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Comparative biology of red spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae) on Brinjal, Okra and Marigold

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Abstract
In this study, the impact of the three different host plant Brinjal, Okra and Marigold on life cycle, development and reproductive characteristics of the red spider mite, *Tetranychus urticae* Koch. was studied at the laboratory, Department of Entomology, College of Horticulture, Mandsaur. The biology of red spider mites (*T. urticae*) consisted of egg, larvae, protonymph, deutonymph and adult stages. The lifecycle (egg to adult) of red spider mite found to vary from 18-28 days (male, mated female and unmated female) on different host plant viz., longest on Marigold (21.32±2.49, 28.18±2.18 and 25.68±2.63 days) followed by Okra (21.10±2.18, 26.86±1.69 and 25.36±1.85 days) and Brinjal (18.93±1.33, 24.16±2.01 and 21.16±1.70 days) for male mated female and unmated female, respectively. The ovipositional (fecundity) period of red spider mite was found to be lower in Brinjal (8.80±1.32 days) and higher in okra (10.40±2.01 days). The higher fecundity (no. of eggs) was observed in Okra (86±14.49). Mated female's of red spider mite progeny consisted of both males and females in the ratio varied from 1: 2.00 to 1:3.50 in Brinjal, Okra and Marigold, while unmated female produced only male.

Keywords: *Tetranychus urticae*, Brinjal, okra, marigold, biology, male, female

Introduction
Red spider mite, *T. urticae* (acari: Tetranychidae) is a notorious and polyphagous pest of various fruit and vegetable crops with a around world. It has been recorded to feed on more than 900 crops and plants and is a very serious pest of at least 140 economically important agricultural and ornamental crops (Kavitha *et al*., 2007) [6]. The nymphs and adults of red spider mites prefer older leaves of the plant and suck the sap from under surface of the leaf. The infested leaves turn yellowish and developed brownish patches which ultimately results in drying and withering (Kulkarni *et al.*, 2008) [7]. Apart from its polyphagous nature, short lifecycle capable to have multiple overlapping generations, high reproductive potential, climatic conditions and higher use of plant protection (insecticides and acaricides) compound, the spider mite problem increased. However, the influence of the biological parameters of red spider mites correlated with abiotic factor was not thoroughly studied. Life table studies of red spider mites provide information about the suitable host plant for the development and growth of the insect and mites. The growth, fecundity rates and mortality factors of insect pests and mites are greatly influenced by the variety, host plant and physico-chemical properties of the host plant. The present study was undertaken to investigate the biological parameters of red spider mite in selected three host plant *viz*., Brinjal, Okra and Marigold.

Materials and Methods
The study on the life cycle and development of red spider mite (*T. urticae)* on brinjal, okra and marigold was conducted at Krishi Vigyan Kendra with the help of Department of Entomology, College of Horticulture, Mandsaur (M.P.) during February- April, 2021 at Av. 23.30±10.98 °C and Av. 51.60±27.95% RH, on leaf of brinjal, okra and marigold placed on wet cotton wad in petri plates (10 cm diameter). *T. urticae*wasmass cultured in the laboratory on brinjal, okra and marigold leaves was placed on plastic trays with layer of blotting paper and well moistened synthetic absorbent sponge. Leaves were changed every day to avoid poor nutrition. Ten gravid females were collected from mass culture and transferred to individual leaf discs (1 female/ disc) for oviposition. After 24 hr, eggs were counted and transferred to another disc having leaf bit (5 cm^2) using a fine hair camel brush and biology were studied. Developed immature stages were observed with the help of a stereo binocular microscope until reached

maturity. Newly emerged females and males were maintained on separate leaf discs to record their longevity. To record the duration of sexual period of mated female, female of teliochrysalis was transferred to another leaf disc and 4 adult males released into the disc and allowed to mate after the final moult. Removed of males after 24 hr emergence of female. Observations on behavior, oviposition, preoviposition and postoviposition periods were recorded. Reproductive biology of mated and unmated female was also studied using teliochrysalis stage that moulted to female and allowed to mate with male in case of biology of mated female while, female was not allowed to mate with male in case of biology of unmated female. The number of eggs laid by the unmated as well as mated females was recorded by replacing the leaf discs carrying eggs with fresh discs till death of the female. Sex ratio and viability of eggs data also recorded.

