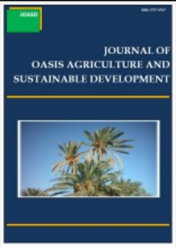
*Journal of Oasis Agriculture and Sustainable Development*
*www.joasdjournal.org*

**RESEARCH ARTICLE**




**JOURNAL OF OASIS AGRICULTURE AND SUSTAINABLE DEVELOPMENT**

**www.joasdjournal.org**

JOASD

p-ISSN: 2724 – 699X
e-ISSN: 2724-7007

# Dynamics of three phytophagous mites *Tetranychus urticae*, *Panonychus citri* and *Eutetranychus orientalis* (Acari, Tetranychidae) on citrus in Tunisia

Chouikhi Sabrine[1*], Sahraoui hajer[2] & Lebdi Grissa Kouather[1]

[1]*Laboratory of Entomology-Acarology, National Agronomic, Institute of Tunisia*

[2] *Citrus Technical Center, Nabeul*

## Article info

Article history:
Received: 20/02/2022
Accepted: 05/05/2022

Keywords: *Tetranychus urticae*, *Panonychus citri*, *Eutetranychus orientalis*, dynamic, citrus

OPEN ACCESS
Copyright©2022 JOASD

*** Corresponding author**
chouikhisabrine22@gmail.com

**Conflict of Interest :** The authors declare no conflict of interest.

## Abstract

Phytophagous mites of the family Tetranychidae are important pests of citrus in Tunisia, reducing the quality of the product in marketing value every year. In this study, the population dynamics of *Tetranychus urticae*, *Panonychus citri* and *Eutetranychus orientalis* were studied in the nursery and in the field from the beginning of February until the end of May. The results showed that the population dynamics of these three mites varied with temperature. The evolution of the *T. urticae* population showed three peaks in February, mid-March and April. In addition, the population of *E. orientalis* showed four peaks in February, March, April and May. For *P. citri*, this mite is active in winter and spring when climatic conditions are favourable for its development. Field monitoring has shown that the fauna of predatory mites linked to these three plant pests is diverse. Three species (*Neoseiulus californicus*, *Phytoseiulus persimilis*, *Euseius stipulatus*) of the phytoseiid family have been identified. Given the diversification of predatory mites and their importance in the regulation of phytophagous mites, it is necessary to favor biological control by conserving these species, for which it is important to reason chemical control.

## 1. INTRODUCTION

In Tunisia, citrus cultivation is a key agricultural sector. Citrus harbor pests that can cause damage. Following the unreasonable use of phytosanitary treatments against the citrus leaf miner in 1994, attacks of phytophagous mites began to reappear, belonging essentially to four families: *Tetranychidae, Tenuipalpidae, Tarsonemidae* et *Eriophyidae* (Lebdi Grissa and Khoufi, 2012). Spider mites (Acari: Tetranychidae) are the most important phytophagous mite pests in agricultural crops worldwide (Hoy and Jeyaprakash, 2005; Walter et al., 1995).This family of mites includes five stages of development, egg, larva (with three pairs of legs), protonymph, deutonymph and adult (with four pairs of legs in the last three stages) (Kasap, 2009). The two-spotted spider mites, *Tetranychus urticae* (Koch), is an extremely polyphagous mite recognized as a major citrus pest in the Mediterranean climate (Jacas et al., 2010). *T. urticae* can damages plant cells, causing chlorotic spots on leaves. Defoliation can occur when a heavy infestation coincides with a lack of water. However, the most serious damage caused by this mite is fruit scarring, which devalues the fruit quality and severely affects the market price (Ansaloni et al., 2008). *T. urticae* causes significant damage, especially on the “Navel” and “Valentia” orange varieties (Pyle and Stevens, 2004). The citrus brown mite, *Eutetranychus orientalis* (Klein), native to the Middle East, is a harmful mite of citrus crops in Australia, Africa and South and East Asia (Walter et al., 1995). It essentially affects all varieties of lemon trees, orange trees and, to a lesser extent, mandarin trees. Detection of symptoms of *E. orientalis* is possible as soon as the female begins to lay her eggs on the upper surface of the leaf, along the central vein going towards the lateral secondary veins (Lebdi and Dhouibi, 2002). Another species of spider mites, the citrus red mite, *Panonychus citri* (McGregor) is one of the most important pest mite species reported in almost all citrus growing regions of the world (Gerson, 2003; Kasap, 2009). Adults and larvae of P. citri prefer the upper surfaces of mature citrus leaves. Orange, lemon and tangerine trees are severely affected by this mite, as its high population densities in hot, dry spring conditions can cause severe defoliation and branch dieback (Vassiliou and Papadoulis, 2009). Several species of predatory mites in the family Phytoseiidae are known to be effective natural enemies of phytophagous mites for different crops worldwide, including citrus orchards (Cakmak et al., 2009; McMurtry and Croft, 1997).The main phytoseiid species reported on citrus in Tunisia are *Euseius stipulatus* (Athias-Henriot), *Neoseiulus californicus* (McGregor) and *Phytoseiulus persimilis* Athias-Henriot (Sahraoui et al., 2014).

