E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(3): 159-162
Received: 12-12-2023
Accepted: 18-01-2024

Mutthuraju GP
Assistant Professor, University of Horticultural Sciences, Bagalkot, Karnataka, India

Srinivasa N
Professor (Rtd.), University of Agricultural Sciences, Bangalore, Karnataka, India

Doddabasappa B
Assistant Professor, University of Horticultural Sciences, Bagalkot, Karnataka, India

Tanveer Ahmed
Assistant Professor, University of Horticultural Sciences, Bagalkot, Karnataka, India

Corresponding Author:
Dr. Tushar B Patil
Associate Professor, ACPM Medical College, Dhule, Maharashtra, India

Effects of two-spotted spider mite (*Tetranychus urticae*) population density on yield loss and damage to brinjal crop

Mutthuraju GP, Srinivasa N, Doddabasappa B and Tanveer Ahmed

DOI: https://doi.org/10.33545/2618060X.2024.v7.i3c.397

Abstract
Research on the effects of two-spotted spider mite (Tetranychus urticae Koch) population density and crucial crop stage on yield loss and damage in brinjal crop cv. Green Long was investigated at the Gandhi Krishi Vigyan Kendra, Bangalore, Zonal Agricultural Research Station farm. A controlled infection (50–250 mites/plant) conducted between 15 and 105 days following planting showed that the largest mite accumulation during the cropping period occurred when 250 mites/plant were infected at 15 days post-planting. Additionally, throughout the summer, plots infested with 250 mites per plant at 15 DAP had low yields of 18.7 kg/plot, with a corresponding yield loss of 26.09%. Comparably poor yields of 21.3 kg/plot meant a 38.62% loss in kharif.

Keywords: *Tetranychus*, critical stage, brinjal, loss

Introduction
Tetranychus urticae Koch, the two-spotted spider mite, is a common agricultural pest that is well-known for its detrimental consequences (Jeppson *et al.*, 1975) [7] on crops. These microscopic pests frequently congregate in sizable colonies under delicate, silky webs on the underside of leaves, where they feed by puncturing and draining plant tissues and cells. Webbing on flowers and buds and distinctive yellow chlorotic patches on foliage are the effects of this feeding behaviour. Chloroplast destruction brought on by an increase in mite population reduces transpiration, stomatal closure, photosynthesis, and eventually impacts crop production quantity and quality (Brandenburg and Kennedy, 1987; Martinez *et al.*, 2006) [5, 9]. Owing to their quick development rate, short generation time, and high net reproduction rate, *T. urticae* can multiply to harmful population sizes very fast, which causes the quality of the host plant to rapidly deteriorate.
T. urticae poses a serious danger to brinjal (*Solanum melongena* L.), popularly known as aubergine, among its many hosts, resulting in notable losses in crop yield (Basu and Pramanik, 1968) [4]. According to Anonymous (1992 & 1994) [1-2], spider mites are a significant pest in brinjal production, resulting in yield decreases of up to 31% in Varanasi, Uttar Pradesh, and Bangalore, Karnataka. The purpose of this study is to assess the effects of *T. urticae* population densities and crucial crop stages on yield loss and damage to brinjal crops.

Materials and Methods
Evaluation of the impact of spider mite population density and critical crop stage on damage and production loss in brinjal cv. Green Long was investigated in the field at the Gandhi Krishi Vigyan Kendra farm's Zonal Agricultural Research Station in Bangalore during the summer and kharif.
Factorial Randomised Block Design was used to plan the experiment, which included two factors and two replications for each component. Factor 1: There are seven degrees of crop growth, and mites were released at 15, 30, 45, 60, 75, 90, and 105 days following planting. Factor 2: The quantity of mites emitted per plant, divided into six levels: 0, 50, 100, 150, 200, and 250 mites. Plots were 3 m by 3 m and included 20 plants each.

