Volume 77(1). Published November, 01, 2020
www.jnsciences.org
E-ISSN 2286-5314

Importance of Thrips (Thysanoptera: Thripidae) in Tunisian citrus groves

***W. HACHED* [*1], *H. SAHRAOUI*[2], *S. ATTIA*[1], *K. GRISSA-LEBDI*[1]**

[1]*Entomology-Acarology Laboratory / Plant Health and Environment Department/ National Agronomic Institute of Tunisia, 43 Charles Nicolle Avenue, Mahrajène City 1082 Tunis/ Carthage University, Tunisia.*
[2]*Citrus Technical Center (CTA). 8099 Zaouiet Jedidi- Béni Khalled- BP 318- Nabeul- Tunisia*

***Corresponding author:** hached_wiem@yahoo.fr

Abstract - In Tunisian citrus groves, damages caused by thrips (Thysanoptera: Thripidae), were firstly observed in 2008. The symptoms of attack were in the form of silver rings and mottling of the bark, depreciating the fruit appearance and thereby reducing their market value. In order to determine the areas of citrus production (particularly on Thomson oranges) most affected by this new pest, a survey was launched in 2013 in four study biotopes: Cap Bon (12 plots), Morneg (4 plots), El Alia (3 plots) and Boussalem (3 plots) thanks to blue sticky traps. On the other hand, in order to evaluate the effect of trap colors on the attractiveness of thrips, two colors were tested: blue and yellow, in three plots only of each biotope. In addition, a trial was conducted in 4 plots of Cap Bon to test the varietal sensitivity of thrips on Thomson and Maltaise oranges.
The results of this study showed the regular presence of thrips in the four study biotopes and that the biotope of Boussalem was the most affected by the presence of this new pest. In addition, the most important generations were recorded around the second half of July 2013 for all biotopes. Besides, the blue traps showed a greater attractiveness for this pest. Concerning the varietal sensitivity of thrips, the catch rate at the sticky traps recorded on Thomson oranges was almost twice that recorded on Maltaise oranges.
These different results suggest early identification of new thrips attacks and increased monitoring of the most affected biotopes and the most sensitive varieties to prevent their multiplication.

Keywords: Blue trap, Maltaise oranges, Thomson oranges, thrips.

1. Introduction

Thrips (Thysanoptera: Thripidae) are minute insects with an elongated shape, narrow and fringed wings, often hidden in the flowers and the calyx of young fruits which makes their identification, catches and rearing difficult (Fraval 2006). These pests attack various botanical families such as Poaceae, Fabaceae, Solanaceae, Rosaceae, Cucurbitaceae, Myrtaceae, Vitaceae and Ebenaceae (Elimem et al. 2011, Elimem and Chermiti 2013a, Razi 2016, Razi et al. 2017).
In Tunisia, and in the fruit arboriculture sector, thrips damages appear mainly on vines (Besbes 2011). The damage on this crop is due to nutrition stinging, which causes a blockage of neighboring cells growth which is reflected later in the fruit enlargement by bursting berries (M'Hafdhi et al. 2015). During the last decade, thrips attacked Rutaceae in the Mediterranean basin countries such as Italy Spain and Algeria (Conti et al. 2001, Navarro et al. 2011, Koutti and Bounaceur 2013). In Tunisia, the damage attributable to these Thysanoptera was observed in 2008 in the citrus orchards of Cap Bon (Trabelsi and Boulahia-Kheder 2009). On this crop, the damage of all thrips species was about 47% whose attack symptoms were in the form of silver rings and mottling of the bark, depreciating the external appearance of the fruits (Belaam and Boulahia-Kheder 2012). However, since thrips are sucking biting insects, the danger of some species is the transmission of fungi, bacteria and viruses, causing many diseases (Bournier 1982, Fraval 2006, Reitz 2009). On this fact, the knowledge of citrus growing areas most affected by this pest as well as the most sensitive varieties can help to control the numbers of these insects and to limit their spread. In this context, the objectives of this study were, on the one hand to survey the thrips population level on Thomson oranges according to four citrus growing areas, on the other hand to determine the most attractive color of sticky traps to these pests. Moreover, this work aimed to evaluate the varietal sensitivity of thrips on Thomson and Maltaise oranges.