The present work aims to follow the population dynamics of phytophagous mites *T. urticae*, *E. orientalis* and *P. citri* on citrus in nurseries and in open fields from the beginning of February until the end of May.

## 2. MATERIAL AND METHODS

### 2.1. Sampling site

The monitoring of the population dynamics of P. citri in the field was carried out in the biotope of Manzel bouzelfa, Nabeul (36°40'56.3"N 10°34'33.6"E). The sampling was carried out in a parcel of orange trees, Maltese varieties over an area of one hectare. For populations of *T. urticae* and *E. orientalis*, the monitoring was done from the bitter orange plants (*Citrus aurantium* L.) in two greenhouses which are located in at the Nabeul Citrus Technical Center, Cap-Bon region, Nabeul (CTA) (36°37'53.7"N 10°33'24.1"E). The climatic conditions (temperature and rainfall) were illustrated during the study period in Fig. 1.

### 2.2. Sampling and control under binocular microscope

Sampling was random at all three study sites. Fifty leaves were randomly collected. All samples were controlled weekly under a binocular microscope (Leica® Model MS5) in the laboratory of the National Agronomic Institute of Tunisia. The monitoring period of the mite population was from February to May 2016. The predatory phytoseiid mites found in the observed samples were preserved in spittoons containing 70% ethyl alcohol for identification. The mites were transferred into a thinning liquid (lactic acid) which allows the body to swell and the legs to spread between a slide and a coverslip. The chitinised cuticle was preserved while the internal tissues were digested and the mite subsequently became transparent.

## 3. RESULTS AND DISCUSSION

### 3.1. The dynamics of population of *T. urticae* and the predatory mite *P. persimilis* in the nursery of bitter orange

The evolution of the *T. urticae* population showed three peaks: the first peak coinciding with 22 mobile forms per 50 leaves was observed on 23 February; the second peak reached 14 mobile forms/50 leaves on 15 March and the third to 26 mobile forms/50 leaves on 5

