Persian J. Acarol., 2025, Vol. 14, No. 2, pp. 253–262.
https://doi.org/10.22073/pja.v14i2.86318
Journal homepage: http://www.biotaxa.org/pja

Article

# The role of host plant resistance as a critical factor for the management of *Tetranychus urticae* (Acari: Tetranychidae) in strawberry

**Hassan Ansari-Shiri[1], Hamidreza Hajiqanbar[1†], Myron P. Zalucki[2] and Yaghoub Fathipour[1*]**

1. *Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran; E-mails: h.ansari@modares.ac.ir, hajiqanbar@modares.ac.ir, fathi@modares.ac.ir*
2. *School of Biological Sciences, The University of Queensland, St. Lucia, Queensland 4072, Australia; E-mail: m.zalucki@uq.edu.au*

† Deceased
* Corresponding author

**ABSTRACT**
The two-spotted spider mite (TSSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is a significant pest of strawberries, both in greenhouse and field conditions. Research was conducted to evaluate the impact of seven different strawberry cultivars (Albion, Gaviota, Camarosa, Paros, Ventana, Sabrina, and Selva) on the life history of TSSM under laboratory conditions at 25 ± 1 °C, 65 ± 5% RH, and a photoperiod of 16:8 (L:D). The results showed that the pre-adult duration varied significantly from 8.95 to 9.92 days, where Albion and Gaviota had the longest (9.69 and 9.92 days, respectively), while Ventana had the shortest duration (8.59 days). Female longevity was longer on Albion compared to other cultivars, but there was no significant difference among the other cultivars tested. The highest fecundity was observed on Sabrina and Gaviota (113 and 108 eggs/female, respectively), while the lowest was recorded on Paros (67.97 eggs/female). TSSM had the highest intrinsic rate of increase (*r*) and finite rate of increase (λ) (0.265 $d^{-1}$ and 1.304 $d^{-1}$, respectively) on Sabrina, while on Albion had the lowest ones (0.230 $d^{-1}$ and 1.259 $d^{-1}$, respectively). The results indicated that TSSM preferred Sabrina, while Albion was less favorable for this phytophagous mite. This information can be useful for designing an integrated pest management programs to control the TSSM population.

**KEYWORDS:** Antibiosis, life table, resistant host plant, strawberry cultivars, two-spotted spider mite.

**PAPER INFO.:** Received: 19.10.2024, Accepted by: *A. Farazmand*, 02.12.2024, Published: 15.04.2025

## INTRODUCTION

Strawberry is an herbaceous plant from the Rosaceae family. It is an economically important product and a rich source of antioxidants (Livinali *et al*. 2014), which has led to its cultivation around the world (Zhou *et al*. 2023). However, one of the most common pests on strawberry in fields and greenhouses is the two-spotted spider mite (TSSM), *Tetranychus urticae* Koch, which is a generalist feeder with a wide host range (Monteiro *et al*. 2014). By feeding on plant cells, this pest causes paleness and necrosis. In high population density, it can reduce the yield and even destroy the plants (Meck *et al*. 2013; Nyoike and Liburd 2013).

**How to cite:** Ansari-Shiri, H., Hajiqanbar, H., Zalucki, M.P. & Fathipour, Y. (2025) The role of host plant resistance as a critical factor for the management of *Tetranychus urticae* (Acari: Tetranychidae) in strawberry. *Persian Journal of Acarology*, 14(2): 253–262.

To combat the TSSM, the acaricides like abamectin, spiromesifen, and etoxazole are commonly used (Aly *et al*. 2023), however, the effectiveness of these pesticides has been decreased due to the rapid development of resistance (Marques-Francovig *et al*. 2014). Additionally, these chemicals can harm human health and cause pollution in the environment, especially on fresh products (Himanen *et al*. 2005).

One of the best alternative strategies for managing TSSM population is to utilize resistant host plant cultivars (Follett 2017). This technique is advantageous when combined with a more comprehensive pest control program. Resistant cultivars can significantly decrease the population density of this pest, reduce herbivory damage, enhance predator effectiveness, and decrease the necessity for pesticides (Osman *et al*. 2019).

Extensive research has been conducted on the resistance of various host plant cultivars, including soybean, bean, cucumber, eggplant, and strawberry to the TSSM (Razmjou *et al*. 2009; Sedaratian *et al*. 2011; Khanamani *et al*. 2013; Maleknia *et al*. 2016; Karlec *et al*. 2017). Each host cultivar displays different levels of resistance including strawberry (Gugole Ottaviano *et al*. 2013; Rezaie *et al*. 2013). Different cultivars of strawberry plants contain varying levels of substances and chemical compounds that can affect the growth and reproductive rates of TSSM (Buricova *et al.* 2011). To determine how resistant host plants affect TSSM, researchers utilized the life table parameters to get a better understanding of how long it takes for TSSM to develop, survive, and grow when it feeds on different host plants. This research aims to investigate an analytical approach to the impact of new strawberry cultivars on the life table parameters of TSSM, which will be useful for designing a comprehensive package for managing destructive populations of this serious pest.