Results

Comparative biology of red spider mite, *T. urticae* on brinjal, okra and marigold

The duration period of red spider mite considered of egg, larva, protonymph, deutonymph and adult stages (Tab. 1). The egg was white in colour, which gradually turned to creamy white colour near hatching. The mean duration of egg period in mated female was 3.15, 3.65 and 3.71days in brinjal, okra and marigold, respectively, while unmated female was 4.25, 4.79 and 4.88 days in brinjal, okra and marigold, respectively. The newly emerged larvae shape were spherical and creamy white yellowish in colour with two bright, prominent red spots on the dorsal sides of the red spider mite. The average duration period of larval were 1.55±0.36 days in brinjal, 1.70±0.33 days in okra and 1.80±0.34 days in marigold for male, while 2.40±0.42 days in brinjal, 2.92±0.41 days in okra and 3.00±0.39 days in marigold for female.The duration of the larva was longest in marigold for male and female, while shortest in brinjal. The protonymph appeared pale white colour which turned to light yellow near maturity and four pairs of legs. The duration period of protonymphal stage for 2.47±0.33 and 2.25±0.34 days in brinjal, 2.63±0.31 and 3.04±0.23 days in okra and 2.60±0.26 and 3.03±0.21 days in marigold for male and female, respectively. The protonymph period was found to be highest in okra for both male and female followed by marigold and brinjal. After the protonymphal stage, the *T. urticae* entered into the deutonymphal stage which was similar to protonymph except for the duration period and size. The period of deutonymphal stage were 1.75±0.33 and 2.18±0.49 days in brinjal, 1.88±0.35 and 2.54±0.47 days in okra and 1.93±0.41 and 2.59±0.46 days in marigold for male and female, respectively. The longest period was recorded in marigold for both males and females. The total development period (immature stages) were 7.43±0.43 and 9.46±0.57 days in brinjal, 8.30±0.72 and 12.36±0.59 days in okra and 8.72±0.88 and 12.68±0.98 days in marigold for male and female, respectively. The longest development period was found in Marigold for bath male and female (Tab. 1).

Table 1: Duration periods (Days) of different stages of red spider mite on different host plant

S. No	Stages	Brinjal			Okra			Marigold		
		Mini.	Max.	AV.±SD	Mini.	Max.	AV.±SD	Mini.	Max.	AV.±SD
1	**Incubation Periods**									
	Unmated Female	2.50	3.50	3.15±0.34	2.95	4.00	3.65±0.31	3.10	4.00	3.71±0.28
	Mated Female	3.00	5.50	4.25±0.75	3.50	5.95	4.79±0.75	3.75	6.20	4.88±0.75
2	**Larvae**									
	Male	1.10	2.20	1.55±0.36	1.30	2.25	1.70±0.33	1.50	2.50	1.80±0.34
	Female	1.75	3.00	2.40±0.42	2.25	3.35	2.92±0.41	2.40	3.50	3.00±0.39
4	**Protonymph**									
	Male	2.10	3.20	2.47±0.33	2.10	3.20	2.63±0.31	2.25	3.10	2.60±0.26
	Female	2.10	3.20	2.25±0.34	2.80	3.50	3.04±0.23	2.80	3.45	3.03±0.21
5	**Deutonymph**									
	Male	1.20	2.30	1.75±0.33	1.20	2.40	1.88±0.35	1.10	2.60	1.93±0.41
	Female	1.30	3.00	2.18±0.49	1.65	3.25	2.54±0.47	1.75	3.30	2.59±0.46
6	**Total development period (immature stages)**									
	Male	6.90	8.35	7.43±0.43	6.60	9.15	8.30±0.72	6.60	9.75	8.72±0.88
	Female	8.70	10.60	9.46±0.57	11.60	13.60	12.36±0.59	11.70	15.25	12.68±0.98
7	**Adult period**									
	Male	9.00	13.00	11.50±1.43	10.00	16.00	12.80±1.81	10.00	17.00	12.60±1.90
	Mated female	11.00	17.00	14.70±1.77	12.00	18.00	14.50±1.90	13.00	20.00	15.50±2.12
	Unmated female	9.00	14.00	11.70±1.42	10.00	15.00	13.00±1.94	9.00	16.00	13.00±2.11
8	**Total life period**									
	Male	16.35	20.35	18.93±1.33	17.60	25.15	21.10±2.18	16.60	26.75	21.32±2.49
	Mated female	19.70	26.60	24.16±2.01	24.40	30.20	26.86±1.69	25.40	31.90	28.18±2.18
	Unmated female	18.40	23.80	21.16±1.70	22.40	28.10	25.36±1.85	21.30	30.25	25.68±2.63