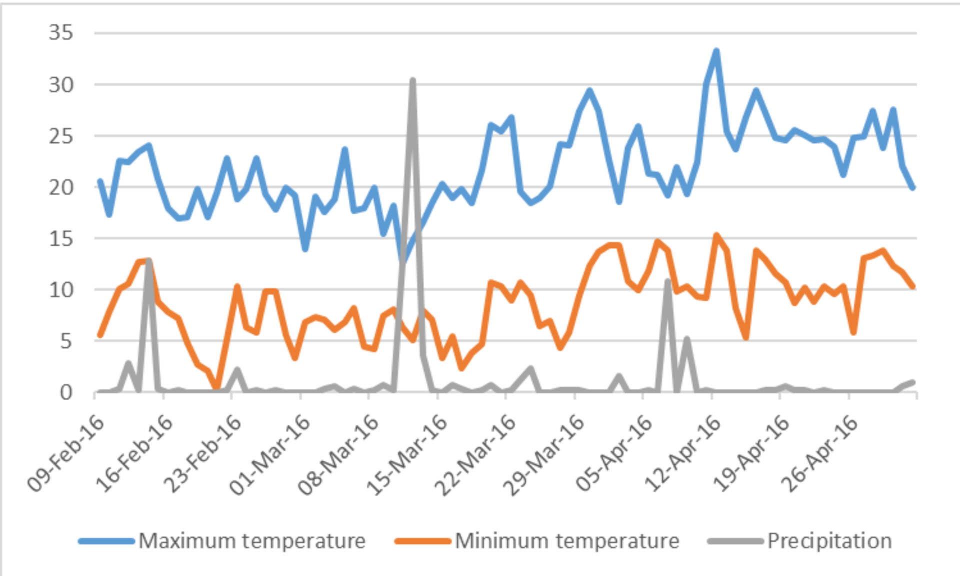



**Fig. 1.** Evolution of the maximum and the minimum temperature (°C) and the precipitation (mm) in the sampling area during the working period (CTA, 2016).

April. However, the population never reached the damage threshold of three mobile forms per leaf. The number of predatory mite's *P. persimilis*, although present, remained below two per 50 leaves on March 15 and zero until May 26 (Fig. 2). The evolution of the T. urticae population is positively correlated with temperature. Thus, the 3 peaks observed coincide with temperatures varying between 25 and 35°C, having noted from 14 February the maximum population(eggs and mobile forms) at a temperature of 25°C. In contrast, as the temperature drops, the population falls.

Concerning the population structure of *T. urticae*, a high percentage of eggs up to 80% of the total population was reached on 22 February. A drop was observed however in the beginning of March. The female population peaked in mid-March at 35% of the total population. During April, peaks in eggs (43.5%) and larvae (48%) characterized the population. At the start of May, the population structure consisted only of adults (Fig. 3).

The study of the dynamics of *T. urticae* shows that its population is sensitive to low temperatures. In Tunisia, *T. urticae* is active in citrus orchards, mainly in summer and autumn, from mid-June to mid-November and prefers varieties of the Clementine group (Lebdi Grissa and Khoufi, 2012). This explains the low