## MATERIALS AND METHODS

*Plant cultivation*

Bare-root seedlings of seven strawberry cultivars, including Camarosa, Sabrina, Paros, Gaviota, Albion, Ventana, and Selva were obtained from the Agricultural Organization of Kurdistan Province, Sanandaj, western Iran. Twenty seedlings of each cultivar were planted in plastic pots (14 cm diameter and 30 cm height) filled with a mix of leaf mold and soil (ratio 1:1), inside a greenhouse at 25 ± 5 °C, 65 ± 10% RH, and natural photoperiod. To ensure that all experiments were conducted under the same conditions, all plants were watered simultaneously. No fertilizers or pesticides were used on any plants during the experiments.

*Stock culture of TSSM*

An initial population of TSSM was maintained on bean plants (*Phaseolus vulgaris* variety of Khomein) in a greenhouse under natural photoperiod, temperature of 25 ± 5 °C, and a relative humidity of 65 ± 10%. Fresh bean seedlings were regularly supplied to the TSSM stock culture. The stock colony was reared for several generations before experimentation.

*Experimental setup*

The experimental setup involved a rearing unit consisting of a whole leaf of strawberries placed on several cotton threads inside a water-containing Petri dish (6 × 1 cm in diameter and height, respectively). To maintain the freshness of the rearing arena, old leaflets were replaced with fresh ones every four days.

Twenty adult males and females of TSSM were isolated from the stock colony on bean plants and moved to different leaf discs of strawberry cultivars. For the experiments, 70 same-aged eggs (< 24 hours old) were used. Each egg was transferred individually using a 000 brush to the leaf discs. The pre-adult stages were monitored daily by stereomicroscope. After the emergence of adults, males and females were mated, and their survival and fecundity were recorded until the death of the last individual. The leaves of the discs were replaced with fresh ones every four days. All experiments were conducted under laboratory conditions at 25 ± 1 °C, 65 ± 5% RH, and a photoperiod of 16:8 (L: D) h.

*Statistical analysis*

The study used the age-stage, two-sex procedure (Chi and Liu 1985; Chi 1988) to obtain the life table parameters for TSSM on different strawberry cultivars. The TWOSEX-MSChart software (Chi 2023), which uses the bootstrap resampling technique was used to calculate all parameters. The study employed 100,000 resamplings to estimate the standard errors and variances of different life table parameters. Instead of ANOVA multiple comparisons based on variance, the study used the paired bootstrap test to evaluate the differences in all parameters.

## RESULTS

*Duration of different life stages, survival rate, and fecundity*

The duration of different developmental stages of TSSM varied significantly on different strawberry cultivars, as shown in Table 1. Gaviota and Albion took the longest to reach adulthood (9.92 and 9.69 days, respectively), while Ventana took the shortest (8.59 days). In terms of female longevity, Albion (25.88 days) had the longest period, while there was no significant difference among the other cultivars. Camarosa (25.61 days) had the longest male longevity, while the shortest period was recorded on Paros (12.58 days). The total lifespan of TSSM on Albion (35.82 days) was the longest, and that on Ventana (25.19 days) the shortest. The age-stage survival rate curves suggest that the TSSM can thrive on all tested cultivars and complete its life cycle (Fig. 1). However, the cultivars had a slight impact on TSSM pre-adult survival. The survival rates of TSSM pre-adults ranged from 0.86 to 0.97.

**Table 1.** Mean (± SE) duration of different life stages and fecundity of *Tetranychus urticae* on different strawberry cultivars. All parameters in days except for Fecundity (eggs/female).

| Parameters | Sabrina | Camarosa | Gaviota | Ventana | Selva | Albion | Paros |
|---|---|---|---|---|---|---|---|
| **Egg** | 4.02 ± 0.13ab | 3.73 ± 0.07c | 4.07 ± 0.07ab | 4.06 ± 0.06ab | 3.88 ± 0.09bc | 4.14 ± 0.07a | 3.69 ± 0.10c |
| **Larva** | 1.80 ± 0.10bc | 1.69 ± 0.10bc | 2.15 ± 0.13a | 1.53 ± 0.10c | 1.81 ± 0.08b | 1.83 ± 0.09b | 1.89 ± 0.09ab |
| **Protonymph** | 1.71 ± 0.10a | 1.65 ± 0.08ab | 1.67 ± 0.10ab | 1.42 ± 0.09b | 1.62 ± 0.10ab | 1.69 ± 0.09a | 1.81 ± 0.10a |
| **Deutonymph** | 1.59 ± 0.08b | 1.88 ± 0.15ab | 2.00 ± 0.10a | 1.56 ± 0.09b | 1.84 ± 0.09ab | 2.03 ± 0.10a | 1.91 ± 0.12a |
| **Preadult** | 9.11 ± 0.18b | 8.97 ± 0.19bc | 9.92 ± 0.18a | 8.59 ± 0.12c | 9.16 ± 0.18b | 9.69 ± 0.15a | 9.23 ± 0.17b |
| **Female longevity** | 19.03 ± 1.87b | 19.97 ± 1.63b | 19.64 ± 1.51b | 17.96 ± 1.56b | 20.28 ± 1.07b | 25.88 ± 1.90a | 18.58 ± 1.66b |
| **Male longevity** | 23.49 ± 3.58ab | 25.61 ± 2.45a | 18.00 ± 1.47bc | 14.00 ± 2.50cd | 18.17 ± 3.80acd | 26.89 ± 5.36ab | 12.58 ± 1.88d |
| **Total life span** | 29.34 ± 1.61bc | 30.31 ± 1.39b | 29.18 ± 1.20b | 25.19 ± 1.40c | 29.04 ± 1.07b | 35.82 ± 1.91a | 26.61 ± 1.43bc |
| **APOP** | 1.20 ± 0.08a | 1.39 ± 0.15a | 1.18 ± 0.12a | 1.29 ± 0.14a | 1.31 ± 9.13a | 1.42 ± 9.78a | 1.43 ± 9.37a |
| **TPOP** | 10.32 ± 0.25c | 10.39 ± 0.30bc | 11.18 ± 0.29ab | 10.10 ± 0.22c | 10.50 ± 0.21bc | 11.35 ± 0.22a | 10.64 ± 0.23bc |
| **Oviposition days** | 15.95 ± 1.50b | 14.83 ± 1.08b | 17.04 ± 1.27ab | 14.81 ± 0.94b | 15.58± 0.89b | 19.76 ± 1.11a | 14.86 ± 1.25b |
| **Fecundity** | 113.50 ± 14.53a | 92.94 ± 10.42abc | 88.18 ± 8.81abc | 108.19 ± 6.42a | 81.26± 6.26bc | 94.89 ± 7.88ab | 67.97 ± 7.46c |

