



Research Article

Incidence of *Tetranychus urticae* Koch on brinjal under field and screen house conditions

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Abstract

The incidence of *Tetranychus urticae* Koch, a two-spotted spider mite, was studied in brinjal ecosystem (*Solanum melongena* L.). Brinjal seeds (var. BR112) were raised in the Research Farm area, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during June 2014 and seedlings were transplanted during mid-July, 2014 in the field. In screen house, the crop was raised during mid-June, 2014. In field and screen house, two-spotted spider mite was recorded to study the population fluctuation on brinjal during the first week of September and continued until the first week of November 2014 at Hisar region. Different stages of *T. urticae* viz., eggs, larvae, nymphs and adults from ten randomly selected plants were recorded weekly on both ventral and dorsal surface of tender, grown up and older leaves of brinjal. The results revealed that the mite population showed a gradual increase until attainment of the peak in the last week of September 2014. The results clearly showed that 5.19 and 5.85 mites/sq cm leaf *T. urticae* population peak in the last week of September 2014 on brinjal plant under field and screen house conditions, respectively. Afterwards, a gradual decline in mite population was recorded until November. Mites showed a preference for grown-up leaves of brinjal as compared to tender and older leaves under field and screen house condition.

Keywords brinjal, field, incidence, mite population, screen house, *Tetranychus urticae*

Introduction

The two-spotted spider mite (*Tetranychus urticae* Koch) is phytophagous species of spider mites, and probably the most important mite pest, common in greenhouses and field crops throughout the world. It feeds on more than 3,877 plant species belonging to more than 140 different plant families including species known to produce toxic compounds [1]. It is the most notorious pest responsible for significant yield losses in many economic crops, agronomic crops, ornamental, fruit tree and vegetable crops worldwide [2]. Pest status of *T. urticae* on horticultural crops greenhouse vegetables and ornamental crops is well-documented worldwide [3]. Mite feeding producing noteworthy alterations in the biochemical configuration of leaves and fruits have been described in cucumber, beans, tomato, and grapevine [4]. Brinjal is threatened by two-spotted spider mite, *T. urticae* next to shoot and fruit borer [5]. *T. urticae* feeding can damage protective leaf surfaces, stomata, the palisade layer and the lowest parenchymal layer. It results in typical “stippling” damage, with white- or grayish-colored spots due to the punctures made by feeding [6]. In view of this, it becomes important to monitor the population buildup of mite, so that suitable management strategy can be formulated.

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Methodology

Population Dynamics of Tetranychus urticae

The crop was raised under field conditions to record the population dynamics of *T. urticae*. The brinjal variety BR112 seeds were selected for the proposed study. Seeds were sown in triplicate in nursery bed at Research Farm Area, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar (Haryana) following standard agronomical practices. Transplanting of seedlings was done in the month of July and harvesting was done in the month of January. The field was divided into plots of 3.6 m × 3.6 m with spacing 60 cm × 45 cm. Plots were made as per the requirement of experiment design.

In the screen house, the crop was raised from mid-June, 2014 to November 2014. Brinjal seeds were sown in earthen pots and placed to germinate. After plant emergence was complete, all pots were thinned into one seedling per pot and watered as per the requirement. The plants were continuously monitored in unprotected conditions and these were naturally attacked by *T. urticae*. The observations were taken from ten randomly selected plants per sampling.

Collection of Leaf Samples

Ten brinjal plants were selected randomly from each replicated plot for counting the number of mites. Samples were taken weekly from crop up to harvesting. Two leaves per plant at each stage (tender, grown up and old leaves) were separately collected in labeled polybags. Altogether, six leaves were collected from each plant. The collected leaves were brought to the Acarology laboratory for counting the number of mites.

Counting

Examination of mite-infested leaves was done with the aid of stereo zoom binocular microscope. From both the surface (dorsal and ventral), the mite number was counted from three different places and the average of these spots was considered as final observation per replicate. While counting the mite population, the surface of the leaf was observed to know the exact pattern of the mite distribution on leaf and symptoms of their damage. Remarks on the mixed population of mites were documented per square centimeter of leaf area from both dorsal and ventral surfaces of the leaf.

Statistical analysis

Critical differences (CD) were calculated to compare the leaf stages by using two factorial CRD to know the effect of leaf stages on population dynamics of *T. urticae* in brinjal plants. The Software 'OPSTAT', developed at the Computer Centre, College of Basic Sciences and Humanities, CCS Haryana Agricultural University, Hisar, was used for the analysis.