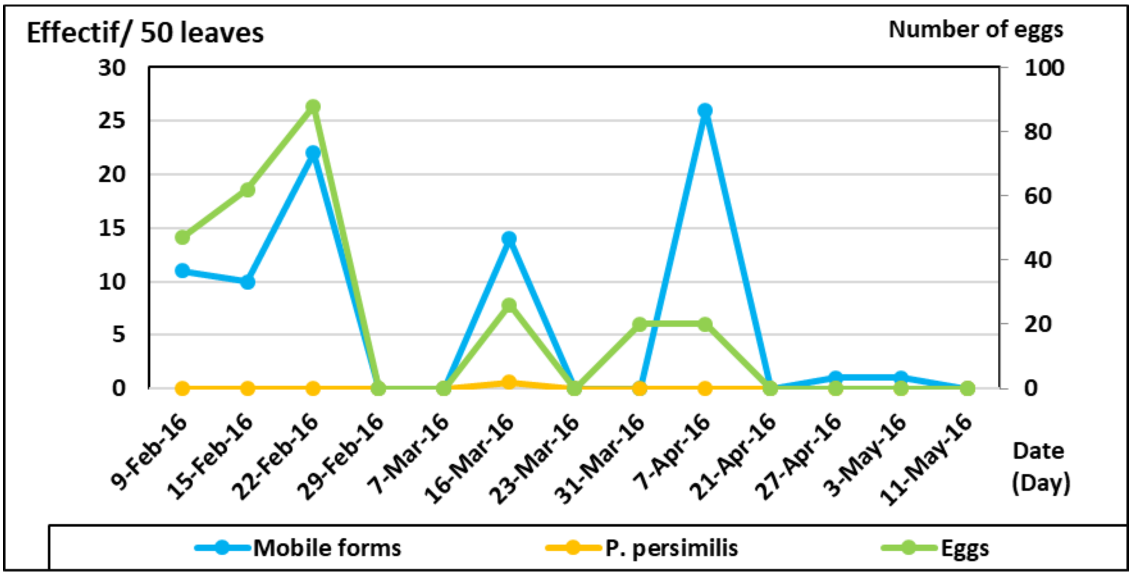



**Fig. 2.** The dynamics of population of *T. urticae* and the predatory mite *P. persimilis* in the nursery of bitter orange.

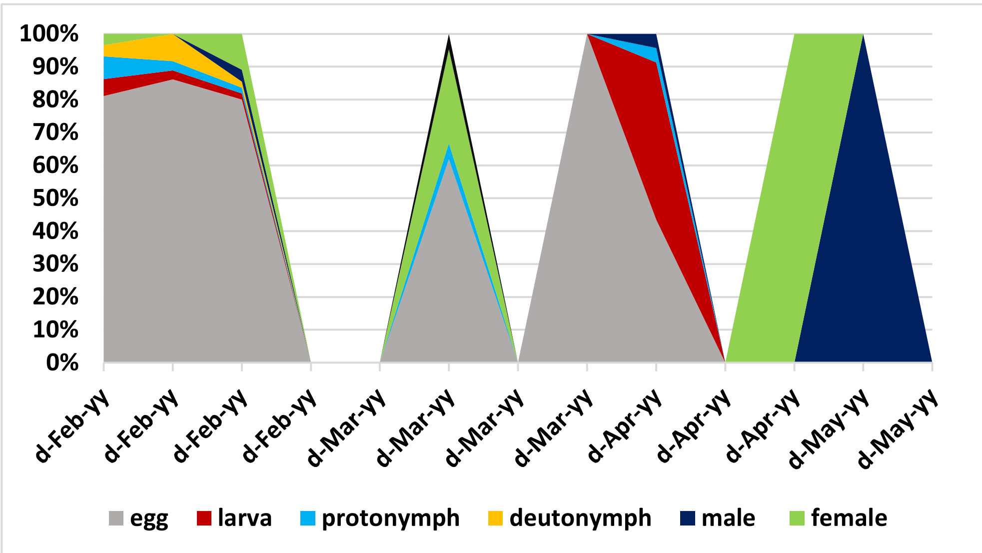



**Fig. 3.** Population structure of *T. urticae* on bitter orange.

numbers of mites during the sampling period from February to mid-May. In addition, the presence of the predatory mite *P. persimilis*, a specific predator of *T. urticae*, might explain the low population of this mite during the observation period.

### 3.2. The dynamics of population of *E. orientalis* and the predatory mite *N. californicus* in the nursery of bitter orange

During the sampling period, the *E. orientalis* population had four peaks observed on 23 February, 23 March, 27 April and 11 May. The number of eggs was high between 16 February and 15 March, and then decreased to a minimum on March 27, peaking afterwards at the end of April to 1169 eggs/50 leaves. According to the sampling, the population numbers of *E. orientalis* reached a maximum of 119 mobile forms/50 leaves on 27 April and 116 mobile forms/50 leaves on 11 May (Fig. 4). Thus, the number of mites per leaf increases with temperature (between 25 and 33°C).

During the whole sampling period (from February to May), the population structure of *E. orientalis* was essentially composed of eggs (90%) except on 15 February when the percentage of mobile forms reached a maximum (100%) (Coinciding with the start of the colony) and on 27 March when half of the population consisted of mobile forms (57.53%) and the other half of eggs (42.43%) (Fig. 5).