Brindajals in the relevant treatment plots were kept "spider mite free" by using acaricides on a daily basis, prior to releasing the mites at the intended crop growth stage (s). Propargite 57EC (Omite) (570 g a.i/ha) and fenazaquin 10EC (Magister) (125 g a.i/ha) were the acaricides utilised for this.

Every two weeks, starting from 15 days after planting and continuing until crop maturity, observations on the number of mites in various treatments were made on five randomly chosen plants from each plot. To count the variety of mite stages, including eggs and active stages (larvae, nymphs, and adults on the entire leaf), three leaves from each plant were sampled, one from the top, middle, and bottom canopies. The leaves were then examined under a stereo-binocular microscope in the lab. At each picking, the quantity of harvestable fruits and the fruit yield (kg) per plot were noted. Following an appropriate transformation (if required), the fruit production (weight and number) and the mite population data were statistically analysed using an ANOVA for Factorial RCBD. The results were interpreted at the 5% level of significance.

Results and Discussion

Spider mite infestations affected the brinjal plants at seven distinct growth stages, which were 15, 30, 45, 60, 75, 90, and 105 days after planting. The number of mites per plant varied, ranging from 0 to 250. Plots where the crop was infested early, at 15 DAP, showed a greater accumulation of mites; during summer and kharif, these plots recorded a mean of 5546.4 and 4337.1 mites per leaf (up to 120 DAP), respectively. When the crop was infested late at 105 DAP, the lowest number of mites per leaf was observed, with 119.4 and 77.4 mites per leaf during summer and kharif, respectively (table 1 and 3).

The quantity of mites released (or infested) and the subsequent mite population buildup further showed a direct association, according to a perusal of mite population buildup data across the various levels of initial infection. When plants were infested at a rate of 250 mites per plant during the summer and kharif, respectively, the maximum number of mites was reported at 3743 and 2921.4 mites per leaf. Due to natural mite movement or dispersal from the nearby "mite released" plots, up to 168.7 and 125.4 mites/leaf during summer and kharif, respectively, could be reported in no mite released plot.

The way that mite infestation levels and crop age interacted also varied greatly in terms of how the mite population grew. In the plot infested with 250 mites per plant at 15 DAP, the maximum number of mites (10532.1 and 8244.6/leaf throughout summer and kharif, respectively) was gathered and recorded (table 1 and 3). The highest mean marketable fruit yield-32.7 and 38.3 kg/plot, respectively was observed in the summer and kharif, when there were presumably no mite releases. When the brinjal crop was infested by mites at 15 DAP, the mean marketable fruit output was at its lowest, 21.2 and 25.2 kg/plot during summer and kharif, respectively. This accounted for 19.37% and 32.73% loss in fruit yield, respectively (table 2 and 4).

There was a substantial interaction between crop age and the degree of mite infestation on fruit output. In the summer, plots infested with 250 and 200 mites per plant, respectively, at 15 DAP had low yields of 18.7 and 19.8 kg/plot; the corresponding yield loss was 26.09% and 21.74%, respectively. Comparably low yields of 21.3 and 22.5 kg/plot during kharif matched losses of 35.16% and 38.62%. Therefore, during the kharif season, the maximum avoidable loss in fruit yield was 38.62%, and during the summer, the maximum loss was 26.09%.

However, as this study shows, Reddy and Baskaran (1987a & b) [11-12] found a significant decline in the growth and yield components of the brinjal crop when T. ludeni, a spider mite, infested it in the early, mid, and late seasons. They believed that early crop mite infestation lowers leaves' ability to photosynthesize, which lowers the quantity of fruits produced and the yield that results. In addition to reducing the amount of fruits and making the fruits smaller, a severe infestation may also result in blossom and fruit shedding. According to Dhooria (1985) [6], who examined the effects of varying infestation levels (1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 75, and 100/plant) of the red spider mite, T. cinnabarinus, on young brinjal plants (3–4 leaves stage) in a greenhouse, even a single adult female mite per plant could have a serious impact on plant growth and flower and fruit setting, especially in May and June.

