Thrips diversity and *Frankliniella occidentalis* trends on three melon cultivars at Biskra, Algeria

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Abstract
Globally, thrips pest of agro-ecosystems are well studied. Nevertheless, in Algeria this insect group remains poorly known. The research was conducted to determine thrips composition and population changes of *F. occidentalis* on three melon cultivar. The study highlighted six thrips species on three melon cultivars (*Star plus, DRM* and *Mimosa)*, including two of economic importance pests, namely *Frankliniella occidentalis* and *Thrips tabaci*. The remaining species are: *Odontothrips loti*, *Aeolothrips intermedius*, *T. minutissimus* and *Melanthrips fuscus*. The western flowers thrips (WFT) *F. occidentalis* was eudominant species, while *T. tabaci* was subrecedent. Blue sticky traps allow detecting thrips early for monitoring and from crop development starting. A positive and significant relationship was observed between thrips abundance in traps and WFT recovered from flowers and leaves on all cultivars. The highest numbers of WFT were recorded on *DRM* flowers and *Star plus* leaves while the least numbers were noticed on *Mimosa* flowers and leaves. *F. occidentalis* flight activity was observed early in the growing season. Similar trend of thrips population changes was recorded during crop season. Nevertheless, one to two peaks of *F. occidentalis* population were registered on flowers and leaves on all cultivars. They were mainly observed in April when temperatures were high and humidity low, their numbers were not considerable. No fruits damage was observed *in situ* on all cultivars. This work allowed to improve knowledge about thrips linked to some melon cultivars the most used in greenhouse in the region of Biskra. The presence of these pests can be a source of concern for farmers. Extending monitoring to other crops and localities to know their status and distribution remains a priority due to direct damage caused and virus transmission hazard.

Key words
Thrips, diversity, relationship, population changes, *Frankliniella occidentalis*, Algeria

Résumé
Dans le monde, les thrips ravageurs des agro-écosystèmes sont bien étudiés. Cependant, en Algérie ce groupe d'insecte reste mal connu. Le but de l'étude est de déterminer la composition des thrips et la dynamique de population de *F. occidentalis* sur trois cultivars de melon (*Star plus, DRM* et *Mimosa)*. Six espèces de thrips dont deux sont considérées nuisibles d'importance économique ont été identifiées : *Frankliniella occidentalis* et *Thrips tabaci*. Les autres espèces sont *Odontothrips loti*, *Aeolothrips intermedius*, *T. minutissimus* et *Melanthrips fuscus*. *Frankliniella occidentalis* (thrips californien) est une espèce eudominante, tandis que *T. tabaci* est subrésidente. Les pièges bleus adhésifs permettent de détecter les thrips tôt avant la croissance des cultures. Une relation positive et significative a été observée pour l'abondance de thrips sur les fleurs et feuilles de tous les cultivars. Le thrips californien est le principal thrips nuisible. Il est présent sur tous les cultivars à des taux différents. Les nombres les plus élevés du thrips californien ont été enregistrés sur les fleurs de *DRM* et les feuilles *Star plus*. Les abondances les plus faibles ont été notées sur les fleurs

et les feuilles du cultivar *Mimosa*. L'activité de vol de *F. occidentalis* a été observée au début de la saison de croissance du melon. La dynamique de population des thrips sur les trois variétés présente la même tendance. Un à deux pics ont été enregistrés sur les fleurs et feuilles de tous les cultivars. Ils sont observés en avril où les températures sont élevées et l'humidité faible, leur nombre n'était pas considérable. Aucun dommage aux fruits n'a été observé *in situ* durant l'étude. Ce travail a permis d'améliorer les connaissances des thrips liés à quelques variétés de melon les plus utilisées sous serre dans la région de Biskra. La présence de ces ravageurs peut constituer une source de préoccupation pour les agriculteurs. Etendre le suivi à d'autres cultures et localités pour connaitre leur statut et distribution reste une priorité à cause des dégâts directs qu'ils peuvent occasionner et le risque de transmission de virus.