2. Material and Methods

2.1. Prospection sites

The prospection, on the thrips population level on Thomson and Maltaise oranges, was carried out in 2013 in 4 study biotopes distributed as follows (Tabl. 1):

Table 1: Distribution of study plots according to biotopes and varieties concerned

Biotope (Governorate)	Number of plots	Study plots	Orange variety
Cap Bon (Nabeul)	12	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12	Thomson
	2	B1, B2	Maltaise
Morneg (Ben Arous)	4	M1, M2, M3, M4	Thomson
El Alia (Bizerte)	3	A1, A2, A3	Thomson
Boussalem (Jendouba)	3	J1, J2, J3	Thomson

On Maltaise oranges only 2 plots were chosen in the Cap Bon biotope (B1, B2).
All plots were conducted in conventional mode with a drip irrigation system. The survey period was from May 20th to September 2nd, 2013.

2.2. Thrips monitoring

Thrips adult populations monitoring was by the 25 x 10 cm blue sticky traps made of polyvinyl chloride. One trap per orchard was hung on the north side of the tree at a height of 1.5m.
The traps were checked and replaced weekly. The thrips captured by the traps were counted in the laboratory under a binocular loupe.

2.3. Effect of the trap color on the thrips attractiveness

In order to compare the effect of the trap color on the number of thrips caught on Thomson oranges, only 3 plots of each biotope were selected and presented as follows: for the Cap Bon biotope (C1, C2 and C3), for Morneg (M1, M2 and M3), for el Alia (A1, A2 and A3) and for Boussalem (J1, J2 and J3). In each plot only one yellow trap was installed (in addition to the blue trap). The survey duration was during five weeks for all the study plots.

2.4. Effect of the orange variety on the thrips attractiveness

Four plots located at the Bou Argoub delegation (Cap Bon biotope) were chosen to evaluate the presence rate of these pests on Thomson (plots: C8 and C9) and Maltaise oranges (plots: B1 and B2) with blue sticky traps only. The survey period was from May 20th to September 2nd, 2013.

2.5. Climatic data

The temperature variation between the different study biotopes during the survey period was very similar (Fig.1). The lowest temperature average (around 20°C) was recorded in May while the highest average (around 28 °C) was recorded in August.

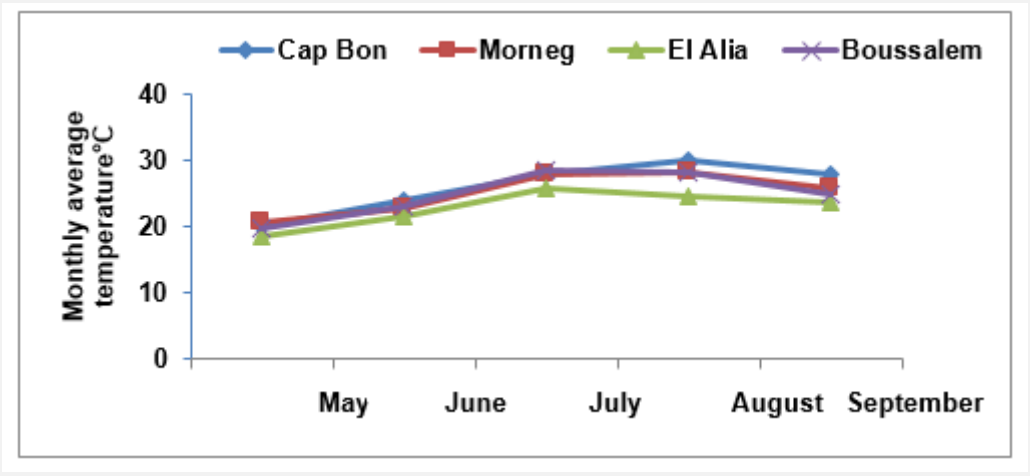

Figure 1: Monthly average temperature variation by biotope during the survey period from May 20th to September 2nd 2013

2.6. Statistical Analyses

Statistical analyses were performed using SPSS software 16.0 (Inc.2007). In order to evaluate the most affected citrus production areas, variance analysis was performed and the averages comparisons were carried out with the Duncan test with P = 0.05. The Student test was used with a 5% significance level to compare the effect of trap color and orange variety on the thrips attractiveness.