Adult red spider mite was broad with a pair of distinct spots. The first pair of legs was longer than the rest of the pairs of legs in both male and female adult. The abdomen of the adult female is broad as compare to male. The adult males were usually spotted near the deutonymphs. The duration of adult mites were 11.50±1.43 and 14.70±1.77 days in brinjal, 12.80±1.81 and 14.50±1.90 days in okra and 12.60±1.90 and 15.50±2.12 days in marigold for male and female, respectively. The lifecycle (egg to adult) of red spider mite found to vary from 18-28 days (male, mated female and unmated female) on different host plant viz., longest on Marigold (21.32±2.49, 28.18±2.18and 25.68±2.63days)

followed by Okra (21.10±2.18, 26.86±1.69 and 25.36±1.85 days) and Brinjal (18.93±1.33, 24.16±2.01 and 21.16±1.70 days) for male mated female and unmated female, respectively. Thus the life span of the red spider mite wasthe shortest on Brinjal and the longest in Marigold (Tab. 1).

Ovipositional period and fecundity of red spider mite, *T. urticae*

The lifespan of adult female consists of Pre-ovipositional, Ovipositional and Post-ovipositional period. The duration of mated female mitewas2.80±0.63, 8.80±1.32 and 2.10±0.57 days in Brinjal, 2.90±0.57, 10.40±2.01 and 1.80±0.63 days in Okra and 3.10±0.88, 10.00±1.89 and 2.10±0.74 days in Marigold, while unmated female were 3.80±0.92, 6.80±1.14 and 1.70±0.48 days in Brinjal, 3.30±1.06, 7.10±1.20 and 2.00±0.47 days in Okra and 3.50±1.08, 6.90±0.88 and 2.00±0.74 days in Marigold for Pre-ovipositional, Ovipositional and Post-ovipositional period, respectively (Tab. 2).

Table 2: Ovipositional period (days), fecundity and sex ratio of different stages of red spider mite on different host plant

S. No.	Stages		Brinjal			Okra			Marigold		
	Mated Female		**Min.**	**Max.**	**AV.±SD**	**Min.**	**Max.**	**AV.±SD**	**Min.**	**Max.**	**AV.±SD**
1.	i	Pre-ovipositional Period	2.00	4.00	2.80±0.63	2.00	4.00	2.90±0.57	2.00	5.00	3.10±0.88
	ii	Ovipositional Period	6.00	10.00	8.80±1.32	8.00	13.00	10.40±2.01	7.00	13.00	10.00±1.89
	Iii	Post-ovipositional Period	1.00	3.00	2.10±0.57	1.00	3.00	1.80±0.63	1.00	4.00	2.10±0.74
2.	**Unmated Female**										
	i	Pre-ovipositional Period	3.00	5.00	3.80±0.92	2.00	5.00	3.30±1.06	2.00	6.00	3.50±1.08
	ii	Ovipositional Period	5.00	9.00	6.80±1.14	5.00	9.00	7.10±1.20	6.00	8.00	6.90±0.88
	iii	Post-ovipositional Period	1.00	5.00	1.70±0.48	1.00	3.00	2.00±0.47	1.00	3.00	2.00±0.74
3	**No. of egg laid per individual female**										
	i	Mated Female	40.00	85.00	71.90±14.45	55.00	105.00	86.50±14.49	45.00	93.00	72.80±15.85
	ii	Unmated Female	17.00	31.00	24.20±4.08	19.00	44.00	29.00±7.12	14.00	37.00	26.80±7.24
	No. of egg laid per day per female										
	i	Mated Female	4.00	9.00	7.70±1.49	6.00	12.00	8.70±2.06	6.00	12.00	8.40±1.71
	ii	Unmated Female	2.50	4.50	3.60±0.61	2.50	5.50	4.00±0.94	3.00	5.00	3.95±0.69
4.	**Sex Ratio (Male: Female)**										
	i	Bisexual	1:2.00	1:3.50	-	1:2.50	1:3.50	-	1:2.50	1:3.50	-
	ii	Parthenogenation	1:0.00	1:0.00		1:0.00	1:0.00		1:0.00	1:0.00	