Results and Discussion

In Field Conditions

Field incidence of *T. urticae* was recorded on brinjal crop raised from July to December during the year 2014. Weekly data showed the appearance of mites in the first week of September (08.09.14) with an average of 2.98, 3.17 and 2.19 mites/sq cm leaf on ventral surface and 0.80, 0.84 and 0.39 mites/sq cm leaf on dorsal surface of tender, grown up and older leaves of brinjal, respectively (Table 1). *T. urticae* population showed a gradual increase until the attainment of the peak in the last week of September 2014 (29.09.14). At this stage, 5.72, 5.89, 3.96 mites/sq cm leaf and 1.76, 1.83, 1.59 mites/sq cm leaf were recorded on the ventral and dorsal surface of tender, grown up and older leaves, respectively. Afterwards, a gradual decline in mite population was recorded till 3.11.14. On this sampling day, the lowest mite count of 0.10, 0.17 and 0.04 mites/sq cm leaf was recorded on the ventral surface of the leaves of three stages (tender, grown up and older), respectively. Thereafter, no mites were observed on the crop till harvesting (January 2015).

Statistical analysis depicted a significant effect of leaf stage on population buildup of *T. urticae* on brinjal (CD =0.25; p = 0.05) (Table 2). Results revealed that maximum population developed on grown-up



leaves (2.56 mites/ sq cm leaf) followed by 2.47 mites/sq cm leaf on tender leaves and both were statistically comparable to each other, but significantly lower population was recorded on older leaves (1.70 mites/sq cm leaf).

Table 1. Incidence of *Tetranychus urticae* on brinjal under field conditions during 2014

Date of observation	Average number of <i>Tetranychus urticae</i> / sq cm leaf*					
	Tender leaves		Grown up leaves		Older leaves	
	Dorsal surface	Ventral surface	Dorsal surface	Ventral surface	Dorsal surface	Ventral surface
08.09.014	0.80±0.14	2.98±0.19	0.84±0.21	3.17±0.14	0.39±0.12	2.19±0.09
15.09.014	0.81±0.12	3.92±0.20	0.93±0.31	4.00±0.38	0.50±0.05	2.55±0.13
22.09.014	1.32±0.24	3.94±0.17	1.06±0.23	3.98±0.42	0.82±0.05	3.18±0.36
29.09.014	1.76±0.10	5.72±0.30	1.83±0.14	5.89±0.52	1.59±0.19	3.96±0.24
06.10.014	0.83±0.18	4.00±0.62	1.06±0.22	2.23±0.41	1.04±0.27	2.53±0.27
13.10.014	0.44±0.16	1.28±0.03	0.39±0.08	1.52±0.36	0.36±0.07	0.64±0.07
20.10.014	0.40±0.13	1.00±0.05	0.38±0.12	0.68±0.18	0.24±0.06	0.17±0.05
27.10.014	0.11±0.04	0.15±0.05	0.14±0.02	0.36±0.08	0.03±0.02	0.08±0.03
03.11.014	0.03±0.03	0.10±0.04	0.09±0.03	0.17±0.06	0.00±0.00	0.04±0.02

*Mean ±S.E.

When the results on population buildup of *T. urticae* over weekly observations were compared, a significant effect of observation period was recorded (CD= 0.43; p=0.05) (Table 2). Irrespective of the leaf stage, the mite count was established to significantly rise with each observation period till the attainment of peak in the population in the last week of September (5.19 mites/sq cm leaf), which afterwards showed a gradual decline to the lowest count of 0.10 mites/ sq cm leaf on first week of November. During September, the mites count was statistically insignificant in the second (3.49 mites/sq cm leaf) and third (3.70 mites/sq cm leaf) week. Mite incidence during the first week of September and the first week of October was also found to be at par with each other. Similarly, comparable *T. urticae* population was recorded on third, fourth week of October and the first week of November. The interaction between observation periods and leaf stage was not significant.

Table 2. Relative incidence of *Tetranychus urticae* on brinjal leaves of different stages under field conditions during 2014

Observation Period	Average number of <i>Tetranychus urticae</i> / sq cm leaf			
	Tender leaves	Grown up leaves	Older leaves	Mean
08.09.014	2.98	3.17	2.19	2.78 ^c
15.09.014	3.92	4.00	2.55	3.49 ^{a,b}
22.09.014	3.94	3.98	3.18	3.70 ^a
29.09.014	5.72	5.89	3.96	5.19
06.10.014	3.50	3.23	2.53	3.09 ^{b,c}
13.10.014	1.28	1.52	0.64	1.15
20.10.014	0.60	0.68	0.17	0.48 ^d
27.10.014	0.15	0.36	0.08	0.19 ^d
03.11.014	0.10	0.17	0.04	0.10 ^d
Mean	2.47 ^a	2.56 ^a	1.70	