* Means followed by different letters in the same row are significantly different using the paired bootstrap test at a 5% significance level.

** *APOP* adult pre-oviposition period; *TPOP* total pre-oviposition period (from egg to first oviposition).

According to Table 1, the reproductive period of TSSM was affected by various cultivars, except APOP. The fecundity of TSSM varied from 67.97 to 113.50 eggs/female on different cultivars. The

Sabrina cultivar caused the highest fecundity, while the Paros cultivar caused the lowest. Figure 2 shows that TSSM reproduced on all cultivars tested. The age-specific fecundity ($m_x$) and age-stage-specific fecundity ($f_{xj}$) demonstrate the daily oviposition patterns of TSSM throughout its lifespan. The Sabrina cultivar caused the highest daily fecundity (7.12 eggs/female/day) at the age of 18 (Fig. 2).

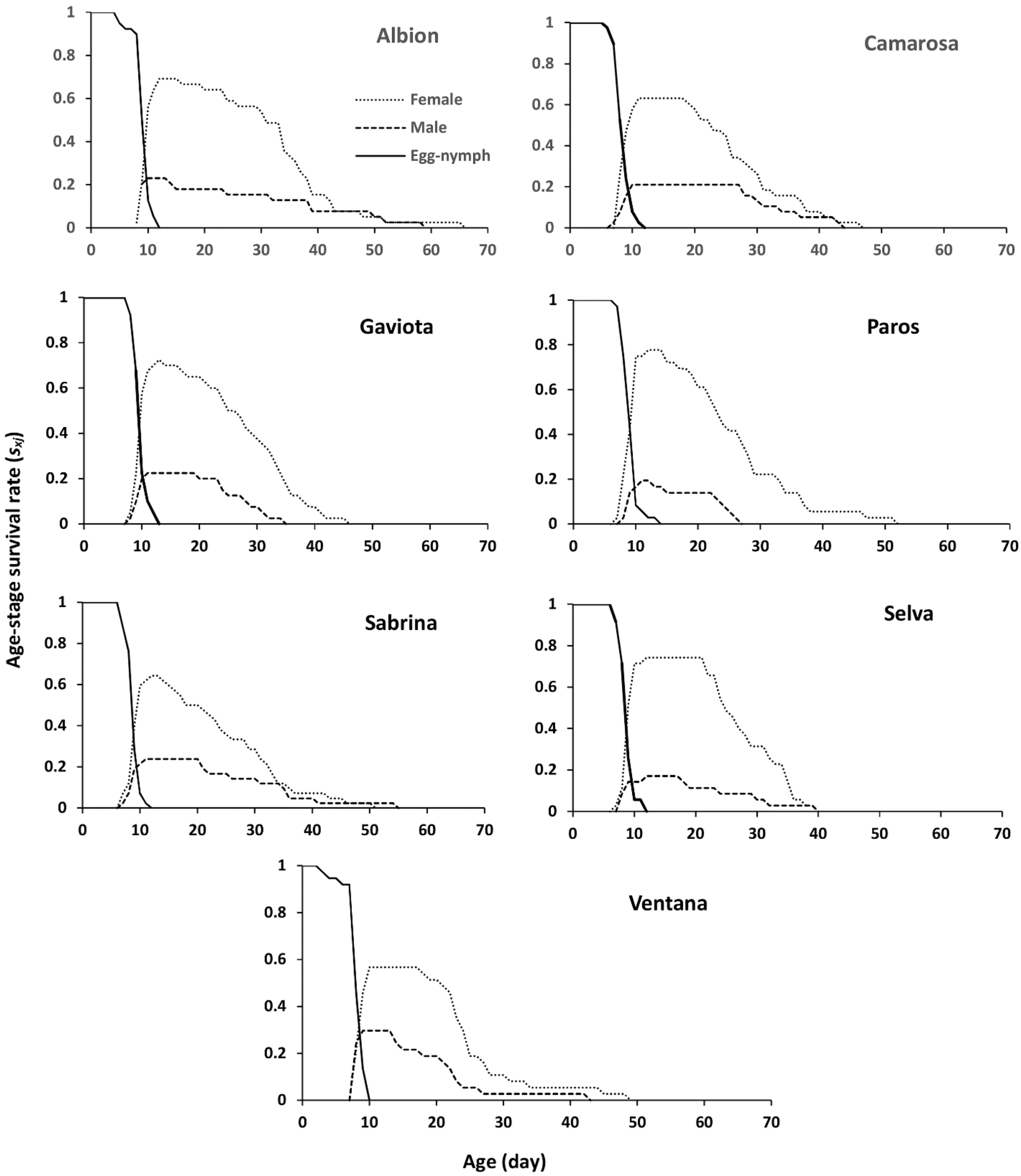


**Figure 1.** The age-stage-specific survival rate ($s_{xj}$) of *Tetranychus urticae* on different strawberry cultivars.

*Population growth parameters*

Table 2 displays the population parameters of TSSM on different strawberry cultivars. The values of gross reproductive rate (*GRR*) and net reproductive rate ($R_0$) on the cultivars were not significantly different. The $R_0$ and *GRR* values on different cultivars varied between 60.36–73.00 and 74.10–109.75 (eggs/individual), respectively. The TSSM demonstrated the highest and lowest intrinsic rate of increase (*r*) and finite rates of increase (λ) on Sabrina (0.265 and 1.304 day$^{-1}$, respectively) and Albion (0.230 and 1.259 day$^{-1}$, respectively). Finally, it was observed that the mean generation time (*T*) was longer on Albion (18.13 days) compared to the other cultivars (Table 2).