3. Results and Discussion

3.1. Determination of the thrips presence level according to the biotope

The results of this survey showed that significant rates of thrips catches, for all species combined, were recorded in the all study biotopes during the monitoring period from May to early September (Fig.2). The study of Elimen and Chermiti (2013b) showed that during this monitoring period, the populations of *Frankliniella occidentalis*, *Pezothrips kellyanus* and *Thrips tabaci* were the most important on different citrus species. While Attia et al., (2019) found that the most abundant species were *Thrips major* Uzel with 69.66% and *Frankliniella occidentalis* Pergande with 22.47% during 2012 and 2013 in Takelsa region (Cap Bon Biotope).

Moreover, the presence rate of these pests was variable between the biotopes where the highest capture level was recorded in Boussalem with an average of around 1300 captured adults, while the Morneg biotope showed the lowest catch rate with an average of around 600 adults (Fig.2). Variance analysis showed a significant difference for the Boussalem biotope with (P = 0.011, F = 2.305, df = 21).

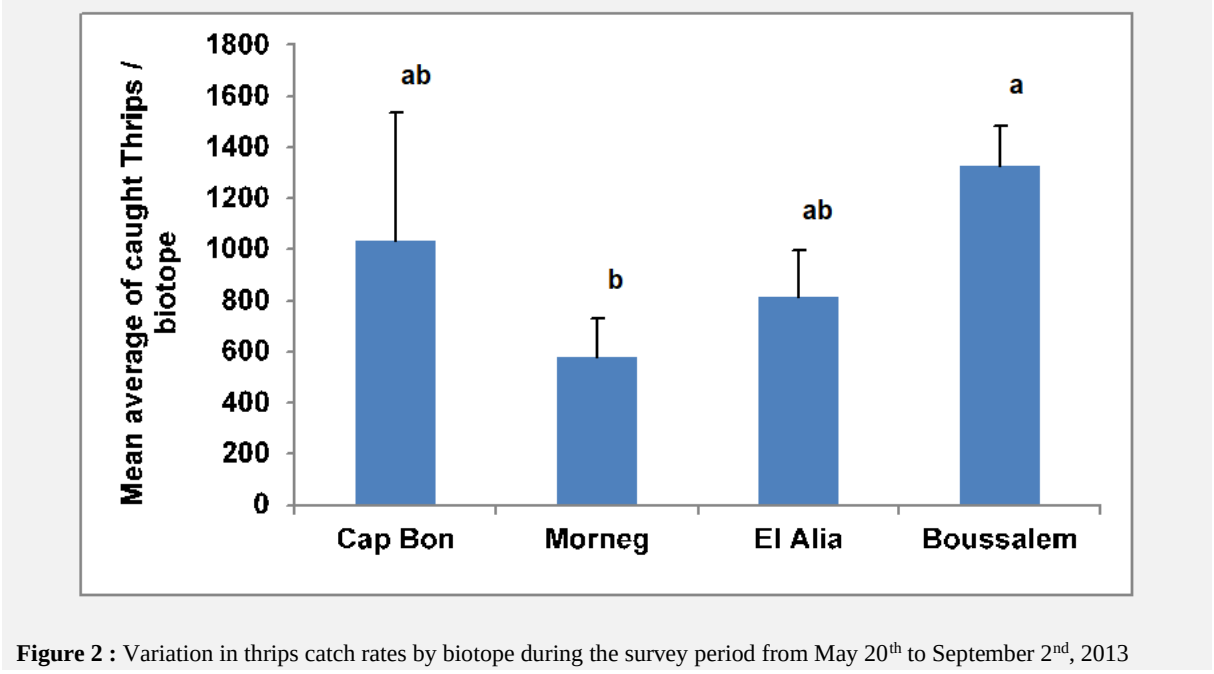

Figure 2 : Variation in thrips catch rates by biotope during the survey period from May 20th to September 2nd, 2013

The high catch rate recorded in the Boussalem biotope could be explained by the proximity of the study plots to the fields planted by poaceae and fabaceae, which are reservoir host plants for these pests. In accordance with our results, the study of Belaam Kort and Boulahia Khedher (2017a) carried out in the biotopes of Cap Bon, Bizerte and Morneg in 2012 showed also the low presence of these pests in the Morneg biotope.