At various phases of the crop / plant, Patil and Nandihalli (2008) [10] noted a decrease in the parameters related to growth and production of brinjal with an increase in the amount of mite release / infestation. The magnitude of harm induced by *T. urticae's* differential discharge on potted brinjal plants was shown by studies conducted in Ludhiana. Seven days after the release of 100 mites per plant, more than 75% of the yellowing symptoms were shown on plants that were one month old; in contrast, 50 to 75% of the yellowing symptoms were seen following the release of 50 mites (Anonymous, 2000) [3]. The association between initial *T. urticae* densities and yield loss was explained by a linear regression, $Y=1.085X+2.474$, ($R^2=0.9659$), as demonstrated by Lim *et al*. (2008) [8]. This revealed that the rate of yield loss in brinjal rose with increase in initial mite density.

Table 1: Artificial infestation of two spotted spider mite, *Tetranychus urticae* and population build up at different plant ages on brinjal (Summer)

No. of mites released/ plant	Age of the plant							Mean
	15 DAP (45 DOP)	30 DAP (60 DOP)	45 DAP (75 DOP)	60 DAP (90 DOP)	75 DAP (105 DOP)	90 DAP (120 DOP)	105 DAP (135 DOP)	
0	410.9 (20.3)	262.3 (16.2)	135.0 (11.6)	129.0 (11.4)	66.6 (8.2)	109.4 (10.5)	67.8 (8.3)	168.7^{f} (12.3)
50	3249.4 (57.0)	1906.5 (43.7)	1396.3 (37.4)	509.3 (22.6)	442.1 (21.0)	300.4 (17.3)	101.8 (10.1)	1129.4^{e} (29.9)
100	4830.4 (69.5)	2437.9 (49.4)	1781.3 (42.2)	893.9 (29.9)	607.8 (24.7)	399.2 (20.0)	155.7 (12.5)	1586.6^{d} (35.4)
150	5884.7 (76.7)	3742.7 (61.2)	2320.4 (48.2)	1343.8 (36.7)	969.5 (31.1)	619.4 (24.9)	127.0 (11.3)	2143.9^{c} (41.4)
200	8371.0 (91.5)	5333.2 (73.0)	3242.8 (56.9)	1653.2 (40.7)	1151.0 (33.9)	753.7 (27.5)	120.0 (11.0)	2946.4^{b} (47.8)
250	10532.1 (102.6)	6560.6 (81.0)	4107.1 (64.1)	2350.1 (48.5)	1570.9 (39.6)	935.8 (30.6)	144.2 (12.0)	3743.0^{a} (54.1)
Mean	5546.4^{a} (69.6)	3373.9^{b} (54.1)	2163.8^{c} (43.4)	1146.6^{d} (31.6)	801.3^{e} (26.4)	519.7^{f} (21.8)	119.4^{g} (10.9)	

(DAP: Days after planting; DOP: Days old plant * Cumulative mite population per leaf from eight fortnightly observations recorded from 30 DAP; Values in the parentheses are √X+0.5 transformed values; Mean values with same alphabetical superscript within a column/row are not significantly different)

Treatment	S.EM±	CD @ 0.05
Age of plant (A)	(0.65)	(1.85)
No. of mites released /plant (M)	(0.60)	(1.71)
A x M	(1.58)	(4.52)

Table 2: Effect of artificial infestation of two spotted spider mite, *Tetranychus urticae* on marketable fruit yield (kg/plot*) in brinjal (Summer)

No. of mites released/ plant	Age of the plant								Yield loss over zero infestation (%)
	15 DAP (45 DOP)	30 DAP (60 DOP)	45 DAP (75 DOP)	60 DAP (90 DOP)	75 DAP (105 DOP)	90 DAP (120 DOP)	105 DAP (135 DOP)	Mean yield	
0	25.3	32.4	33.1	33.4	34.6	34.6	35.3	32.7^{a}	-
50	21.9	24.9	26.7	30.7	31.7	32.7	35.2	29.1^{bcd}	11.01
100	21.1	23.9	25.8	28.1	31.8	31.3	34.0	28.0^{cde}	14.37
150	20.4	23.4	24.9	28.0	29.6	31.6	34.1	27.4^{def}	16.21
200	19.8	22.3	24.3	26.6	28.9	30.7	33.1	26.5^{df}	18.96
250	18.7	21.2	23.0	26.0	28.0	29.7	32.6	25.6^{f}	21.71
Mean yield	21.2^{f}	24.7^{e}	26.3^{de}	28.8^{c}	30.8^{bc}	31.8^{b}	31.1^{a}		

