Assessment of Thrips Damage in Citrus Orchards in Tunisia

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ABSTRACT

Belaam-Kort, I., and Boulahia-Kheder, S. 2019. Assessment of thrips damage in citrus orchards in Tunisia. Tunisian Journal of Plant Protection 14 (1): 55-68.

Before the 2000s, damage produced by thrips have been considered rare or absent in Tunisian citrus orchards. However, during these ten last years and since the first report of the species *Pezothrips kellyanus*, fruit scars attributed to thrips are increasingly being reported. This study aimed to assess thrips damage on citrus and susceptibility of different citrus species and orange varieties to these pests. The relationship between thrips damage and frequency of pesticide use was also studied. The assessment of thrips damage was achieved by visual observation of 200 to 1000 mature fruits from each of the 101 visited orchards located in different regions in Cap-Bon, Bizerte and Mornag during December, January and February from 2015 to 2017. The examined citrus species and orange varieties were Lemon, Bergamot, Grapefruit, Clementine, Mandarin, Navel, Maltaise, Valentia Late and Double Fine oranges. Frequency of insecticide treatments and type of active ingredients in visited citrus orchards were noted in relation with damage rate. Fruit scars caused by thrips were 20% on average for all citrus species and orange varieties. Bergamot and Lemon seem to be the most sensitive citrus species to *P. kellyanus*, while Maltaise and Navel oranges were the most orange varieties affected by marbling caused by other thrips species. Data provided by 94 citrus orchards showed that damage increases with the rise of the number of pesticide applications per year. In fact, thrips are currently common in citrus orchards in Tunisia. However, their harmfulness may become more severe as the management of citrus pests is based mainly on broad-spectrum insecticides that eliminate the beneficial insects and could enhance thrips populations. The introduction of new invasive species could also contribute to increase economic importance of thrips.

Keywords: Chemical treatments, citrus, *Frankliniella occidentalis*, marbling, *Pezothrips kellyanus*, ring, sensitivity, Thrips, *Thrips major*

Thrips are an increasing threat to citrus production in the world and in the Mediterranean region (Marullo and De Grazia 2012). Many species are known for their feeding damage on flowers, leaves and fruits of citrus on which they cause silvery scars on the tissues around the calyx or other lesions located in the lateral parts or in the basis. The most important thrips pests on citrus are *Scirtothrips citri* in California (Tanigoshi et al.1985), *S. aurantia* in South Africa (Grove et al. 2000), *S. dorsalis* in East Asia (Masui 2007), *Pezothrips kellyanus* in New Zealand (Blank & Gill 1996), Australia (Smith et al. 1997), and in some Mediterranean countries such as Italy (Conti et al. 2001), Spain (Navarro-Campos et al. 2011) and Cyprus (Vassiliou 2007). The species *Chaetanaphothrips orchidii* is also known

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Accepted for publication 31 March 2019

as an important citrus pest in Florida and Argentina (Goane et al. 2013). It was recently reported in Spain causing rind blemishes damaging 70% of citrus fruits in some orchards (Campos-Rivela et al. 2017).

In Tunisia, an inventory of thrips in citrus orchards showed 21 species but only one is known as a pest of citrus: *P. kellyanus*, that was first detected in citrus groves in 2008 (Trabelsi and Boulahia-Kheder 2009). In 2012, it represented 3.3% of the thrips fauna causing less than 2% of damage in 22 citrus orchards visited in the regions of Mornag, Bizerte and Cap-Bon (Belaam-Kort and Boulahia-Kheder 2017a). The polyphagous species *Thrips major* and *Frankliniella occidentalis* were the most abundant in citrus orchards of Tunisia with 90 % and 2.6 % of thrips fauna respectively and are considered as potential pests of citrus (Belaam and Boulahia-Kheder 2012; Belaam-Kort and Boulahia-Kheder 2017a). This study dealing with damage assessment follows determination of thrips species and their abundance in citrus orchards (Belaam and Boulahia-Kheder 2012; Belaam-Kort and Boulahia-Kheder 2017a).