In addition, the highest peak catches were recorded during the second half of July for all study biotopes with 185, 182, 173 and 86 adults captured respectively for Boussalem, El Alia, Cap Bon and Morneg (Fig.3). On the one hand, these results could be explained by the increase of the temperature during this period, between 25 and 30°C (Fig.1), which is ideal for the development of *Frankliniella occidentalis* for example (Koutti et al.2017).

These finding concord with Kaur (2018), who demonstrated that the population of citrus thrips increased progressively with the increase in temperature and the decrease in relative humidity.

On the other hand, the presence of weeds and the flowering of other thrips host plants at the study sites could also influence the increase in catch rates of these pests.

Moreover, Tanigoshi (1991) reported that the period from May to early July was a critical phase for the attack of Navel orange fruits by citrus thrips. After this period, the fruit diameter is bigger than 4 cm

which became unfavorable to thrips attacks, for that, these pests change their feeding and egg laying mode in the summer to attack the foliage.

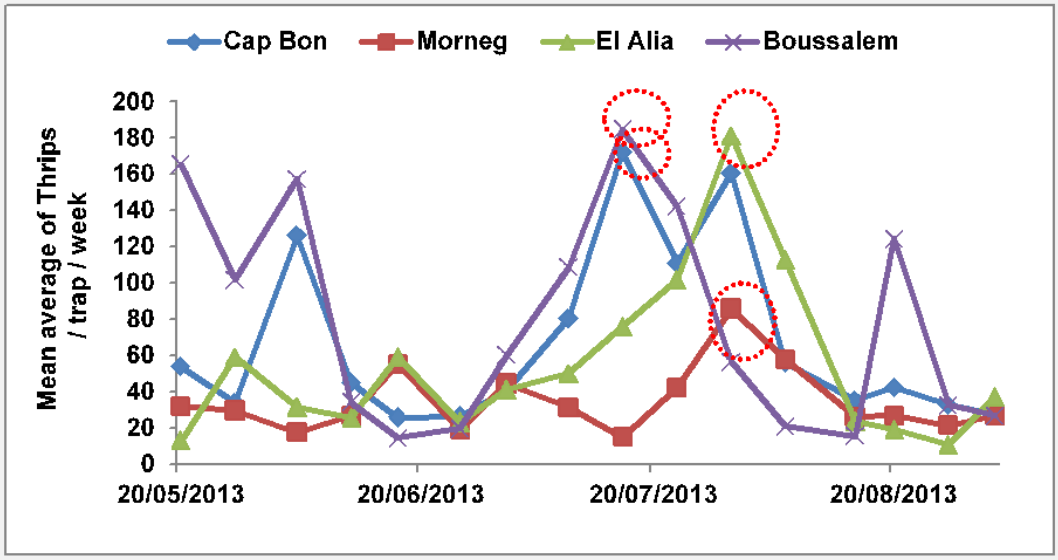

Figure 3: Variation of the adult thrips flight activity by biotope between May20th and September 2nd, 2013

3.2. Effect of the sticky traps color on the thrips attractiveness

By comparing the thrips rates captured by the sticky traps, it was noticed that, the blue traps caught three times more thrips (76%) than yellow traps (24%) (Tabl.2). Statistical analysis showed a significant difference between the two trap colors with (P = 0.022).

Table 2: Variation of adult thrips capture rates by trap color

	Blue traps	Yellow traps
Total number of captured thrips	2733	853
Mean average of captured thrips / plot	227.67± 22.49a	71.17± 9.85b
Capture percentage (%)	76	24

Several studies have investigated the effect of trap colors on the attractiveness of thrips different species in citrus orchards. Childers and Brecht (1996) showed the important attractiveness of white traps compared to yellow traps for *Frankliniella bispinosa* capture on lemon and Navel oranges.

On lemon and grapefruit, Vassiliou (2010), showed that the white colored traps were more attractive than those of sky blue, navy blue and yellow colors for the attractiveness of *Pezothrips kellyanus*, *Frankliniella occidentalis* and *Thrips tabaci*.