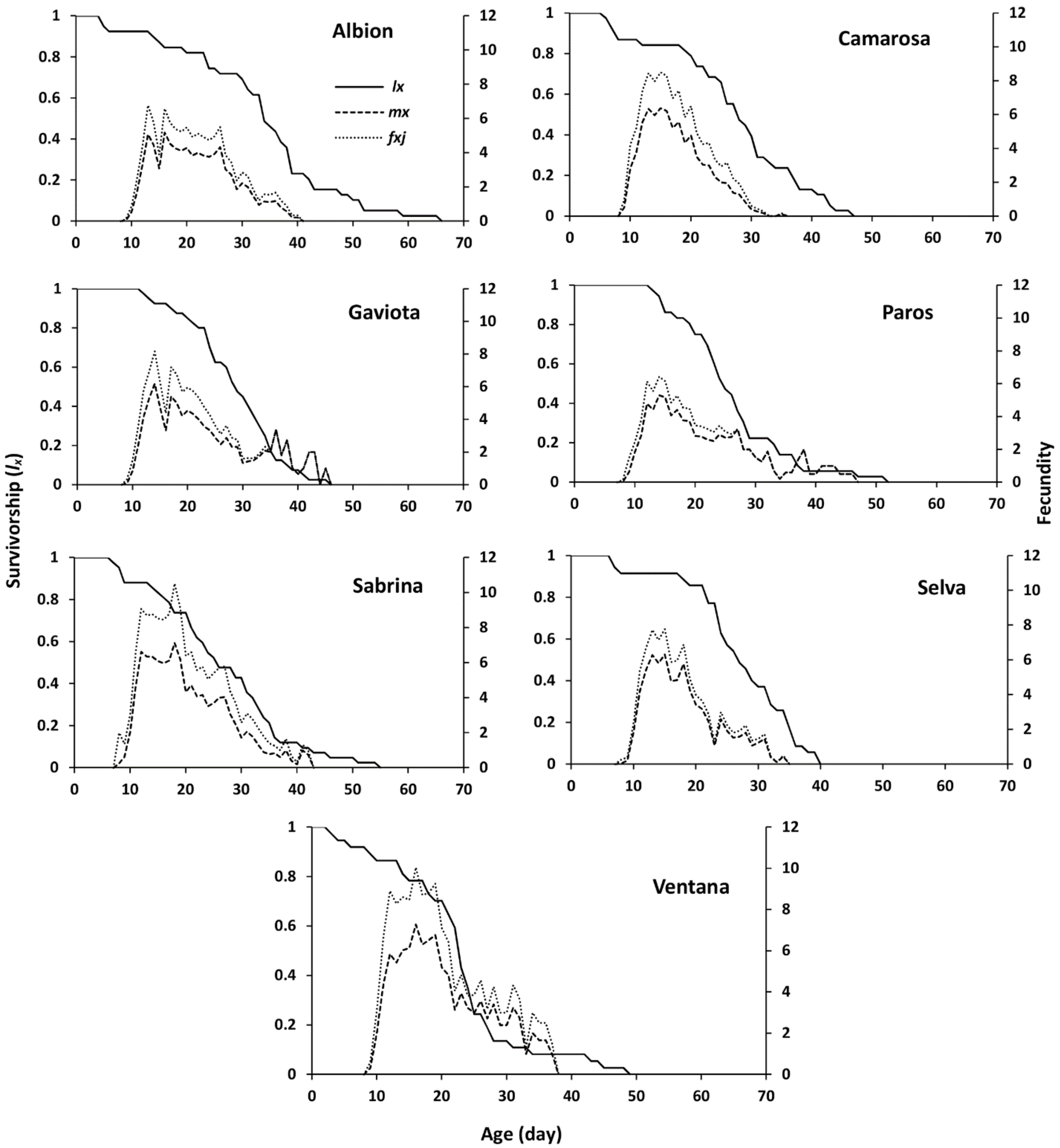


**Figure 2.** The age-specific survivorship ($l_x$), age-specific fecundity ($m_x$) and age-stage-specific fecundity ($f_{xj}$) of *Tetranychus urticae* on different strawberry cultivars.

**Table 2.** Population growth parameters (Mean ± SE) of *Tetranychus urticae* on different strawberry cultivars.

| Cultivars | *GRR* (eggs/individual) | $R_0$ (eggs/individual) | $r$ (day$^{-1}$) | $\lambda$ (day$^{-1}$) | $T$ (day) |
|---|---|---|---|---|---|
| **Sabrina** | 109.75 ± 17.97a | 73.00 ± 12.50a | 0.265 ± 0.012a | 1.304 ± 0.016a | 16.12 ± 0.36bc |
| **Camarosa** | 77.73 ± 11.59a | 61.14 ± 9.86a | 0.259 ± 0.012ab | 1.296 ± 0.016ab | 15.83 ± 0.28c |
| **Gaviota** | 98.06 ± 15.42a | 66.14 ± 8.93a | 0.245 ± 0.009ab | 1.277 ± 0.012ab | 17.10 ± 0.40ab |
| **Ventana** | 107.81 ± 15.80a | 61.40 ± 9.52a | 0.257 ± 0.011ab | 1.293 ± 0.014ab | 15.98 ± 0.35c |
| **Selva** | 74.10 ± 8.35a | 60.36 ± 7.56a | 0.259 ± 0.008a | 1.295 ± 0.011a | 15.83 ± 0.21c |
| **Albion** | 83.69 ± 10.10a | 65.66 ± 8.87a | 0.230 ± 0.009b | 1.259 ± 0.011b | 18.13 ± 0.41a |
| **Paros** | 81.85 ± 11.76a | 52.88 ± 7.46a | 0.250 ± 0.010ab | 1.284 ± 0.013ab | 15.86 ± 0.34c |

* Means followed by different letters in the same column are significantly different using the paired bootstrap test at a 5% significance level.

** *GRR* gross reproductive rate; $R_0$: net reproductive rate; $r$: intrinsic rate of increase; $\lambda$: finite rate of increase; $T$: mean generation time.

## DISCUSSION

When it comes to pest control, it's crucial to evaluate the impact of different plant cultivars on pest populations. Life table analysis is an effective technique that can be used for this purpose (Chi *et al*. 