However, there is a difficulty with assessment of thrips damage because they can be confused with many abiotic and biotic agents that cause scarring very similar to those produced by thrips. The wind, for example, is an important abiotic agent that makes young fruits rub against branches, leaves and twigs. This leaves scars on fruits that can be superficial in the case of low wind or more severe in case of strong dust or sand wind causing fruit abrasions. Other abiotic agents are phytotoxicity, sunburns, and hail that may cause spotting and yellow to brown leathery scars on fruits (Dreistadt 2012; Garcia-Marí and Palacios 1999; Grafton-Cardwell et al. 2003). Moreover, some other insects produce silvery or brownish scars that may be confused with those caused by thrips. For example, the larva of Tortricidae (Lepidoptera) feed under the calyx causing circular brown scars around the calyx similar to that caused by citrus thrips, but deeper. The larvae of the citrus leaf miner *Phyllocnistis citrella*, although not very common on fruits, feed in pale tunnels beneath the surface of rinds and green stems. Besides caterpillars, other chewing insects like grasshoppers or crickets (Orthoptera) can cause on young fruits a single corky and deep scar around the midsection of fruit. Leafhoppers can also cause roundish discoloring on fruits by puncturing and feeding on rind cells that can be confused with scars of citrus thrips (Dreistadt 2012; Garcia-Marí and Palacios 1999; Grafton-Cardwell et al. 2003).

Hence the interest of this study which aims to evaluate accurately thrips damage after being able to distinguish thrips symptoms from others that are very similar; to determine the sensitivity of citrus species and orange varieties to thrips, and to correlate the frequency of chemical treatments with thrips damage.

MATERIALS AND METHODS

Experimental sites.

This study was carried out from 2015 to 2017, in 101 citrus orchards; 44 located in different regions in the governorate of Bizerte (Ghar El Melh, El Alia and Ras-Jebel), 21 in the region of Mornag and 36 in the peninsula of Cap-Bon situated in Beni-Khaled, Menzel-Bouzelfa, Takelsa and Bou-Argoub (Table 1).

Table 1. Geographic coordinates of the visited localities

Regions	Localities	Geographic coordinates
Bizerte	GharMelh	37° 10′ 26″ N, 10° 11′ 31″ E
	El Alia	37° 10′ 08″ N, 10° 02′ 00″ E
	Ras-Jebel	37° 12′ 54″N, 10° 07′ 26″ E
Cap-Bon	Beni-Khaled	36° 38′ 57″ N, 10° 35′ 29″ E
	Menzel Bouzelfa	36° 41′ N, 10° 35′ E
	Takelsa	36° 47′ N, 10° 38′ E
	BouArgoub	36° 32′ N, 10° 33′ E
Mornag	Mornag	36° 40′ 51″ N, 10° 17′ 25″ E

Thrips damage assessment.

Assessment of thrips damage was achieved on mature fruits during harvest. In each orchard, thrips damage was assessed by randomly selecting samples of 200 to 1000 mature fruits for each species and variety. The examined crop fruits were those of the citrus species Lemon, Bergamot, Grapefruit, Clementine, Mandarin, and of the orange varieties Navel, Maltaise, Valentia Late and Double Fine (Table 2).

Table 2. Number of fruits and orchards of the citrus species and orange varieties checked for thrips damage

Species/Varieties	Number of orchards	Number of sampled fruits
Lemon	37	6700
Bergamot	15	3200
Grapefruit	25	4500
Navel Orange	91	77000
Maltaise Orange	69	48300
Mandarin	42	8400
Clementine	22	6600
Valentia Late	3	600
Double fine	7	1400

The rate of damage for each species and variety was calculated according the following formula: Thrips damage (%) = Number of damaged fruits × 100 / Total of fruits.

Thrips damage and frequency of chemical treatments.

Frequency of chemical treatments and pesticides employed in 94 citrus orchards visited were noted and were correlated with the level of observed thrips damage. Statistical analyses were performed using the statistical software XLSTAT Pearson Edition (Addinsoft 1995-2014).

RESULTS

Scars confused with those caused by thrips.

As pointed out in the introduction, thrips damage evaluation was difficult because there were many abiotic and biotic agents that may cause scars very similar to those produced by thrips. The Fig. 1 shows some of the most common types of physical (Fig. 1a,b,c,e), chemical (Fig. 1d) or biotic symptoms (Fig. 1f,g,h,i) observed on citrus fruits in visited orchards.