CD (p=0.05) for Observation Period = 0.43; SE (m) =0.15
 CD (p=0.05) for Leaf age = 0.25; SE (m) =0.08
 CD (p=0.05) for Observation Period × Leaf age = NS
 Values with the same superscript do not differ significantly



Under Screen House Conditions

Adults mite first time appeared on the dorsal and ventral surface of tender, grown up and older leaves in the first week of September (3.9.14). At this duration, average number of adults was 2.30, 2.90 and 2.30 adult /sq cm leaf on the dorsal surface and 3.20, 2.27 and 1.77 adult/sq cm leaf on the ventral surface of tender, grown up and older leaves, respectively (Table 3). *T. urticae* adult population showed a gradual increase until the attainment of the peak in the last week of September 2014 (24.09.14). At this stage, 5.63, 5.63, 4.70 adult /sq cm leaf on the dorsal surface and 6.46, 6.93, 5.14 adult /sq cm leaves on the ventral surface were recorded from three leaves, respectively (Table 3). Afterwards, a gradual decline in mite population was recorded until the end of experimentation.

Table 3. Incidence of *Tetranychus urticae* adults on brinjal under screen house conditions during 2014

Observation period	Average number of adults / sq cm leaf*					
	Tender leaves		Grown up leaves		Older leaves	
	Dorsal surface	Ventral surface	Dorsal surface	Ventral surface	Dorsal surface	Ventral surface
03.09.014	2.30±0.54	3.20±0.58	2.90±0.51	2.27±0.53	2.30±0.33	1.77±0.35
10.09.014	4.61±0.47	5.26±0.39	4.66±0.60	5.06±0.48	3.46±0.28	4.23±0.30
17.09.014	4.94±0.46	5.33±0.33	5.34±0.44	5.56±0.53	4.06±0.46	4.92±0.40
24.09.014	5.63±0.53	6.46±0.57	5.63±0.70	6.93±0.45	4.70±0.71	5.14±0.39
01.10.014	4.31±0.39	4.30±0.67	4.05±0.34	4.82±0.80	3.40±0.38	3.36±0.49
08.10.014	4.83±0.38	2.21±0.47	3.72±0.35	4.09±0.43	3.10±0.47	3.16±0.46
15.10.014	4.83±0.38	3.15±0.55	4.23±0.48	3.74±0.56	2.24±0.39	3.03±0.58
22.10.014	3.19±0.30	2.10±0.46	2.34±0.57	4.00±0.82	3.04±0.33	3.93±0.47
29.10.014	1.75±0.30	1.93±0.47	1.45±0.40	1.85±0.54	1.43±0.44	1.80±0.42
05.11.014	1.24±0.27	0.33±0.13	0.86±0.26	0.52±0.18	0.28±0.20	0.44±0.21

*Mean ±S.E.

A comparison of *T. urticae* population on brinjal leaves of different stages viz. tender, grown up and older leaves showed that leaves of all three stages were susceptible to mite infestation but varied significantly with each other. The distribution of *T. urticae* was found to be more on grown-up leaves (3.48 mites/sq cm leaf) which were statistically higher (CD = 0.31; p = 0.05) than the mite density on the older leaves of the plants (2.55 mites/sq cm leaf) (Table 4). On tender leaves, number of mites (3.05 mites/ sq cm leaf) was statistically comparable with mite number on grown up and older leaves. Statistical analysis of *T. urticae* incidence showed a significant effect of the observation period (CD = 0.57; p = 0.05). Irrespective of leaf age, statistically higher number of mites was recorded during last week of September 2014 (5.85 mites/ sq cm leaf) than the mites recorded at other observation periods. Statistically comparable data were recorded in the first week (2.73 mites/sq cm leaf) of September, second (2.66 mites/sq cm leaf), third (2.55 mites/sq cm leaf) and fourth (2.56 mites/sq cm leaf) week of October 2014 (Table 4). Likewise, *T. urticae* population was at par during the second week of September (4.04 mites/sq cm leaf) and the first week of October (3.57 mites/sq cm leaf); during the second and third week of October 2014. The ANOVA presented a non-significant interaction amongst observation periods and leaf stage of plants. Mites were significantly equivalent on the tender, grown up and older leaves at each observation period.