2023). To better understand the growth, development, and reproduction of populations, several parameters such as development time, fecundity, intrinsic rate of increase ($r$), finite rate of increase ($\lambda$), and net reproductive rate ($R_0$) should be evaluated (Afifi *et al*. 2010; Rezaie *et al*. 2013). It has been shown in previous studies that the plants which serve as hosts for TSSM like bean (Razmjou *et al*. 2009), cucumber (Maleknia *et al*. 2016), soybean (Sedaratian *et al*. 2011), eggplant (Khanamani *et al*. 2013), and strawberry (Ferrer *et al*. 1993; Azadi Dana *et al*. 2018; Vásquez *et al*. 2018) vary in their resistance to the TSSM.

The results of the current research showed that the pre-adult stages of TSSM, including egg hatching, larva, protonymph, and deutonymph varied significantly across different cultivars. The egg duration varied slightly among cultivars, which is in line with previous studies on strawberry cultivars (Esteca *et al*. 2017; Karlec *et al*. 2017). In contrast, the difference with some studies (Monteiro *et al*. 2014; Azadi Dana *et al*. 2018) is probably due to the effects of the last host or the differences in rearing methods. The pre-adult duration of TSSM varied among different cultivars, with slightly shorter values observed in Selva and Albion compared to previously reported data for the same cultivars (Gugole Ottaviano *et al*. 2013). In addition, the duration of this stage on the Paros cultivar was shorter than what was reported by Azadi Dana *et al*. (2018). However, the pre-adult stage of TSSM on the Albion, Camarosa, and Ventana cultivars was found to be longer (Karlec *et al*. 2017) compared to the values obtained in the present study. These differences are likely attributed to variations in the rearing conditions before the experiment, the methodology of the experiment, environmental conditions, and even rearing generations on each cultivar.