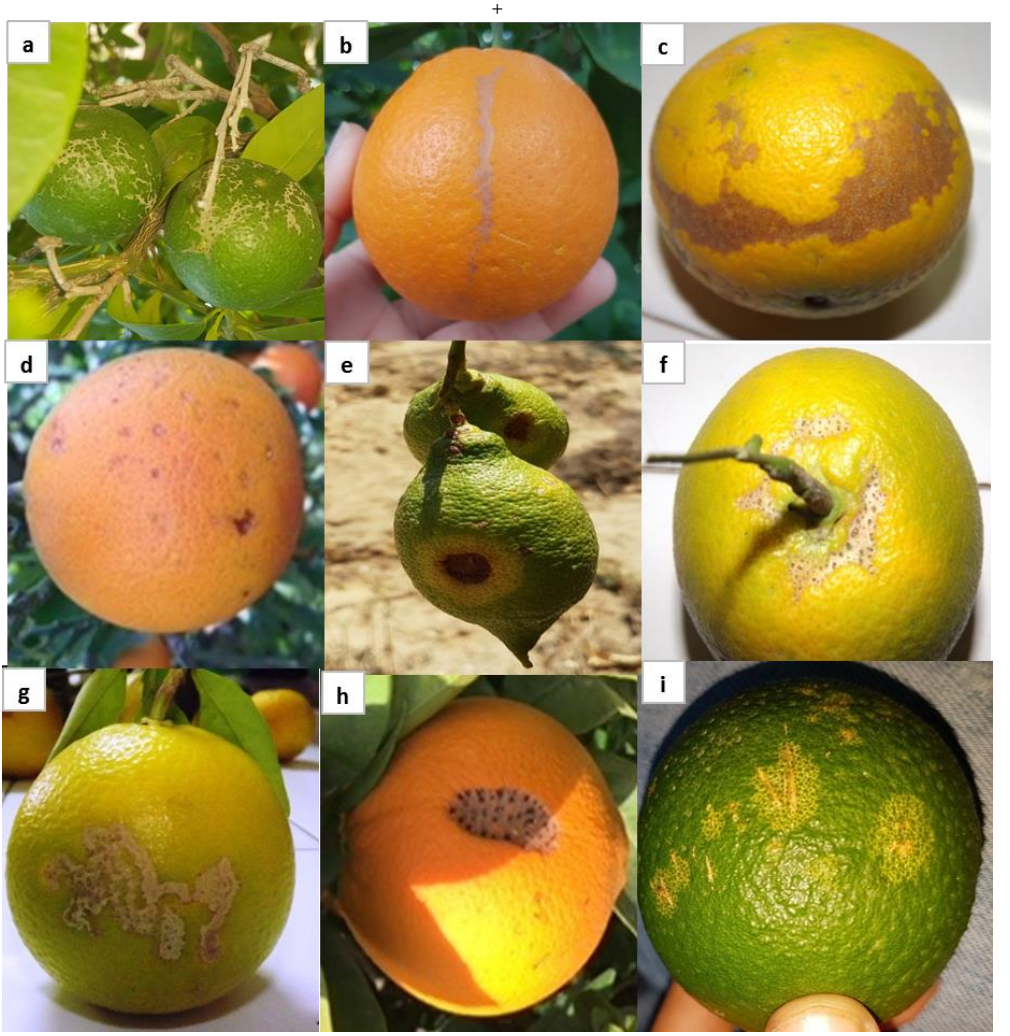

Fig. 1. Citrus symptoms that can be confused with thrips scars, a and b: Scars resulted from rubbing between fruit and other plant organ caused by wind; c: Strong dust wind effect; d: phytotoxicity; e: sunburn effect; f: damage probably of Amorbia larva; g: tunnels caused by the citrus leaf-miner; h: scars caused by chewing insects probably Orthoptera; i: scars of leafhoppers.

Thrips damage.

Two types of thrips damage were observed in the 101 visited citrus orchards: 1/ a silvery partial or complete ring at the base of the fruit or fruit peduncle (Fig. 1a,b) and 2/ marbling more or less developed (Fig. 2c).

The ring depreciation is caused specifically by *P. kellyanus*. It affects 12.17% of fruits for all citrus species and orange varieties (Table 3). Regarding the marbling scars, they are probably produced by *Frankliniella occidentalis* and *Thrips major*, which are major species, found in citrus orchards (on flowers and fruits) in Tunisia (Belaam-Kort and Boulahia-Kheder 2017). They were estimated on 5.13% of fruits for all citrus species and orange varieties (Table 3).

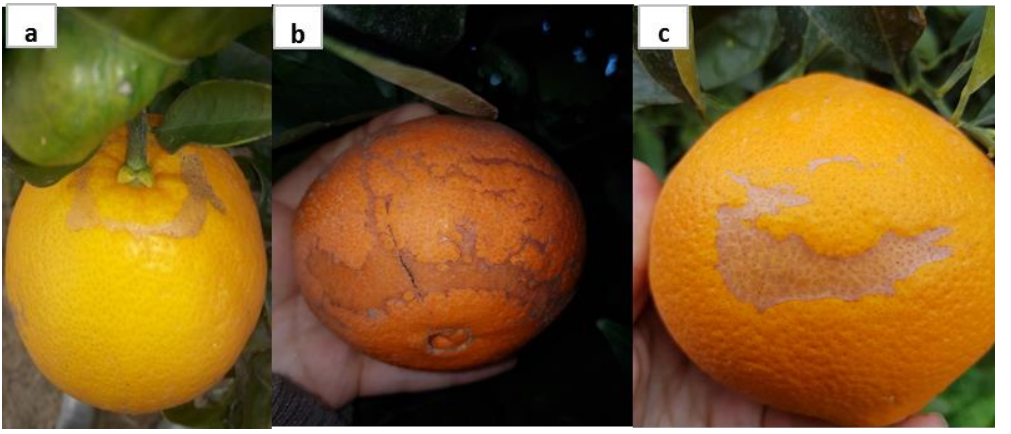

Fig. 2. Thrips damage, a: ring around the peduncle of a fruit; b: ring at the base of a fruit; c: marbling on Navel Orange.

