bright Sun Shine

Table 4. Correlation factors between the incidence of *T. urticae* and weather parameters during Rabi season, 2022-23

Weather parameters	Correlation coefficient
Maximum temperature	0.653*
Minimum temperature	-0.576**
Relative humidity	-0.728*
Hours of Bright Sun Shine (HBSS)	0.832*
Rainfall	-0.729*
Wind velocity	-0.381 ^{NS}

(* = Highly Significant at 1%; ** = Significant at 5%; NS= Non- Significant)

but this association was not statistically significant. In other words, as the relative humidity and rainfall increased, the mite population decreased. On contrary, as the temperature increased, the mite population also increased. Bhullar and Kaur [11] demonstrated that as the maximum temperature increased, the population of *T. urticae* also significantly increased and this indicates a positive correlation. Conversely, there were a significant negative correlation between morning relative humidity and the mite population. In other words, with increasing humidity, the *T. urticae* population significantly decreased.

Interestingly, these studies also showed a significant positive correlation between maximum temperature and mite population, suggesting that warmer temperature favors mite development. The findings of the current study align with that of the above observations.

4. CONCLUSION

The first infestation of brinjal crops with the two spotted spider mite was observed during kharif (2022) and rabi (2022-23) in the second week of June at kharif and in the third week of November in the rabi season. The average of mite population was 20.66 mites in July and recorded 21.80 mites in March. Additionally, the mite population increased with higher temperature and decreased at the lowest temperature and higher sunshine hours. On the other hand, higher relative humidity and rainfall led to lower mite population. This study suggests that implementing Integrated Pest Management (IPM) techniques based on these environmental factors could effectively reduce the brinjal losses which caused by two-spotted spider mite.

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 or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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