One of the parameters significantly influenced by a strawberry cultivar was fecundity. The Sabrina cultivar was the most desirable for TSSM, showing the highest fecundity. In contrast, the Paros cultivar exhibited the lowest mite fecundity, highlighting its less suitability for TSSM. Additionally, the study found that Camarosa, Albion, and Selva were not statistically different, which confirms the research conducted by Gugole Ottaviano *et al*. (2013). Rather than fecundity, demographic parameters such as $r$ and $\lambda$ are more convenient in determining the resistance of different cultivars to the TSSM. The values of r and λ differed significantly among cultivars. These differences may result from variations in cultivar quality. Our findings indicated that the Sabrina cultivar caused the highest $r$ and λ (0.265 and 1.304 day$^{-1}$, respectively), while the Albion cultivar caused the lowest (0.230 and 1.259 day$^{-1}$, respectively). This study found that the Sabrina cultivar was highly favorable to the TSSM, while Albion was the least favorable. Strawberry leaves contain essential nutrients like sugar, amino acids, and antioxidants that support the growth and reproduction of TSSM (Buricova *et al*. 2011; Livinali *et al*. 2014). However, secondary metabolites such as phenol in strawberry leaves negatively affect the growth, reproduction, and population increase of TSSM (Luczynski *et al*. 1990a, b). The amount of these metabolites varies among strawberry cultivars (Akhatou *et al*. 2016) and affects their attractiveness to TSSM (El-Sawi 2006; Esteca *et al*. 2017; Karlec *et al*. 2017; Azadi Dana *et al*. 2018; Gong *et al*. 2018).

Overall, our findings suggest that the TSSM clearly prefers Sabrina, while Albion is significantly less attractive for this phytophagous mite. Therefore, it is important to consider the selection of strawberry cultivars when designing integrated pest management strategies to control TSSM.

## ACKNOWLEDGEMENTS

This study is a part of the Ph. D. thesis of the first author. The financial support from Tarbiat Modares University (Grant No. 9830462002) is greatly appreciated.

## REFERENCES

Afifi, A.A.M., El-Laithy, A.Y., Shehata, S.A. & El-Saiedy, E.S.M. (2010) Resistance of strawberry plants against the two-spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae). *In*: Sabelis, M.W. & Bruin, J. (Eds.), *Trends in Acarology: Proceedings of the 12th International Congress of Acarology*, pp. 505–507.

Akhatou, I., González-Domínguez, R. & Fernández-Recamales, Á. (2016) Investigation of the effect of genotype and agronomic conditions on metabolomic profiles of selected strawberry cultivars with different sensitivity to environmental stress. *Plant Physiology and Biochemistry*, 101: 14–22. DOI: 10.1016/j.plaphy.2016.01.016

Aly, M.F., Van Timmeren, S. & Isaacs, R. (2023) Efficacy of insecticides for control of two-spotted spider mites in strawberries, 2022. *Arthropod Management Tests*, 48(1): tsad029. DOI: 10.1093/amt/tsad029

Azadi Dana, E., Sadeghi, A., Güncan, A., Khanjani, M., Babolhavaeji, H. & Maroufpoor, M. (2018) Demographic comparison of the *Tetranychus urticae* Koch (Acari: Tetranychidae) reared on different cultivars of strawberry. *Journal of Economic Entomology*, 111(6): 2927–2935. DOI: 10.1093/jee/toy242

Buricova, L., Andjelkovic, M., Cermakova, A., Réblová, Z., Jurcek, O., Kolehmainen, E. & Kvasnicka, F. (2011) Antioxidant capacities and antioxidants of strawberry, blackberry and raspberry leaves. *Czech Journal of Food Sciences*, 29(2): 181–189. DOI: 10.17221/300/2010-CJFS

Chi, H. (1988) Life-table analysis incorporating both sexes and variable development rates among individuals. *Environmental Entomology*, 17(1): 26–34.

Chi, H. (2023) TWOSEX-MSChart: A computer program for the age-stage, two-sex life table analysis. Available from: http://140.120.197.173/Ecology/Download/TWOSEX-MSChart.rar (Accessed on 10 April 2023)

Chi, H., Kavousi, A., Gharekhani, G., Atlihan, R., Özgökçe, M.S., Güncan, A. & Desneux, N. (2023) Advances in theory, data analysis, and application of the age-stage, two-sex life table for demographic research, biological control, and pest management. *Entomologia Generalis*, 43(4): 705–35.

Chi, H. & Liu, H. (1985) Two new methods for the study of insect population ecology. *Bulletin of* *the Institute of Zoology, Academia Sinica*, 24(2): 225–240.

El-Sawi, S.A. (2006) Effect of different strawberry cultivars on the development and fecundity of the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), with special reference to their chemical contents. *Annals of Agricultural Sciences*, 51(1): 295–302.