The increasing order of fecundity of red spider mite on the three host plants (Tab. 2) are Brinjal <Marigold<Okra. The mated female laid average86.50±14.49 eggs in 10.40±2.01 days in Okra, 72.80±15.85 eggs in 8.80±1.32 days in Marigold and 71.90±14.45 eggs in 10.00±1.89 days in Brinjal, while unmated female were 24.20±4.08 eggs in 6.80±1.14days, 26.80±7.24 eggs in 6.90±0.88 days and 29.00±7.12eggs in7.10±1.20 daysin Brinjal, Marigold and Okra, respectively. The number of eggs laid per day matedfemale in decreasing order was 8.70±2.06, 8.40±1.71 and 7.70±1.49, Okra, Brinjal and Marigold, respectively. Mated female produced a progeny of both males and females in the ratio of 1: 2.00 to 1:3.50 whereas, the unmated females produced only males (Tab. 2).

Discussion

The comparative biology of red spider mite was studied on three host plant Brinjal, Okra and Marigold. The lifecycle of red spider mite was consisting of egg, larvae, protonymph, deutonymph and adult stages. The total lifecycle of red spider mite was found to be longest on Marigold followed by Okra and Brinjal for both male and female. This is clear evidence that red spider mite can complete many generations in a season on host plats favourable for its development causing heavy damage symptoms. The result can be used for the control of red spider mite in other ways that short duration spraying would be more effectiveness for red spider mite. Since, red spider mite has a life cycle between 18-25 days, miticides spray interventions can be done in 2-3 week intervals to manage the overlapping populations of red spider mite in the different host plants. The present studyis more or less similar to the earlier findings Kasap (2004) [4], Satish *et al.*, (2018) [14], Siddhapara and Virani (2018) [18] and Aswath and Bhaskar (2014) [3] also observed that the total life cycle (egg to adult) ranged from 17 to 29 days for *T. urticae* on different host plants.

The period of egg and larval and nymphal stages (protonymph, deutonymph) of red spider mite was varied among the host crops, being longest on Marigold followed by Okra andBrinjal. Siddhapara and Virani (2018) [18], Kumar *et al.* (2013) [8] and Shah and Shukla (2014) [17] reported similar finding that the egg, larval and nymphal period of *T. urticae*in different host crops. Longevity of adults was found to be longest in Okra indicating that the adult can cause damage for longer periods comparatively other host plants. Fecundity was observed to be relatively lowest in Brinjal as compared to the rest of the host crops. These results also more or less similar to the earlier findings, Prasad and Singh (2011) [11], Satish *et al.*, (2018) [14], Sejalia *et al.*, (1993) [16] and Puja and Jandial (2009) [12] alsorecorded fecundity, sex ratio and ovipositional period indifferent host crops. Manjunatha and Puttaswamy (1989) [9] recorded a sex ratio (1:10) in mites on French beans. (Kaur *et al.*, 2012) [5] reported unmated females exhibit parthenogenesis.

The red spider mites, *T. urticae* showed relatively better developed on Marigold and least development on Brinjal. The

poor performance of red spider mites on Brinjal may be attributed to the low fecundity. The reason for relatively lower fecundity and development of mite in Brinjal may be due to dense hairs on the ventral side of leaf. This finding is in similar with the reports of Steinite and Ievinsh (2003) [20] that dense hairy leaf cultivars of strawberry confer resistance to *T. urticae*, compared to the low hair varieties of. This may be due to the reduced physical activity and movement on the leaves with high dense hairs. Other probable reasons may be due to the presence of alellochemicals and morphological features present in the variety (Pietrosiuk *et al*. 2003 and Agrawal 2000) [10, 1].

Another reason to evaluate the growth potential of a red spider mite population under specific food and climatic conditions, as it reflects the effects of temperature and food on pest development, survival and reproduction (Southwood and Handerson, 1978) [19]. The increase in temperature enables these red spider mites to fastmultiply and attain pest status especially during the hotter and drier months of the year.

Conclusion

In these three host plants, brinjalare most preferred to *T. urticae* and suitable for their growth, development, survival and reproduction than other host plants.