The number of *E. orientalis* is following a normal trend due to the positive correlation between the multiplication of the mites in particular and the temperatures. It spends the winter hidden in the tree and resumes its activity in summer and autumn when it has 3 to 5 overlapping generations (Lebdi Grissa, 2010). In Jordan, this

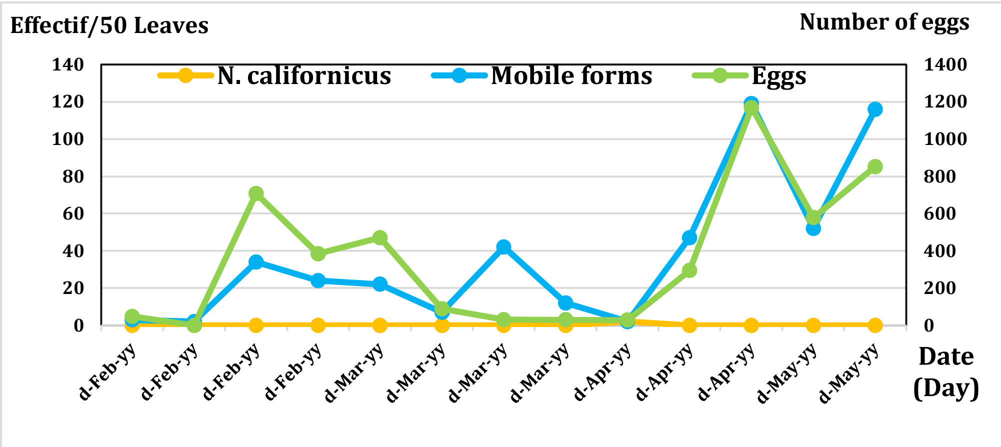



**Fig. 4.** The dynamics of population of *E. orientalis* and the predatory mite *N. californicus* in the nursery of bitter orange

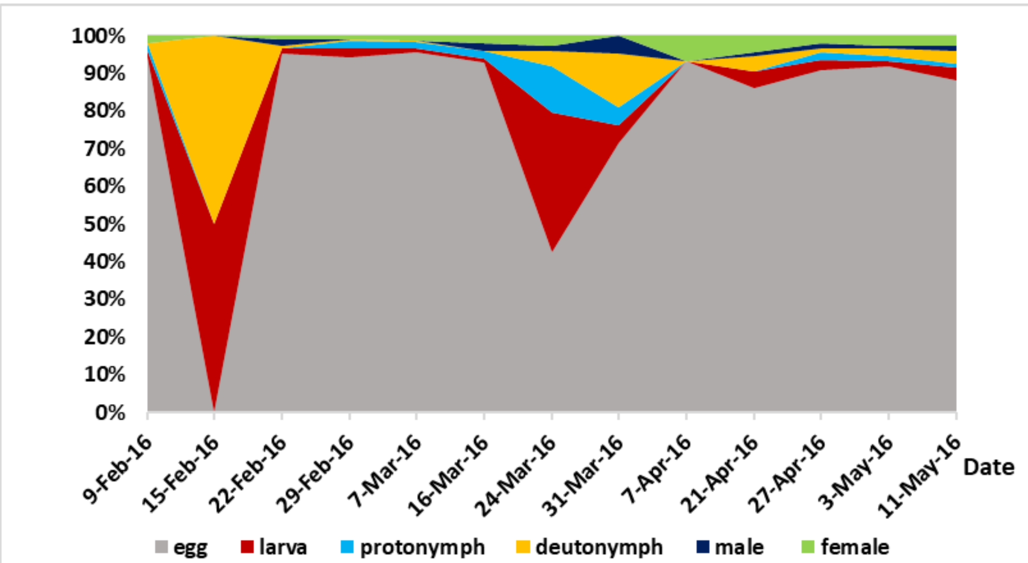



**Fig. 5.** Population structure of *E. orientalis* on bitter orange

mite is most abundant on lemon trees during late November and December, when temperatures are low and rainfall is increasing (Tanigoshi et al., 1990). In other cases, the population dynamics of *E. orientalis* varied according to the host plant (Halawa et al., 2020).