Esteca, F.D.C.N., Dainese, C.D.N., Rodrigues, L.R., Lourenção, A.L., Passos, F.A. & Moraes, G.D. (2017) Resistance of new strawberry genotypes to the two-spotted spider mite (Acari: Tetranychidae). *Journal of Agricultural Science*, 9(8): 119–129. DOI: 10.5539/jas.v9n8p119

Ferrer, R.M.G., Scheerens, J.C. & Erb, W.A. (1993) In vitro screening of 76 strawberry cultivars for two spotted spider mite resistance. *HortScience*, 28(8): 841–844. DOI: 0.21273/HORTSCI.28.8.841

Follett, P.A. (2017) Insect-plant interactions: Host selection, herbivory, and plant resistance-an introduction. *Entomologia Experimentalis et Applicata*, 162(1): 1–3. DOI: 10.1111/eea.12524

Gong, Y.J., Chen, J.C., Zhu, L., Cao, L.J., Jin, G.H., Hoffmann, A.A., Zhong, C.-F., Wang, P., Lin, G. & Wei, S.J. (2018) Preference and performance of the two-spotted spider mite *Tetranychus urticae* (Acari: Tetranychidae) on strawberry cultivars. *Experimental and Applied Acarology*, 76: 185–196. DOI: 10.1007/s10493-018-0295-2

Gugole Ottaviano, M.F., Sánchez, N.E., Roggiero, M.F. & Greco, N.M. (2013) Performance of *Tetranychus urticae* and *Neoseiulus californicus* on strawberry cultivars and assessment of the effect of glandular trichomes. *Arthropod-Plant Interactions*, 7(5): 547–554. DOI: 10.1007/s11829-013-9268-x

Himanen, S., Vuorinen, T., Tuovinen, T. & Holopainen, J. K. (2005) Effects of cyclamen mite (*Phytonemus pallidus*) and leaf beetle (*Galerucella tenella*) damage on volatile emission from strawberry (Fragaria× ananassa Duch.) plants and orientation of predatory mites (*Neoseiulus cucumeris*, *N. californicus*, and *Euseius finlandicus*). *Journal of Agricultural and Food Chemistry*, 53(22): 8624–8630. DOI: 10.1021/jf050676j

Karlec, F., Duarte, A.D.F., Oliveira, A.C.B.D. & Cunha, U.S.D. (2017) Development of *Tetranychus urticae* Koch (Acari: Tetranychidae) in different strawberry cultivars. *Revista Brasileira de Fruticultura*, 39(1): e-171. DOI: 10.1590/0100-29452017171

Khanamani, M., Fathipour, Y. & Hajiqanbar, H. (2013) Population growth response of *Tetranychus urticae* to eggplant quality: application of female age-specific and age-stage, two-sex life tables. *International Journal of Acarology*, 39(8): 638–648. DOI: 10.1080/01647954.2013.861867

Livinali, E., Sperotto, R.A., Ferla, N.J. & Souza, C.F.V.D. (2014) Physicochemical and nutritional alterations induced by two-spotted spider mite infestation on strawberry plants. *Electronic Journal of Biotechnology*, 17(5): 193–198. DOI: 10.1016/j.ejbt.2014.06.002

Luczynski, A., Isman, M.B. & Raworth, D.A. (1990a) Strawberry foliar phenolics and their relationship to development of the two spotted spider mite. *Journal of Economic Entomology*, 83(2): 557–563. DOI: 10.1093/jee/83.2.557

Luczynski, A., Isman, M.B., Raworth, D.A. & Chan, C.K. (1990b) Chemical and morphological factors of resistance against the two spotted spider mite in beach strawberry. *Journal of Economic Entomology*, 83(2): 564–569. DOI: 10.1093/jee/83.2.564

Maleknia, B., Fathipour, Y. & Soufbaf, M. (2016) How greenhouse cucumber cultivars affect population growth and two-sex life table parameters of *Tetranychus urticae* (Acari: Tetranychidae). *International Journal of Acarology*, 42(2): 70–78. DOI: 10.1080/01647954.2015.1118157

Marques-Francovig, C.R., Mikami, A.Y., Dutra, V., Carvalho, M.G., Picareli, B. & Ventura, M.U. (2014) Organic fertilization and botanical insecticides to control two-spotted spider mite in strawberry. *Ciência Rural*, 44(11): 1908–1914. DOI: 10.1590/0103-8478cr20131575

Meck, E.D., Kennedy, G.G. & Walgenbach, J.F. (2013) Effect of *Tetranychus urticae* (Acari: Tetranychidae) on yield, quality, and economics of tomato production. *Crop Protection*, 52: 84–90. DOI: 10.1016/j.cropro.2013.05.011

Meyers, K.J., Watkins, C.B., Pritts, M.P. & Liu, R.H. (2003) Antioxidant and antiproliferative activities of strawberries. *Journal of Agricultural and Food Chemistry*, 51(23): 6887–6892. DOI: 10.1021/jf034506n

Monteiro, L.B., Kuhn, T.M.A., Mogor, A.F. & Da Silva, E.D.B. (2014) Biology of the two-spotted spider mite on strawberry plants. *Neotropical Entomology*, 43: 183–188. DOI: 10.1007/s13744-013-0184-7

Nyoike, T.W. & Liburd, O.E. (2013) Effect of *Tetranychus urticae* (Acari: Tetranychidae), on marketable yields of field-grown strawberries in North–Central Florida. *Journal of Economic Entomology*, 106(4): 1757–1766. DOI: 10.1603/EC12033

Osman, M.A., Al Dhafar, Z.M. & Alqahtani, A.M. (2019) Biological responses of the two-spotted spider mite, *Tetranychus urticae* to different host plant. *Archives of Phytopathology and Plant Protection*, 52(17–18): 1229–1238. DOI: 10.1080/03235408.2019.1703299

Razmjou, J., Vorburger, C., Tavakkoli, H. & Fallahi, A. (2009) Comparative population growth parameters of the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), on different common bean cultivars. *Systematic and Applied Acarology*, 14(2): 83–90. DOI: 10.11158/saa.14.2.1

Rezaie, M., Saboori, A., Baniamerie, V. & Allahyari, H. (2013) Susceptibility of *Tetranychus uticae* Koch (Acari: Tetranychidae) on seven strawberry cultivars. *International Research Journal of Applied and Basic Sciences*, 4(9): 2455–2463.