On Washington Navel, lemon and orange, blue traps were more attractive than white and yellow ones for thrips (Elekcioğlu 2013). On lemon tree also, Conti et al. (2001), showed that white sticky traps were more attractive to *Pezothrips kellyanus* followed by blue ones whereas yellow traps did not show any difference with the control.

On Maltaise oranges, Hassouna (2013) showed the effectiveness of blue traps for catching thrips compared to yellow ones. In addition, Atakan and Pehlivan (2015) showed that white traps were more attractive than blue or green on mandarin for catching *Thrips tabaci.*

These different results showed that the traps color attractiveness to the thrips varied not only according to the citrus species fruits but also according to the target species of thrips. In addition, the effectiveness of the blue color traps was confirmed in comparison with the yellow color. The blue color could thus be used for mass trapping.

3.3. Effect of orange variety on the thrips attractiveness

The attractiveness of thrips varied significantly (where P = 0.021) between the two varieties with 68% and 32% of adults caught on Thomson and Maltaise respectively (Tab.3).

Table 3 : Variation of adult thrips capture rates by orange variety

	Thomson	Maltaise
Total number of captured thrips	2045	945
Mean average of captured thrips / plot/ week	127.81±13.12a	59.06±5.82b
Capture percentage (%)	68	32

In accordance with our results, Belaam (2010) showed that Thomson oranges were more sensitive than Maltaise oranges to the thrips damages with 68.04% and 42.92% of attacked fruits respectively. In addition, Koutti and Bounaceur (2013) showed that the thrips attack rate on Thomson oranges could reach 32% while it did not exceed 14% and 8% on Clementine and Washington Navel respectively. Moreover, previous studies on other citrus species have shown a very variable sensitivity to the thrips attacks. In fact, on particularly sensitive species such as bergamots and lemons, the damage of some species such as *Pezothrips kellyanus*, reached 59% and 45% on lemons (Belaam-Kort and Boulahia-Kheder, 2017b). Elekcioğlu (2013) showed the sensitivity of lemons compared with Washington Navel to thrips damages.

4. Conclusion

Finally, this research has shown that thrips were more abundant in Boussalem biotope. Besides, the blue color of traps was more attractive to these pests. In addition, the Thomson variety was more sensitive to these insects. Thereby, these findings provided a better knowledge of thrips bio-ecology in order to establish an integrated pest management program adapted to the Tunisian citrus groves.

5. Acknowledgments

The authors would like to thank all the farmers for their collaboration in carrying out this study.

6. References

Atakan E, Pehlivan S (2015) Effectiveness of colored sticky traps for collecting onion thrips, *Thrips tabaci* Lind. in citrus 66: 5-12.

Attia S, Khouja S, Belaam-Kort I, Limam E, Ammar M, Lebdi-Grissa K (2019) Pest thrips infesting citrus orchards in the South East region of Tunisia. J Entomol Zool Stud , 7(2) : 1078-1081.

Belaam I, Boulahia-Kheder S (2012) Inventory of thrips species in citrus orchards and assessment of scarring fruits in two citrus producing regions of Tunisia. T J P P 7: 1-9.

Belaam-Kort I, Boulahia-Kheder S (2017a) The status of *Pezothrips kellyanus* Bagnall (Thysanoptera: Thripidae) in citrus orchards of Tunisia – 11th International Conference On Pests in Agriculture. AFPP. Montpellier – 25th and 26th of october 2017.

Belaam-Kort I, Boulahia-Kheder S (2017b) Thrips in citrus orchards, emerging pests in Tunisia. Entomologie Faustique – Faunistic Entomology 70: 77-87.

Besbes O (2011) Les thrips de la vigne : Inventaire, bio-écologie et moyens alternatives de lutte. PFE. INAT.65p.

Bournier A (1982) Les Thrips: biologie, importance agronomique. Ed. Institut National de la Recherche Agronomique. Paris, Références bibliographiques 112,128p.

Childers CC, JK Brecht (1996) Colored sticky traps for monitoring *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) in citrus groves during flowering cycles in citrus. J Econ Entomol 89(5):1240-1249. doi:10.1093/jee/89.5.1240

Conti F, Tumminelli R, Amico C, Fisicaro R, Frittitta C, Perrotta G , Marullo R (2001) Monitoring of *Pezothrips kellyanus* on citrus in eastern Sicily. In: R. Marullo and L.A. Mound, eds., Thrips and Tospoviruses, 207–210. In: Proceedings of the 7th International Symposium on Thysanoptera. University of Reggio Calabria, Italy.