Table3. Thrips damage on citrus fruits for all checked citrus species and orange varieties

Parameter	Type of damage		Total of checked fruits
	Marbling	Ring	
Total of fruits	8039	19090	156700
Damaged fruits (%)	5.13	12.17	100
[Min-Max] (%)	0.41-78.9	0.1-87.6	-

Sensitivity of citrus to thrips damage.

Fig. 3 shows that Bergamot and Lemon are the most sensitive species to *P. kellyanus* with 58.96% and 48% of damaged fruits respectively in all visited citrus orchards (Fig. 4a,b). Grapefruit, Navel orange, Clementine and Mandarin are less sensitive, with less than 1% of affected fruits (Fig. 4c). The Maltaise, Double Fine and Valencia Late oranges did not show any symptoms due to *P. kellyanus* (Fig. 3).

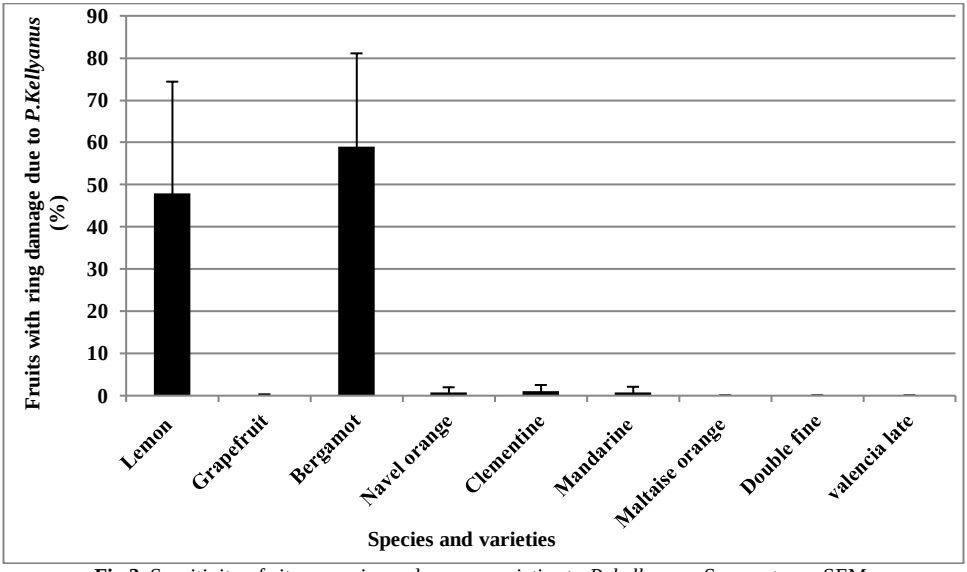

Fig 3. Sensitivity of citrus species and orange varieties to *P. kellyanus.* Segments are SEM.

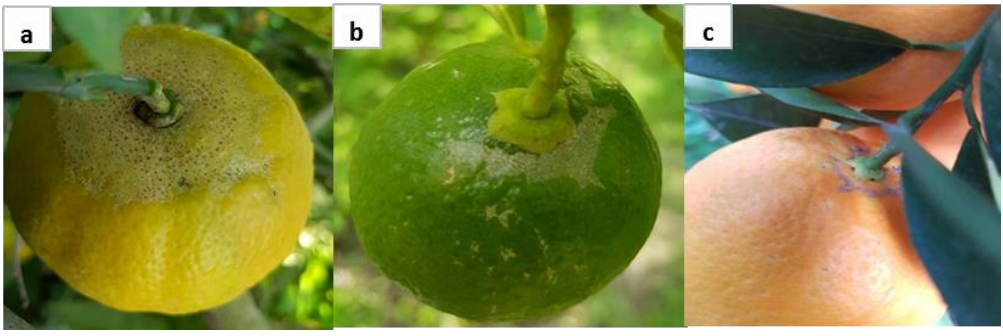

Fig. 4. Silvery ring caused by *P.kellyanus* on Bergamot (a), Lemon (b) and Navel orange (c).