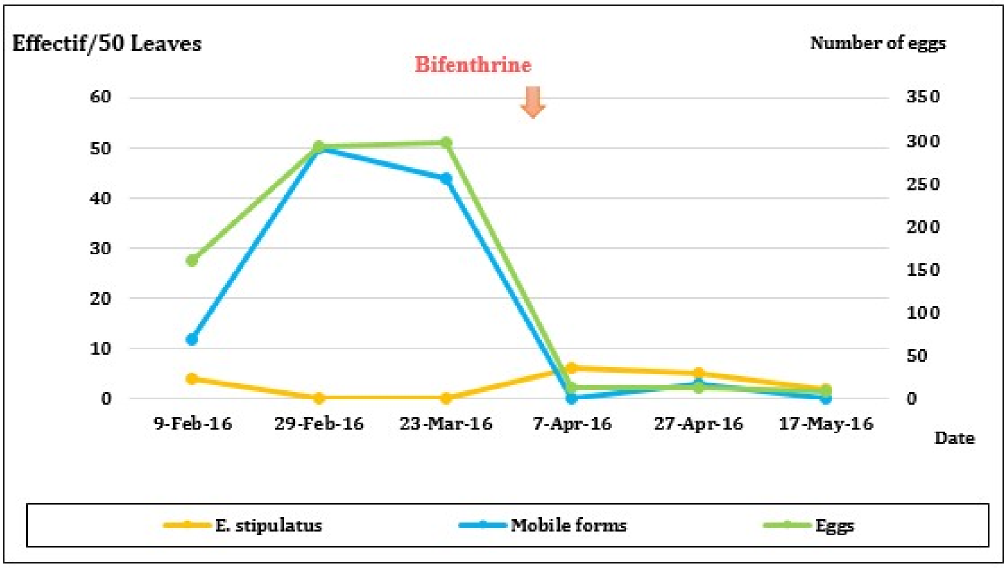



**Fig. 6.** The population dynamics of *P. citri* and the predatory mite *E. stipulatus* in the Maltese citrus

In southwestern Iran, this mite can have two peaks on *Albizialebbeck* L. with highest density and activity observed from September to November and from April to May (Yarahmadi and Rajabpour, 2013). In the Souss region of Morocco, two population peaks of *E. orientalis* were observed in winter and early autumn in citrus fields. In addition, the predatory mite *N. californicus* was more abundant and very active on orange leaves and associated with weeds (Abdellah et al., 2021).

### 3.3. Population dynamics of *P. citri* in the field

During the month of February and beginning of March, the number of mites increased progressively to reach one mobile form/leaf on February 29; but remained below the threshold of damage (10% of leaves occupied by 1 mobile form). During this period, the evolution of *P. citri* started with a high number of eggs (294 eggs/50 leaves) and a low presence of mobile forms (28 larvae and 10 adults per 50 leaves); this is a sign of the start of the spring population after the winter rest. From the end of March to the end of May, the drop in the *P. citri* population is explained by a chemical treatment programmed by the farmer based on Talstar (insecticide-acaricide of the chemical family of synthetic pyrethroids whose active substance is Bifenthrin) applied against the aphids 2 days before the sampling. We also note the presence of a population of the predatory mite *E. stipulatus* in the plot, which participates in the control of the phytophagous population (Fig 6).

During the month of February, the percentage of females is equal to 33% compared to the other mobile forms. On the other hand, for the month of March, the population is formed by a high percentage of larvae (56%) compared to the other mobile forms which have almost equal percentages (18.18% protonymph, 22.72% deutonymph, 13.63% adults) (Fig. 7).