Elekcioğlu NZ (2013) Color Preference, distribution and damage of thrips associated with lemon and orange in Adana, Turkey. Pakistan J Zool 45(6):1705-1714.

Elimem M, Navarro-Campos C, Chermiti B (2011) First record of black vine thrips, *Retithrips syriacus* Mayet in Tunisia. Bull OEPP/EPPO Bull 41 (2): 174–177.

Elimem M, Chermiti B (2013a) Suivi et Identification de trois nouvelles espèces de thrips (Insecta : Thysanoptera) introduites en Tunisie et de leurs prédateurs sur différentes plantes hôtes. Conference paper: Association Tunisienne de Taxonomie "2nd International conference on biodiversity and food security. Hammamet, Méhari 26 -28 April 2013 Tunisia.

Elimem M, Chermiti B (2013b) Thrips species composition and seasonal dynamic populations in an organic citrus orchard in the central eastern coast of Tunisia. Integrated Control in Citrus Fruit Crops IOBC-WPRS Bulletin 95: 77-82.

Fraval A (2006) Les Thrips. Insectes 4 (143): 29-34.

Hassouna S (2013) Contribution à l'étude des thrips inféodés aux cultures de vigne et de l'oranger dans la région de Takelsa et l'évaluation de l'efficacité du piégeage de masse, des bio-insecticides et d'insecticides dans la lutte intégrée contre ce ravageur. Mémoire de mastère de recherche en sciences agronomiques INAT, 120p.

Kaur R (2018) Population dynamics, distribution and rind disorder of mites and thrips on citrus in Punjab. PhD Thesis in Entomological Agriculture, Punjab University, India, 117p.

Koutti A, Bounaceur F (2013) Study of damage of thrips on citrus orchards of Mitidja, Algeria. Angewandten Biologie Forschung 1(3): 35-42.

Koutti A, Bounaceur F, Razi S (2017) Diversité et distribution spatiale des thrips sur différentes variétés d'agrumes en Algérie. Revue Agrobiologia 7(1): 263-273.

M' Hafdhi M, Loussaeif F, Belhaj R (2015) Les Thrips sur vigne. Fiche technique. Ministère de l'Agriculture et des Ressources Hydrauliques, Direction Générale de la Protection et du Contrôle de la Qualité des Produits Agricoles, Sous Direction Santé Interne.

Navarro CC, Aguilar A, Marí FG (2011) Population trend and fruit damage of *Pezothrips kellyanus* in citrus orchards in Valencia (Spain). Integrated control in citrus fruit crops IOBC/WPRS Bulletin 38: 204-209.

Razi S (2016) Etude éco-biologique des thrips de la région de Biskra. Thèse de doctorat en Sciences Agronomiques. Université de Biskra, Algérie, 145p.

Razi S, Bernard EC, Laamari M (2017) A survey of thrips and their potential for transmission of viruses to crops in Biskra (Algeria): First record of the species *Frankliniella intonsa* and *Thrips flavus*. T J P P 12: 197- 205.

Reitz SR (2009) Biology and ecology of the western flower thrips (Thysanoptera: Thripidae): The Making of a Pest. Fla Entomol 92(1):7-13.

Tanigoshi LK (1991) Biological control of citrus thrips, *Scirtothrips citri* by predacious phytoseiidd mites. In: Parker, B.L.. Skinner, M. and Lewis, T. (Eds). Towards Understanding Thysanoptera. General Technical Report NE-147, USDA, Forest Service, Radnor,, PA, 399-418.

Trabelsi I, Boulahia-Kheder S (2009) Sur la présence en Tunisie du thrips des agrumes *Pezothrips kellyanus* (Thysanoptera : Thripidae). Annales de l'INRAT 82: 181-186.

Vassiliou VA (2010) Ecology and behavior of *Pezothrips kellyanus* (Thysanoptera: Thripidae) on citrus. J Eco Entomol 103(1): 47–53. doi:10.1603/ec09114.

to the afares oak (*Quercus afares*) located in the Mediterranean basin by comparing it with cork