Mots clés
Inventaire, corrélation, dynamique de population, *Frankliniella occidentalis*, Algérie

1 INTRODUCTION

Cucurbits crops such melons are cultivated for their fruits throughout the world (Romay *et al.*, 2014). In Algeria, melon cultivation is grown in open fields or in greenhouses. They are harvested and consumed essentially mature as fruits. Melon cucurbit is a crop of high economic importance in Biskra (Algeria) given cultivated areas dedicated each year to this crop (about 1,292 ha). The production was estimated to more than 52203 tons/ ha at Biskra (M. Gouaned, pers. comm.).
Melon crop faces various viral, fungal diseases and other pests of economic importance including nematodes, mites, whiteflies, aphids and thrips (Romay *et al.*, 2014; Abdel-Rahman *et al.*, 2016; Sharma *et al.*, 2016). The latter are among the most important melon pests at Briska as worldwide, corresponding nearly 6000 species (Reynaud, 2010). Only 1% have been reported as serious pests of crops (Mound & Teulon 1995) and 0.15% are known to be vectors of tospoviruses (Mound, 2001), comprising the western flowers thrips (WFT) *Frankliniella occidentalis*. Larvae and adults of the latter are considered very harmful species on plants (Reitz, 2009; Mouden *et al.*, 2017), causing direct damage on different plant parts (stems, leaves, flowers, fruits...etc.) and transmitting viral diseases such as *Tomato spotted wilt virus* (TSWV) and other tospoviruses (Reitz, 2009). Most thrips have cryptic behavior (Mound, 1983; Morse & Hoddle, 2006). Their small size makes them difficult to detect on plants due to delayed damage appearance, which may defer pest control start (Reitz, 2009). Various methods are used to control thrips and protect crops, such as chemical and biological control (Demirozer *et al.*, 2012). Plants display various traits and strategies of defense for their protection against pests (Peterson *et al.*, 2016). Selection of suitable melon varieties correspond to potential undesirable plants for thrips and one preventive control strategy (Papadaki *et al.*, 2008).
The main objective of this study was to investigate thrips species diversity and abundance on three cultivars of melon under greenhouse environment considering the both thrips species diversity and population changes in Biskra conditions.

2 MATERIAL AND METHODS

2.1 Crops sets

The study was conducted in three plastic tunnel greenhouse of 400 m² surface areas, sited at Oued Beraze (east of Biskra) (N34°42.096', E006°00.167'). Greenhouses were oriented east-west. Melons were cultivated after two years of tomato crop growing. Each greenhouse was planted with one melon cultivar. The first greenhouse (G_1) was cultivated with *Star plus* cultivar, the second (G_2) with *DRM* (pineapple melon) and the third (G_3) with *Mimosa* cultivar. The seeds were sown in nursery before transplanting. The greenhouses contained about 300 plants arranged in six rows. The space between rows was 1 m and 0.9 m between plants. Melons were conducted horizontally on the

ground surface without plastic mulch. The crops were irrigated with drip system three times a week according to crop needs. The soil is poor in organic matter, strongly calcareous and very salty with alkaline pH. The most encountered pests were whiteflies, aphids and mites. The pesticides used during cultivation were summarized in table 1. Predatory bugs like *Orius* sp. and *Chrysopa vulgaris* Schneider were frequently observed.

Table 1 : Pesticides used during melon cultivation at Oued Beraze (Biskra)

Nom commercial	**Ingredient actif**	**Type**	**Dose employée**	**Ravageurs**
Romectin 250ml/ l	Abamectin (18 g/ l)	Acaricide/ insecticide	20 ml/ greenhouse	Mites, thrips
Horizel 25 EC	Tebuconazole (250 g/ l)	Fungicide	40 ml/ hl	Fungi (oïdium)
Mospilate	Acetameprid (200 g/ l)	Insecticide	30 g/ hl	Whiteflies

2.2 Thrips sampling

2.2.1 Blue sticky traps

Sticky traps were commonly used for detecting thrips occurrence and adult flight starting (Cloyd, 2009; Ugine *et al.*, 2011). Two blue traps (26 x 21 cm in size) were set in each greenhouse entrances. To avoid the edge effect, the traps were positioned a few meters (approximately 8 m) away from greenhouse doors. The traps were hung at 30 cm above plants and replaced regularly. The thrips were weekly counted *in situ* using a pocket magnifier glass (x10).