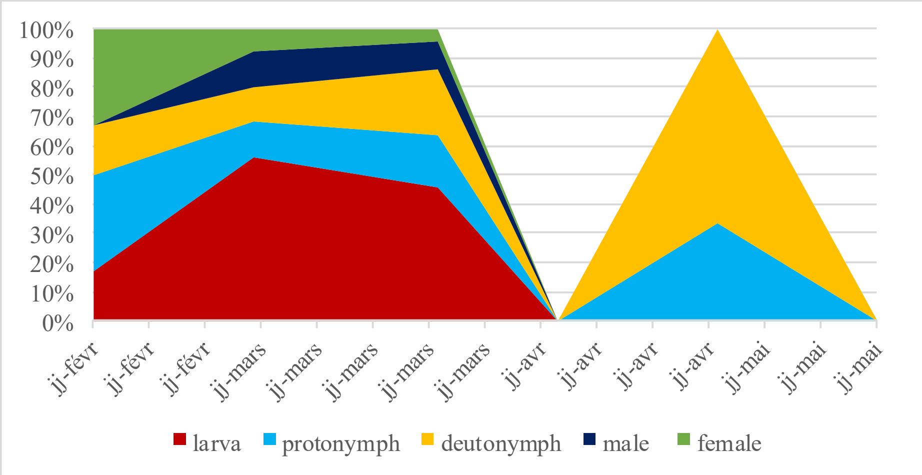



**Fig. 7.** Population structure (mobiles forms) of *P. citri* in the Maltese citrus

The drop in population observed in April can be explained by the effect of the insecticide-acaricide applied against aphids. The predatory mite *E. stipulatus* was found associated with this mite, this species is reported to be the dominant phytoseiid in Tunisian citrus producing areas (Sahraoui et al., 2012). The increase in temperature can also affect the evolution of this mite since it is sensitive to high temperatures such as those observed at the end of April, which exceeded 30°C. From a study by Keetch (1971) on the seasonal abundance of *P. citri*, it was concluded that temperature and relative humidity have an influence on the development of the mite. This is confirmed by Lebdi Grissa (2010) who mentioned that this mite is active in spring and disappears in summer in Tunisia when the temperature increases. According to Lebdi Grissa and khoufi (2012), it occurs on citrus from December to May, usually on Maltese orange varieties. In Brazil, this mite develops preferentially in the driest and coldest environmental conditions of the year (autumn-winter), which are the most favorable for its development and reproduction on citrus (Silva et al., 2012). *P. citri* populations cause damage from late March to mid-September, with at least two population peaks, in citrus orchards in southwest China (Liu et al., 2019; Ran et al., 2009).

## 4. CONCLUSION

The monitoring of the populations of the three mites on citrus provided insight into the seasonal evolution of these mites and the effect of climatic changes on their population dynamics. With high temperatures, population of *E. orientalis* and *T. urticae* are favored, whereas *P. citri* is active at spring temperatures.

## REFERENCES

Abdellah, A., Abdelaziz, Z., Philipe, A., and Serge, K. (2021). Seasonal trend of Eutetranychus orientalis in Moroccan citrus orchards and its potential control by Neoseiulus californicus and Stethorus punctillum. *Systematic and Applied Acarology*26, 1458-1480.

Ansaloni, T., Pascual-Ruiz, S., Hurtado, M. A., and Jacas, J. A. (2008). Can summer and fall vegetative growth regulate the incidence of Tetranychus urticae Koch on clementine fruit? *Crop Protection*27, 459-464.

Cakmak, I., Janssen, A., Sabelis, M. W., and Baspinar, H. (2009). Biological control of an acarine pest by single and multiple natural enemies. *Biological control*50, 60-65.

Gerson, U. (2003). Acarine pests of citrus: overview and non-chemical control. *Systematic and Applied Acarology*8, 3-12.

Halawa, M. A., Metwally, A.-E. M., Abdallah, A. A., and Abo-Zaid, A. (2020). Population Dynamics of Eutetranychus orientalis (Klein) and Predacious Mites Associated with Three Citrus Varieties (Navel orange, Grapefruit, and Lemon) at El-Sharqia Governorate. *Egyptian Academic Journal of Biological Sciences. A, Entomology*13, 47-56.