Fig. 5 shows that Navel and Maltaise oranges are the most sensitive to marbling damages with 24.33 and 17% of damaged fruits respectively in all citrus visited orchards (Fig. 6a,b). Grapefruit, Lemon, Double fine orange, Clementine and Mandarin are less sensitive with less than 2% of affected fruits. Bergamot and Valencia Late oranges did not show any marbling (Fig. 5).

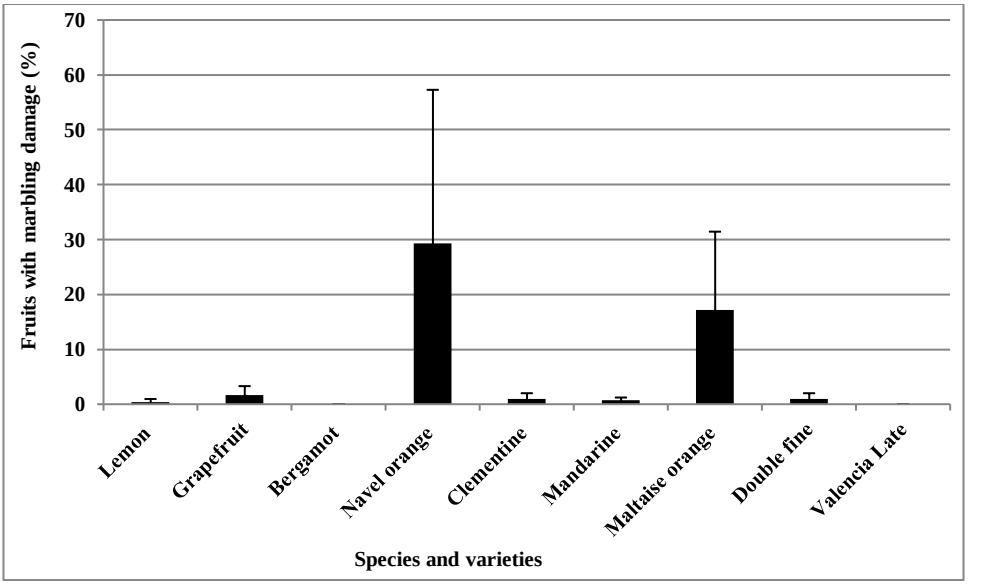

Fig. 5. Sensitivity of citrus species and orange varieties to marbling damage caused by thrips species different from *P. kellyanus*. Segments are SEM.

Fig. 6. Marbling on Navel (a) and Maltaise oranges (b)

Thrips damage and frequency of chemical treatments.

The frequency of chemical treatments in 94 citrus orchards visited in 3 regions of Tunisia (Bizerte, Mornag and Cap-Bon) was between 1 and 25 treatments per year. Among the surveyed orchards, only two organic orchards did

not receive any chemical treatments. Many insecticides, mostly Organophosphates (OP), were used in visited citrus orchards. About 83.78% of orchards were sprayed with malathion, methidathion, deltametrin, thiacloprid, acetamiprid and only 16.21% by organic products: spinosad, abamectin and azadiracthin (Table 4).

Table 4. Frequency of chemical treatments in the citrus orchards visited (n = 94)

Insecticide treatments (number/ year)	Scarred fruits (%)	Organic insecticides		Synthetic insecticides	
		Active ingredient	Sprayed orchards	Active ingredient	Sprayed orchards
<4	14%			Malathion	81
		Spinosad	17	Methidathion	69
4-10	25%	Abamectin	9	Deltametrin	53
		Azadiractin	22	+ Thiacloprid	
>10	48%			Acetamiprid	45

The correlation between damage level of thrips and frequency of chemical interventions shows that the infestation increases with high number of treatments used in citrus orchards (Table 4 and Fig. 6). Data shows a correlation (Pearson) positive (R = 0.836) and significant ($P < 0.01$) between the level of thrips damage and the number of phytosanitary treatments.