2.2.2 Blue water traps

Different colors preferences and attractiveness among many thrips species have been studied (Hoddle *et al.*, 2002; Rodriguez-Saona *et al.*, 2010). However, most thrips were captured and attracted by blue water traps. These help in determining thrips diversity and providing information on thrips activity (Andjus *et al.*, 2001). Three blue water traps (20 cm diameter and 12 cm in deep) were set per greenhouse on the ground and spaced from each other by few meters (approximately 10 m). Two of them were positioned at each greenhouse entrance and one at the middle. The containers were filled to with water and few drops of detergent. Trap contents were weekly collected and brought back to laboratory until crop end. Thrips were carefully recovered in the strainer under binocular magnifier and then placed in tubes containing 70% ethanol to be further slide mounted and identified with identification keys (Mound, 1974; Mound *et al.*, 1976; Mound & Walker, 1982, 1986).

2.2.3 Flowers recovery

Ten fully opened melon flowers (one flower per plant) were collected randomly each week and immediately placed in plastic bags to bring back to the laboratory. The flowers were carefully examined under a binocular magnifying glass for thrips extracting using a moistened brush. Recovered thrips were put in tubes containing 70% ethanol. Bloom sampling continued until plants stop producing flowers. Adult thrips were identified and counted (Manandhar *et al.*, 2017).

2.2.4 Leaves shaking

Shaking method allows to recover 80% of adults and 18% of larvae from leaves (Gonzalez-Zamora & Garcia-Mari, 2003). Foliage shaking started about three weeks after melon transplanting due to plant vigor. Every week, thirty leaves taken randomly were shaken 15 times. The leaves were gently and vigorously shaken to dislodge thrips and avoid damaging the plants on a white plateau of 30 cm diameter and 1.5 cm depth. Thrips dropped and were gathered with a moistened brush and placed in tubes containing 70% ethanol. Thrips were brought back to the laboratory, slide mounted for identification and counting.

2.3 Statistical analyses

Domination coefficient was calculated informing about the amount of collected species participating among sampled specimens in a given area using the formula from Kasprzak & Niedbała (1981): $D_i\ (\%) = n_i / N\ 100$
Di – domination coefficient of particular species in percent,
n_i – number of particular species,
N − total number of all thrips species collected

There are six classes of domination coefficient, they are as follows: eudominant (32.0-100.0%); dominant (10.0-31.9%); subdominant (3.2-9.9%); recedent (1.0–3.1%), subrecedent (0.3-0.9%) and sporadic (< 0.3%).
Recorded data from sampling were transformed using natural logarithm ln (x + 1) before analysis. One-way ANOVA analysis was performed for significance, and then *LSD* test was used to separate means at $P< 0.05$. Relationship between thrips collected on flowers and caught on blue sticky traps on the different cultivars was performed with Pearson's correlation; *P* and *t* values were calculated using t- test of student. Data analyses were carried out using Statistica 6 StatSoft, Inc. 1984-2003.