Discussion

The results of the present study clearly showed a peak in *T. urticae* population in the last week of September 2014 (5.19, 5.85 mites/ sq cm leaf) on brinjal plant under field and screen house conditions, respectively. In earlier studies, a maximum number of mites was reported from June and July in Haryana [7] and May to June in Punjab [8] on brinjal. Seasonal fluctuation in *T. urticae* population in various crops has been reported by various workers. Hoque et al. [9] while studying the population dynamics of *T. urticae* on three host plants recorded the highest number of mites in the month of May on bean and brinjal whereas



in the month of August on okra. During the present study, no mites were observed from the second week of November to January. These studies are in conformity with earlier studies where low to negligible mite population was encountered during December, January, and February months [10-12].

Table 4. Relative incidence of *Tetranychus urticae* on brinjal leaves of different stages under screen house conditions during 2014

Observation Period	Average number of <i>Tetranychus urticae</i> / sqcm leaf			
	Tender leaves	Grown up leaves	Older leaves	Mean
03.09.014	2.82	3.16	2.21	2.73a
10.09.014	4.42	4.35	3.35	4.04
17.09.014	4.42	4.84	4.11	4.45
24.09.014	6.24	6.56	4.74	5.85
01.10.014	3.40	4.41	2.90	3.57
08.10.014	2.45	3.22	2.30	2.66a
15.10.014	2.57	3.08	1.98	2.55a
22.10.014	2.24	2.94	2.50	2.56a
29.10.014	1.45	1.39	1.01	1.28
05.11.014	0.54	0.81	0.39	0.58
Mean	3.05^{ab}	3.48^a	2.55^b	

CD (p=0.05) for Observation Period = 0.57, SE(m)= 0.20;
 CD (p=0.05) for Leaf age = 0.31, SE(m)=0.11
 CD (p=0.05) for Observation Period × Leaf age = NS
 Values with the same superscript do not differ significantly

The variation in above-documented results may be explained by the fact that seasonal population trends of spider mites are influenced by various factors such as climate, predation by natural enemies and host plants [13]. Variations in local climates of respective areas must be influencing *T. urticae* outbreaks.

Effect of Host Crop on *Tetranychus urticae* Population

Host plant species often differ in chemical profiles, thereby affecting host (i.e., herbivore) quality [14]. Many authors have reported on the involvement of secondary metabolites in the interaction between plants and herbivorous pests. During peak population in the present study, *T. urticae* laid 6.95 eggs/sq cm leaf on brinjal variety BR112. According to Khanamani et al. [15], the number of eggs per day varied from 2.04 to 65.6 eggs/female, which was minimum on Neishabour and maximum on Isfahan cultivar of brinjal.

During the present study, 5.85 mites/ sq cm leaf were recorded on brinjal leaves. Afzal and Bashir [16] recorded maximum mite population from brinjal 2.77 mites/ leaf, whereas Dutta et al. (17) recorded a higher number of mites/ leaf on brinjal (32.27). Tripathi et al. (18) recorded maximum population of *T. ludeni* (308.60) on brinjal. Geroh et al. [11] and Kanika et al. [12] recorded 34.7 and 17.80 mites/ sq cm leaf on okra and cucumber, respectively during peak season.

Effect of Leaf Stage on *Tetranychus urticae* Population

The age of the leaf contributes a formidable share to the susceptibility of mite infestation and subsequent population build up. Results on the occurrence of *T. urticae* on the leaves of different stages of brinjal crop (viz. tender, grown up and older) during present study depicted maximum mite density on grown-up leaves (2.56 mites/ sq cm leaf) followed by 2.47 and 1.70 mites/ sq cm leaf on tender and older leaves, respectively; former two were statistically comparable to each other. In brinjal, tetranychids were reported to be abundant on the middle and bottom leaves but favored matured leaves of both the canopies [19-22]. Among the canopy levels, tetranychid preference of middle canopy was shown by Prasanna [23] on brinjal and Geroh (24) on okra. In several studies, maximum population of mites was documented from the middle strata followed by the top and bottom strata on brinjal [25] and okra [10, 24]. However, Dutta et al. [17] observed that *T. urticae* was most densely populated in the upper canopy. This variation in result can be



explained by the fact that mites migrate from older to younger leaves when food reserve in the older leaves becomes scanty.

Conclusion

It is concluded that *T. urticae* population were at the highest peak, 5.19 and 5.85 mites/ sq cm leaf in the last week of September 2014 on brinjal plant under field and screen house conditions, respectively. Afterwards, a gradual decline in mite population was recorded till November. Among the leaves, grown-up leaves were found to harbor maximum population of *T. urticae*, both under screen house and field conditions, followed by tender and older leaves.

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