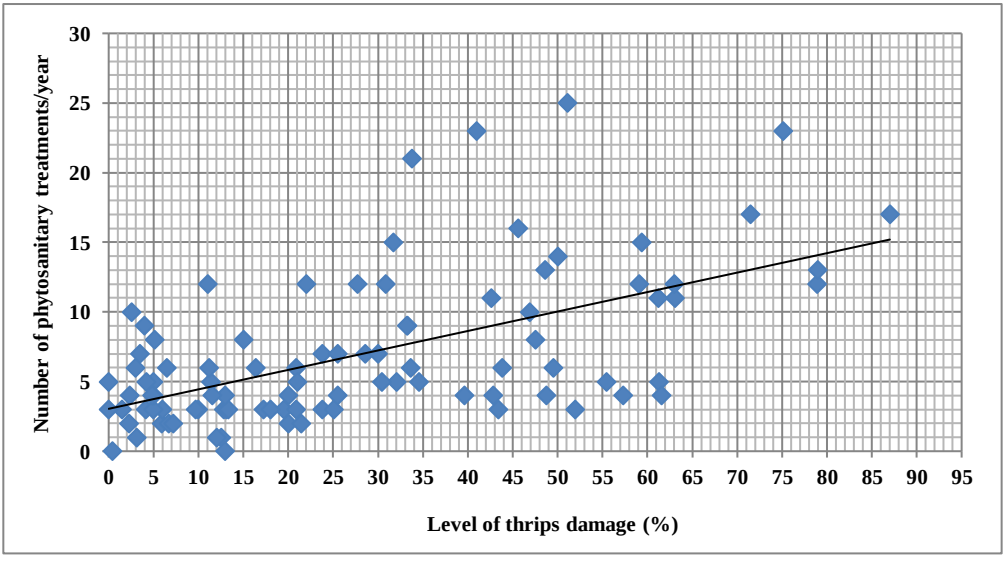

Fig. 6. Regression between thrips damage and frequency of chemical treatments in citrus orchards (n = 94)

DISCUSSION

In Tunisia, thrips were previously not considered as citrus pests. However, recently many farmers have complained about some scarring on citrus fruits that seems to be caused by thrips. This is why we considered it important to assess accurately thrips damage on citrus as well as to identify species living in citrus orchards. Several prospections had shown that 21 species were present in citrus orchards, either on citrus and/or herbaceous plants. The most abundant thrips were *F. occidentalis*, *T. major* and *P. kellyanus* (Belaam-Kort and Boulahia-Kheder 2017a). Regarding damage, field observations showed that scars caused by thrips can be easily confused with injuries caused by other biotic or abiotic agents. This difficulty already cited by other authors (Garcia-Marí and Palacios 1999; Grafton-Cardwell et al. 2003), has been overcome by repeated rigorous observations. The obtained results showed that in Tunisia, thrips symptoms are becoming more noticeable, as they affect about 18% of fruits for all surveyed citrus species and orange varieties. The percentage of injured fruits varies between 0.1 and 87.6%. Two types of fruit damage caused by thrips were observed in the visited citrus orchards: silver ring scars caused by *P. kellyanus* on 12.17% of all citrus species and orange varieties and marbling scars most probably caused by *T. major* or *F. occidentalis* on 5.13% of all citrus species and orange varieties. Bergamot and Lemon were the most sensitive to ring scars with 60 and 50% of damaged fruits, respectively; however, Navel and Maltaise oranges were the most affected by marbling scars with 25 and 17% of damaged fruits, respectively.

This work indicates that the level of thrips damage recorded in Tunisia for 2015-2017, close to 20% for all citrus species and orange varieties, should be considered with attention. Especially for the species *P. kellyanus*, an important citrus pest in some areas of the Mediterranean region, whose damage has increased compared to previous surveys. Indeed, in this study, *P. kellyanus* was detected in 41 citrus orchards over 101 visited, causing injuries on 12.17% of all citrus species and orange varieties, while in 2012, this species damaged no more than 2% of fruits (Belaam-Kort and Boulahia-Kheder 2017). The same results were observed in Turkey, where fruits damaged by thrips ranged between 3.8% and 9.1% depending on varieties (Elekcioğlu 2013). Regarding the specific symptoms of *P. kellyanus*, in 2009 then in 2013, Elekcioğlu (2013) and Teksam and Tunç (2009), reported that they did not exceed 10%. In contrast, in other countries such as Spain, Italy, Cyprus, Australia and New Zealand, the damage caused by *P. kellyanus* was significantly more severe, ranging between 20 and 80% (Baker 2016; Blank and Gill 1997; Conti et al. 2001; Navarro et al. 2010; Vassiliou 2007). Among the factors that increase *P. kellyanus* populations and injuries, is the presence of several alternative host plants in citrus agro-ecosystem that can sustain *P. kellyanus* breeding, as was observed in Spain (Navarro et al. 2013), Cyprus (Vassiliou 2010) and New Zealand (Froud et al. 2001) where *Jasminum* spp., *Lonicera* spp., *Gardenia jasminoides* and *Araujia sericifera* play a determinant role for thrips presence year-round. This is unlike in Tunisia where only 2 alternative host plants for *P. kellyanus* were found: *Jasminum officinale* and *Bunium pachypodium* (Belaam-Kort and Boulahia-Kheder 2017b). Regarding the sensitivity to *P. kellyanus*, Bergamot and