(DAP: Days after planting; DOP: Days old plant *Plot size 3m x 3m (20 plants/plot); Mean values with same alphabetical superscript within a column/row are not significantly different)

Treatment	S.EM±	CD @ 0.05
Age of plant (A)	0.76	2.16
No. of mites released /plant (M)	0.70	2.00
A x M	1.85	5.29

Table 3: Population build up of mites by artificial infestation at different plant ages on brinjal *cv.* Green Long (*kharif*)

No. of mites released/ plant	Age of the plant							Mean
	15 DAP (45 DOP)	30 DAP (60 DOP)	45 DAP (75 DOP)	60 DAP (90 DOP)	75 DAP (105 DOP)	90 DAP (120 DOP)	105 DAP (135 DOP)	
0	314.9 (17.7)	193.7 (13.9)	100.3 (10.0)	98.0 (9.9)	52.9 (7.3)	78.0 (8.8)	39.9 (6.4)	125.4^{f} (10.6)
50	2537.9 (50.4)	1477.1 (38.4)	1076.8 (32.8)	395.4 (19.9)	341.1 (18.5)	227.6 (15.1)	69.8 (8.4)	875.1^{e} (26.2)
100	3793.0 (61.6)	1892.8 (43.5)	1392.7 (37.3)	688.0 (26.2)	466.4 (21.6)	292.5 (17.1)	105.9 (10.3)	1233.0^{d} (31.1)
150	4594.7 (67.8)	2887.1 (53.7)	1808.0 (42.5)	1052.2 (32.4)	740.6 (27.2)	478.1 (21.9)	83.5 (9.1)	1663.5^{c} (36.4)
200	6537.6 (85.8)	4152.8 (64.4)	2520.7 (50.2)	1278.7 (35.8)	882.9 (29.7)	575.5 (24.0)	74.9 (8.7)	2289.0^{b} (41.9)
250	8244.6 (85.8)	5152.8 (71.8)	3196.4 (56.5)	1820.9 (42.7)	1221.5 (34.9)	723.4 (26.9)	90.6 (9.5)	2921.4^{a} (47.6)
Mean	4337.1^{a} (61.5)	2626.1^{b} (47.6)	1682.5^{c} (38.2)	888.9^{d} (27.8)	617.5^{e} (23.2)	395.9^{f} (19.0)	77.4^{g} (8.7)	

(DAP: Days after planting; * Cumulative mite population per leaf from eight fortnightly observations recorded from 30 DAP; Values in the parentheses are √X+0.5 transformed values; Mean values with same alphabetical superscript within a column/row are not significantly different)

.

Treatment	S.EM±	CD @ 0.05
Age of plant (A)	(0.85)	(2.43)
No. of mites released /plant (M)	(0.79)	(2.25)
A x M	(2.08)	(5.95)

Table 4: Effect of artificial infestation of two spotted spider mite, *Tetranychus urticae* on marketable fruit yield (kg/plot*) in brinjal (*Kharif*)