3 RESULTS

3.1 Thrips composition

A total of 2664 thrips individuals were collected from the two sampling methods. The terebrantian thrips were estimated to be 98%. Six thrips species on melon crop were determined: *Frankliniella occidentalis* Pergande, *Thrips tabaci* Lindeman, *Odontothrips loti* Haliday, *Aeolothrips intermedius* Bagnall, *T. minutissimus* L., *Melanthrips fuscus* Sulzer. Some unidentified tubulifers for different reasons were collected during the study (< 2%). The population of *F. occidentalis* (eudominant species) was the commonest species and very significant on the three melon cultivars. The calculated domination coefficient revealed a percentage of 84.9% on *Star plus*, 83.2% on *DRM* and 87.1% on *Mimosa* cultivar. Followed by *T. minutissimus* as dominant species on *Star plus* (13.6%), *DRM* (13.9%) and as subdominant on *Mimosa* cultivar (6.6%). On *Star plus*, the population was subrecedent (0.8%), recedent on *DRM* (2.3%) and subdominant on *Mimosa* (4.1%). However for *O. loti*, it was subrecedent on all cultivars (0.7% on *Star plus*, 0.5% on *DRM* and 0.3% on *Mimosa*). Only one specimen of *M. fuscus* was collected on *Star plus* and *DRM* cultivar. Calculated coefficients of dominance were respectively two times sporadic and one time recedent on *Mimosa*. *T. tabaci* was only recovered on *Mimosa* cultivar as subrecedent species (0.8%). In overall, thrips composition of melon cultivars was similar and varied in numbers of specimen.

3.2 Seasonal trends in thrips abundance

DRM cultivar hosted larger thrips populations in blue sticky traps (69.1 ± 88.5), followed by *Mimosa* cultivar (208.8 ± 196.1) while the lowest thrips captures was noticed on *Star plus* cultivar

(157.5 ± 125.8). The difference between thrips average number caught in blue sticky traps in the different greenhouses was not significant (F = 2.90, P = 0.065). However, the least significant difference test revealed that the difference in thrips abundance was significant between *Star plus* and *DRM* cultivar (P = 0.035).

Flight activity was low and increased progressively from March to mid April for *DRM* cultivar, beginning of May for *Star plus* and for *Mimosa* cultivar. Catches continued until plants grubbing-up by farmer on mid May.