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References

1. Agrawal AA. Host range evolution: adaptation of mites and trade-offs in fitness on alternate hosts. Ecol. 2000;81:500-508.
2. Amala U, Chinniah C, Yadav DS, Phad DS. Comparative biology and fertility parameters of two spotted spider mite, *Tetranychus urticae* Koch. on different grapevine varieties. 2016;55:31-36. DOI: http://dx.doi.org/10.5073/vitis.
3. Aswathi KR, Bhaskar H. Biology of two-spotted spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae) on okra. Asian Journal of Biological and Life Sciences. 2014;3(2):97-101.
4. Kasap I. Effect of apple cultivar and of temperature on the biology and life table parameters of the two spotted spider mite *Tetranychus urticae*. *Phytoparasitica*, 2004;32(1):73-82.
5. Kaur P, Dhooria MS, Bhullar MB. Development of two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) on rose. Journal of Research. 2012;43(2):117-20.
6. Kavitha J, Bhaskaran EV, Gunasekaran RK. Evaluation of new acaricides against two spotted spider mite, *Tetranychus urticae* Koch on bhendi. Acarology. 2007;17(1&2):77-8.
7. Kulkarni NS, Mani M, Banerjee K. Management of Mites on Grape. Extension Folder 15. National Research Centre for Grape, (ICAR), Manji Farm, Pune, Maharashtra, India; c2008.
8. Kumar S, Chinniah V, Muthiah C, Sivasub ramanian C. Influence of temperature on the biology of two spotted spider mite, Tetranychus urticae Koch. on brinjal. Curr. *Biotica* 2013;7:236-240.
9. Manjunatha M, Puttaswamy. Life history of *Tetranychus neocaledonicus* (Acari: Tetranychidae) under green house conditions. Journal of Acarology. 1989;11(1&2):35-40.
10. Pietrosiuk A, Furmanowa M, Kropc zynska D, Kawka B, Wiedenfeld H. Life history parameters of the two-spotted spider mite (*Tetranychus urticae* Koch) feeding on bean leaves treated with pyrrolizidine alkaloids. J Appl. Toxicol. 2003;23:187-190.
11. Prasad R, Singh J. Studies on biology of carmine spider mite, *Tetranychus urticae* Koch on brinjal. Journal of Insect Science. 2011;24(1):1-5.
12. Puja R, Jandial V. Comparative biology of carmine spider mite, *Tetranychus cinnabarinus* Boisduval (Prostigmata: Tetranychidae) infesting marigold. Indian Journal of Entomology. 2009;71(4):34-39.
13. Rajakumar E, Hugar PS, Patil BV. Biology of red spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae) on jasmine. Karnataka-Journal-of-Agricultural-Sciences. 2005;18(1):147-149.
14. Satish SB, Pradeep S, Narayanaswamy M, Manjunatha M. Biology of red spider mite, *Tetranychus macfarlanei* baker and pritchard on soybean. International Journal of Microbiology Research. 2018;10(9):1370-1373.
15. Satish SB, Pradeep S, Narayanaswamy M, Manjunatha M. Biology of red spider mite, *Tetranychus macfarlanei* baker and pritchard on soybean. International Journal of Microbiology Research. 2018;10(9):1370-1373.
16. Sejalia AS, Rai AB, Patel CB, Radadia GG. The biological aspect of *Tetranychus macfarlanei* (Acari: Tetranychidae) infesting okra (*Abelmoschus esculentum*) in south Gujarat. GAU Research Journal. 1993;19(1):32-37.
17. Shah DR, Shukla A. Biology of spider mite *Tetranychus urticae* (Koch) (Acari: Tetranychidae) on gerbera. Pest Management in Horticultural Ecosystem. 2014;20(2):162-169.
18. Siddhapara MR, Virani VR. Biology of two spotted red spider mite *Tetranychus urticae* (Acari: tetranychidae) on okra. Indian Journal of Entomology. 2018;80(1):90-94.
19. Southwood TRE, Handerson PA. Ecological Methods. Blackwell Science Ltd., Oxford, 1978.
20. Steinite I, Ievinsh G. Possible role of trichomes in resistance of strawberry cultivars against spider mite. Acta Univ. Latviensis 2003;662:59-65.