Lemon appear to be the most susceptible with respectively 58.96 and 48% of severe or fine scars on fruits. Grapefruit, Clementine, Mandarin citrus, and Navel, Maltaise, Double Fine, Valencia Late oranges, are much less sensitive to *P. kellyanus* with less than 1% of damaged fruits. Similar results were observed in other Mediterranean countries (Italy, Spain and Turkey) where Lemon was the most commonly attacked species by *P. kellyanus*, followed by orange, then by clementine (Conti et al. 2003; Elekcioğlu 2013; Navarro et Garcia-Mari 2017). Interestingly, based on these results, we see that Lemon is very sensitive to *P. kellyanus*, while it is resistant to the polyphagous fruit fly *Ceratitis capitata* (Bodenheimer 1951; Papachristos et al. 2009). Papachristos et al. (2009) explained the practical immunity of Lemon to *C. capitata* by the high percentage of acid in the Lemon pulp that acts as a protective agent. This component does not seem to be a deterrent factor for thrips. However, regarding the sensitivity/resistance of citrus to thrips, no much research has been conducted. Brodbeck et al. (2001) demonstrated that seasonal trends of *F. occidentalis* on tomato were correlated to the number of flowers per host plant as well as the concentrations of total nitrogen in flowers. Some authors suggested the difference in ovipositional preferences and the suitability of fruit skin for nymphal survival and development (Sreedevi and Rajulu 2008). Other researchers thought that the size of flowers and the presence of aromatic amino acids may play a role in the nutritional ecology of thrips (Brodbeck*et* al. 2001; Marullo 1998). Therefore, investigations on the morphological and biochemical basis of resistance to thrips for genotypes would be one of the promising future topics of research.

Regarding marbling, this depreciation is probably produced by *Frankliniella occidentalis* or *Thrips major*, species that are abundant and common in citrus orchards of Tunisia and living on citrus fruits and flowers (Belaam-Kort and Boulahia-Kheder 2017). Marbling affects about 5% of all citrus species and orange varieties, with a higher sensitivity in Navel and Maltaise oranges for which respectively 24 and 17% of injured fruits have been recorded in all visited citrus orchards. The other citrus species and orange varieties are less sensitive with less than 2% of affected fruits. Currently, this damage poses problems particularly to Navel and Maltaise varieties, since they occupy the first position in citrus production in Tunisia. Concerning the orange Maltaise that is the most exported variety, a percentage of 1% of thrips damage can reduce its marketability, especially that Tunisian citrus exportations are decreasing and lower than the quota set by the UE estimated to 34 000 t for Tunisia (Hassen Daly, personal communication 2018), and this is due to diseases and pests including thrips that affect the quality of citrus fruits.

In addition, this study demonstrates that thrips damage increases with increasing number of treatments used in citrus orchards and this may be explained by the fact that thrips are associated with the phenomenon of secondary pest outbreak. This phenomenon has been known to occur in response to a reduction or destruction of natural enemy populations, releasing the pest population from regulation (Dutcher 2007). This phenomenon could explain the increasing of other pests in Tunisia such as *Icerya purchasi* and *Planococcus citri*. For example, *I. purchasi* spreads the last years at a harmful level in citrus orchards most probably as a result of the

elimination of its natural enemies, especially *Rodolia cardinalis*, by the abusive use of chemicals to control the Mediterranean fruit fly. In fact, malathion which is the main insecticide used is known to be toxic to many beneficials such as *Cryptolaemus montrouzieri* and *Leptomastix dactilopii*, natural enemies of the mealybug *P. citri* (Abbes et al. 2018; Rahmouni et al. 2015).

This study shows that currently, the thrips damage in Tunisian citrus orchards is increasing. Hence, these pests require regular monitoring in order to prevent population outbreak and more importantly to detect early new species that could be very aggressive and cause severe damage. Regarding the species *P. kellyanus*, it needs to be monitored in Tunisia at least on Lemon and Bergamot because of its extensive damage and the increase of its area of invasion in recent years. Further investigation is required to determine the status of the species *T. major* and *F. occidentalis* in citrus orchards and to confirm their harmfulness and role in causing marbling scars. Furthermore, chemical treatments in citrus groves must be managed in order to preserve the natural enemies of thrips: those hosted by the foliage of citrus or by herbaceous plants as well as those living into the ground (Belaam-Kort et al. 2018).

Acknowledgements

The authors thank all farmers visited in Bizerte, Cap-Bon and Mornag for their assistance during this study.

RESUME

Belaam-Kort I. et Boulahia-Kheder S. 2019. Evaluation des dégâts des thrips en vergers d'agrumes en Tunisie. Tunisian Journal of Plant Protection 14 (1): 55-68.