Hoy, M. A., and Jeyaprakash, A. (2005). Microbial diversity in the predatory mite Metaseiulus occidentalis (Acari: Phytoseiidae) and its prey, Tetranychus urticae (Acari: Tetranychidae). *Biological Control*32, 427-441.

Jacas, J. A., Karamaouna, F., Vercher, R., and Zappalà, L. (2010). Citrus pest management in the Northern Mediterranean basin (Spain, Italy and Greece). *In* "Integrated management of arthropod pests and insect borne diseases", pp. 3-27. Springer.

Kasap, İ. (2009). The biology and fecundity of the citrus red mite Panonychus citri (McGregor)(Acari: Tetranychidae) at different temperatures under laboratory conditions. *Turkish Journal of Agriculture and Forestry*33, 593-600.

Lebdi Grissa, K., and Khoufi, A. (2012). Bio-ecology of phytophagous mites on Citrus. *In* "Proceeding of the 7th Symposium of the EURopean Association of ACarologists, Vienna, Austria", pp. 92.

Lebdi, K., and Dhouibi, M. (2002). Essai de traitement contre l'acarien jaune tisserand Tetranychus urticae (Tetranychidae) en pépiniére agrumicole. *Institut National Agronomique de Tunis*2, 153-168.

Liu, Z., Xu, C., Beattie, G. A., Zhang, X., and Cen, Y. (2019). Influence of different fertilizer types on life table parameters of citrus red mite, Panonychus citri (Acari: Tetranychidae). *Systematic and Applied Acarology*24, 2209-2218.

McMurtry, J., and Croft, B. (1997). Life-styles of phytoseiid mites and their roles in biological control. *Annual review of entomology*42, 291-321.

Pyle, K., and Stevens, P. (2004). The integrated management of pests and diseases in New Zealand citrus. *Proceedings of the International Society of Citriculture. Paper*.

Ran, C., Chen, Y., and Wang, J.-J. (2009). Susceptibility and carboxylesterase activity of five field populations of Panonychus citri (McGregor)(Acari: Tetranychidae) to four acaricides. *International Journal of Acarology*35, 115-121.

Sahraoui, H., Grissa, K. L., Kreiter, S., Douin, M., and Tixier, M.-S. (2012). Phytoseiid mites (Acari: Mesostigmata) of Tunisian citrus orchards: catalogue, biogeography and key for identification. *Acarologia*52, 433-452.

Sahraoui, H., Tixier, M.-S., Lebdi-Grissa, K., and Kreiter, S. (2014). Diversity and abundance of Phytoseiidae (Acari: Mesostigmata) in three crop management strategies of citrus orchards in Tunisia. *Acarologia*54, 155-169.

Silva, M. Z. d., Sato, M. E., and Oliveira, C. A. L. d. (2012). Diversidade e dinâmica populacional de ácaros em pomar cítrico. *Bragantia*71, 210-218.

Tanigoshi, L., Bahdousheh, M., Babcock, J., and Sawaqed, R. (1990). Euseius scutalis (Athias-Henriot) a predator of Eutetranychus orientalis (Klein)(Acari: Phytoseiidae, Tetranychidae) in Jordan: Toxicity of some acaricides to E. orientalis. *Arab Journal of Plant Protection*8, 120-114.

Vassiliou, V. A., and Papadoulis, G. (2009). First record of the citrus red mite Panonychus citri in Cyprus. *Phytoparasitica*37, 99-100.

Walter, D. E., Halliday, R., and Smith, D. (1995). The oriental red mite, Eutetranychus orientalis (Klein)(Acarina: Tetranychidae), in Australia. *Australian Journal of Entomology*34, 307-308.

Yarahmadi, F., and Rajabpour, A. (2013). Seasonal dynamics and spatial distribution of Eutetranychus orientalis (Acarina: Tetranychidae) on Albizia lebbeck (Fabaceae) in parks in Ahwaz, southwest Iran. *International Journal of Tropical Insect Science*33, 114-119.