No. of mites released/ plant	Age of the Plant								Yield loss over zero infestation (%)
	15 DAP (45 DOP)	30 DAP (60 DOP)	45 DAP (75 DOP)	60 DAP (90 DOP)	75 DAP (105 DOP)	90 DAP (120 DOP)	105 DAP (135 DOP)	Mean yield	
0	34.7	37.3	38.1	38.4	39.4	39.5	40.4	38.3^{a}	-
50	25.2	28.5	30.6	35.3	36.2	37.1	40.1	33.3^{bcd}	13.05
100	24.3	27.5	29.6	32.3	36.2	36.1	38.7	32.1^{cde}	16.19
150	23.4	26.6	28.4	31.8	33.7	36.0	39.0	31.3^{def}	18.28
200	22.5	25.5	27.7	30.4	32.9	34.9	38.1	30.3^{ef}	20.89
250	21.3	24.4	26.4	29.6	31.7	33.6	37.6	29.2^{f}	23.75
Mean yield	25.2^{g}	28.3^{fg}	30.1^{ef}	33.0^{d}	35.0^{cd}	36.2^{bc}	39.0^{a}		

(DAP: Days after planting; *Plot size 3m x 3m (20 plants/plot); Mean values with same alphabetical superscript within a column/row are not significantly different)

Treatment	S.EM±	CD@0.05
Age of the Plant (A)	0.93	2.67
No. of mites released /plant (M)	0.86	2.47
A x M	2.29	6.53

Conclusion

In conclusion, the study illustrates the complex dynamics between spider mite infestations and brinjal plant growth, particularly highlighting the significant impact of infestation timing and intensity on mite population buildup and fruit yield. Early infestations led to higher mite accumulations, resulting in substantial yield losses, while late infestations correlated with lower mite populations and comparatively higher yields. The findings underscore the importance of timely pest management strategies to mitigate yield losses. Additionally, previous studies corroborate these findings, emphasizing the detrimental effects of spider mites on brinjal growth and yield. Understanding these interactions is crucial for devising effective pest control measures and optimizing brinjal production. Further research in this area could provide valuable insights into developing sustainable agricultural practices to combat spider mite infestations and enhance crop productivity.

References

1. Anonymous. Progress Report for 1990-92. All India Coordinated Research Project on Agricultural Acarology, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore, 1992, 85.
2. Anonymous. Progress Report for 1992-94. All India Coordinated Research Project on Agricultural Acarology, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore, 1994, 78.
3. Anonymous. Progress Report for 1998-2000. All India Coordinated Research Project on Agricultural Acarology, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore, 2000, 122.
4. Basu AC, Pramanik LM. Acaricidal tests of nine pesticides against two spotted spider mite, a serious pest of brinjal in West Bengal. Journal of Economic Entomology. 1968;61(6):768-770.
5. Brandenburg RL, Kennedy GG. Ecological and agricultural considerations in the management of two-spotted spider mite (*Tetranychus urticae* Koch). Agricultural Zoology Reviews. 1987;2(2):185-236.
6. Dhooria MS. Effect of releasing different levels of red spider mite, *Tetranychus cinnabarinus* (Boisd.) on growth of brinjal and okra plants. Acarology Newsletter. 1985;15(1):3.
7. Jeppson LR, Keifer HH, Baker EW. Mites Injurious to Economic Plants. University of California Press, 1975, 614.
8. Lim J, Choi S, Kim J, Moon H, Lee K, Kim D, *et al*. Economic injury levels of Tetranychus urticae Koch (Acari, Tetranychidae) infesting eggplant in the greenhouse. Korean Journal of Applied Entomology. 2008;47(4):395-400.
9. Martinez FMT, Jacas JA, Piolles MJI, Aucejo RS. Approaches for sampling the two-spotted spider mite (*Acari: Tetranychidae*) on clementines in Spain. Journal of Economic Entomology. 2006;99(4):1490-1499.
10. Patil RS, Nandihalli BS. Estimation of loss in brinjal due to red spider mites. Karnataka Journal of Agricultural Sciences. 2008;21(3):456-457.
11. Reddy GVP, Baskaran P. Effect of different mite loads at different stages of the crop growth on plant characters and yield components in four varieties of eggplant. First National Seminar on Acarology, Kalyani, 1987, 30.
12. Reddy GVP, Baskaran P. Biology and varietal preference of *Tetranychus ludeni* (*Acari: Tetranychidae*) on four varieties of eggplant. First National Seminar on Acarology, Kalyani, 1987, 29.