Sedaratian, A., Fathipour, Y. & Moharramipour, S. (2011) Comparative life table analysis of *Tetranychus urticae* (Acari: Tetranychidae) on 14 soybean genotypes. *Insect Science*, 18(5): 541–553. DOI: 10.1111/j.1744-7917.2010.01379.x

Vásquez, C., Pérez, M., Dávila, M., Mangui, J. & Telenchana, N. (2018) Biological parameters of *Tetranychus urticae* Koch (Acari: Tetranychidae) on strawberry cultivars in Ecuador. *Revista Chilena De Entomología*, 44(3): 271−278.

Zhou, C., Lee, W.S., Liburd, O.E., Aygun, I., Zhou, X., Pourreza, A. & Ampatzidis, Y. (2023) Detecting two-spotted spider mites and predatory mites in strawberry using deep learning. *Smart Agricultural Technology*, 4: 100229. DOI: 10.1016/j.atech.2023.100229

# نقش مقاومت گیاه میزبان به عنوان یک فاکتور اساسی برای مدیریت *Tetranychus urticae* (Acari: Tetranychidae) در توت‌فرنگی

**حسن انصاری شیری[۱]، حمیدرضا حاجی‌قنبر[۱*]، مایرون پی. زلوکی[۲] و یعقوب فتحی‌پور[۱**]**

۱. گروه حشره‌شناسی، دانشکدهٔ کشاورزی، دانشگاه تربیت مدرس، تهران، ایران؛ رایانامه‌ها: h.ansari@modares.ac.ir، hajiqanbar@modares.ac.ir، fathi@modares.ac.ir

۲. دانشکدهٔ علوم زیستی، دانشگاه کوئینزلند، سنت لوسیا، کوئینزلند ۴۰۷۲، استرالیا؛ رایانامه: m.zalucki@uq.edu.au

* مرحوم شدند

** نویسندهٔ مسئول

**چکیده**

هرنای تارتن دولکه‌ای (TSSM)، *Tetranychus urticae* Koch (Acari: Tetranychidae)، آفت مهم توت فرنگی هم در شرایط گلخانه و هم مزرعه است. پژوهشی برای ارزیابی تأثیر هفت رقم مختلف توت‌فرنگی (آلبیون، گاویوتا، کاماروسا، پاروس، ونتانا، سابرینا و سلوا) بر تاریخچه زندگی TSSM در شرایط آزمایشگاهی در دمای ۱ ± ۲۵ درجهٔ سلسیوس، رطوبت نسبی ۵ ± ٦۵ درصد و دوره نوری ۱٦:۸ (تاریکی: روشنایی) انجام شد. نتایج نشان داد که طول دورهٔ نابالغ به طور معنی‌داری از ۸/۹۵ تا ۹/۹۲ روز متغیر بود که آلبیون و گاویوتا دارای بیشترین مدت زمان (به ترتیب ۹/٦۹ و ۹/۹۲ روز) بودند، در حالی که ونتانا کوتاه‌ترین مدت زمان (۸/۵۹ روز) را داشت. طول عمر ماده روی آلبیون در مقایسه با سایر ارقام بیشتر بود، اما تفاوت معنی‌داری بین سایر ارقام مورد آزمایش مشاهده نشد. بیشترین باروری روی سابرینا و گاویوتا (به ترتیب ۱۱۳ و ۱۰۸ تخم به ازای هر ماده) و کمترین آن روی پاروس (٦۷/۹۷ تخم به ازای هر ماده) مشاهده شد. TSSM بیشترین نرخ ذاتی (r) و نرخ متناهی افزایش جمعیت (λ) (به ترتیب ۰/۲٦۵ بر روز و ۱/۳۰۴ بر روز) روی سابرینا داشت، در حالی که روی آلبیون کمترین (به ترتیب ۰/۲۳۰ بر روز و ۱/۲۵۹ بر روز) را داشت. نتایج نشان داد که TSSM سابرینا را ترجیح داد، در حالی که آلبیون برای این هرنای گیاهخوار مطلوبیت کمتری داشت. این اطلاعات می‌تواند برای طراحی برنامه مدیریت تلفیقی آفات برای کنترل جمعیت TSSM مفید باشد.

**واژگان کلیدی:** آنتی بیوز، جدول زندگی، گیاه میزبان مقاوم، رقم‌های توت‌فرنگی، هرنای تارتن دولکه‌ای.

**اطلاعات مقاله:** تاریخ دریافت: ۱٤۰۳/۷/۲۸، پذیرش توسط: *آ. فرازمند*، ۱٤۰۳/۹/۱۲، تاریخ چاپ: ۱٤۰٤/۱/۲٦