Avant les années 2000, les dégâts causés par les thrips sur agrumes en Tunisie, étaient considérés comme rares ou absents. Cependant, ces dix dernières années et depuis le premier signalement de l'espèce *Pezothrips kellyanus* en 2008, diverses cicatrices sur fruits attribuées aux thrips, sont de plus en plus enregistrées. Suite à l'inventaire des espèces de thrips en vergers d'agrumes, ce travail vise à évaluer les dégâts causés par ces ravageurs sur différentes espèces d'agrumes et variétés d'orange, afin d'étudier la sensibilité des ces espèces et variétés à ces insectes. L'utilisation des insecticides a également été recensée en relation avec les dégâts des thrips. Ces derniers ont été estimés par l'observation de 200 à 1000 fruits mûrs dans les 101 vergers visités des régions du Cap-Bon, Bizerte et Mornag, de décembre à février, pendant les années 2015 à 2017. Les espèces d'agrumes et variétés d'orange examinées étaient les suivantes : citron, bergamote, pamplemousse, clémentine, mandarine et oranges Navel, Maltaise, Valentia Late et Double Fine. Les insecticides ainsi que leur fréquence d'utilisation dans chaque verger ont été notés. Les dégâts des thrips sur fruits tous types confondus étaient en moyenne de 20% pour toutes les espèces d'agrumes et variétés d'orange. La bergamote et le citron étaient les plus sensibles à l'espèce *P. kellyanus* causant des anneaux argentés, tandis que les oranges Maltaise et Navel étaient plus affectées par les marbrures causées par d'autres espèces. Les données fournies par 94 agrumiculteurs ont montré que les dégâts augmentent avec le nombre de traitements chimiques/an. Cette étude montre que les dégâts des thrips sont de plus en plus fréquents dans les vergers d'agrumes en Tunisie. Ils pourraient dans l'avenir prendre plus d'ampleur car la gestion des nuisibles des agrumes repose principalement sur des insecticides à large spectre qui en éliminant les insectes utiles, risquent de renforcer les populations des thrips, d'où la nécessité de rationaliser les interventions chimiques et de généraliser le recours aux méthodes alternatives.

Mots clés: Agrumes, anneaux, *Frankliniella occidentalis*, marbrures, *Pezothrips kellyanus*, sensibilité, Thrips, *Thrips major*, traitements chimiques

ملخّص

بالعم-قرط، إيمان وسندة بولحية-خذر. 2019. تقييم أضرار حشرة التربس في بساتين القوارص/الحمضيات بتونس.
Tunisian Journal of Plant Protection 14 (1): 55-68.

قبل سنوات 2000، كان الضرر الناجم عن التربس يعتبر نادرًا أو غير موجود في بساتين القوارص/الحمضيات التونسية. مع ذلك، خلال السّنوات العشر الأخيرة ومنذ تسجيل لأول مرّة لنوع *Pezothrips kellyanus* سنة 2008، تمّ تسجيل العديد من أعراض ندوب الفاكهة المنسوبة إلى آفة التربس بنسق تصاعدي. بعد حصر أنواع التربس في بساتين القوارص، يهدف هذا العمل إلي تقييم الأضرار النّاجمة عن هذه الآفة على أنواع مختلفة من القوارص وأصناف مختلفة من البرتقال. تمّت مراقبة 200 إلي 1000 فاكهة ناضجة من 101 بستان في الوطن القبلي وبنزرت ومرناق وذلك منذ ديسمبر إلي فيفري من سنوات 2015 إلي 2017. تمّ فحص أنواع القوارص اللّيمون والليمون الهندي/الزّنباع والبرغموت والكليمنتين والماندرين وأصناف البرتقال نافل وفالنسيا لايت ودبل فين ومالطي. بلغ معدّل نسبة الأضرار النّاجمة عن التربس 20% على جميع أنواع القوارص وأصناف البرتقال. كان نوعيْ اللّيمون والبرغموت لهما حساسية لحشرة *P. kellyanus* الّتي تسبّب حلقات فضّية علي الفاكهة في حين كان صنفيْ البرتقال مالطي ونافل الأكثر حساسية لأنواع أخري من التربس. لوحظ أيضا من خلال بيانات 94 فلاح قوارص، أنّ أضرار التربس تزداد مع تكرار المعاملات بالمبيدات الحشرية وتبيّن من خلال هذا العمل، أنّ أضرار التربس في تصاعد في تونس وقد تصبح الأكثر أهمّية لأنّ إدارة آفات القوارص تعتمد بشكل رئيسي على مبيدات حشرية واسعة الطيف التي تقضي على الحشرات النافعة ومن هنا تتبين الحاجة إلي ترشيد التّدخّلات الكيميائيّة وتعميم استخدام الطّرق البديلة.

كلمات مفتاحية: أعراض حلقات، أعراض مرمرية، تربس، حساسية، قوارص/حمضيات، معاملات كيميائية، *Frankliniella occidentalis*، *Pezothrips kellyanus*، *Thrips major*

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