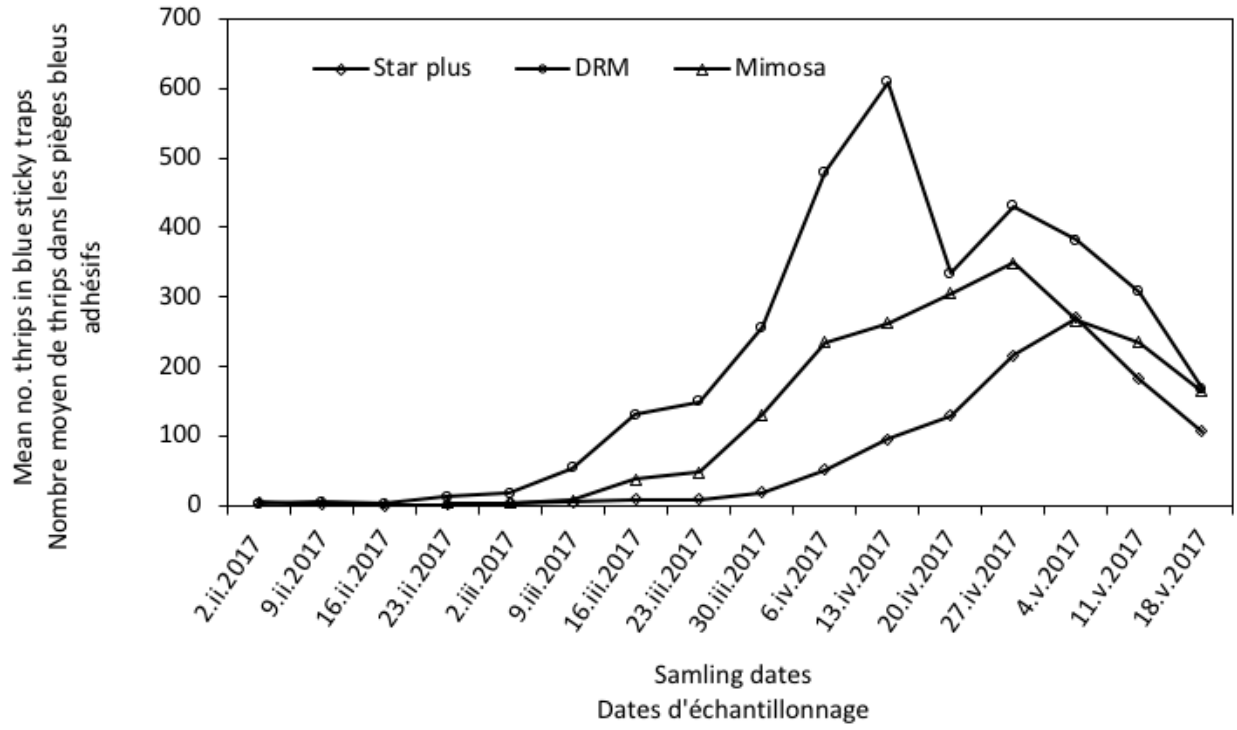


Figure 1: Mean numbers of thrips caught in blue sticky traps coming from three melon cultivars at Oued Beraze (Biskra).

Letters in lowercase indicate that there are no differences between mean numbers of *F. occidentalis* on flowers and leaves of the different cultivars.Letters in uppercase indicate that there are no differences between mean numbers of *F. occidentalis* on flowers and leaves of the same cultivar

Mean numbers of *F. occidentalis* on flowers and leaves of the different cultivars are presented.

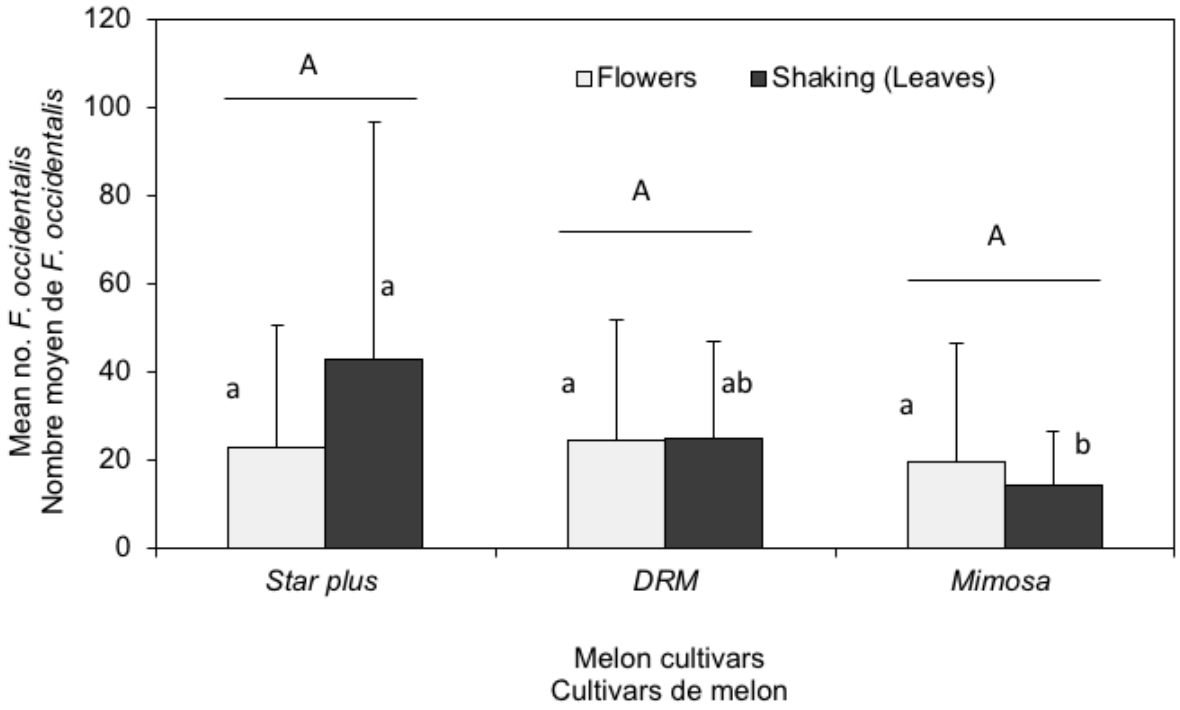
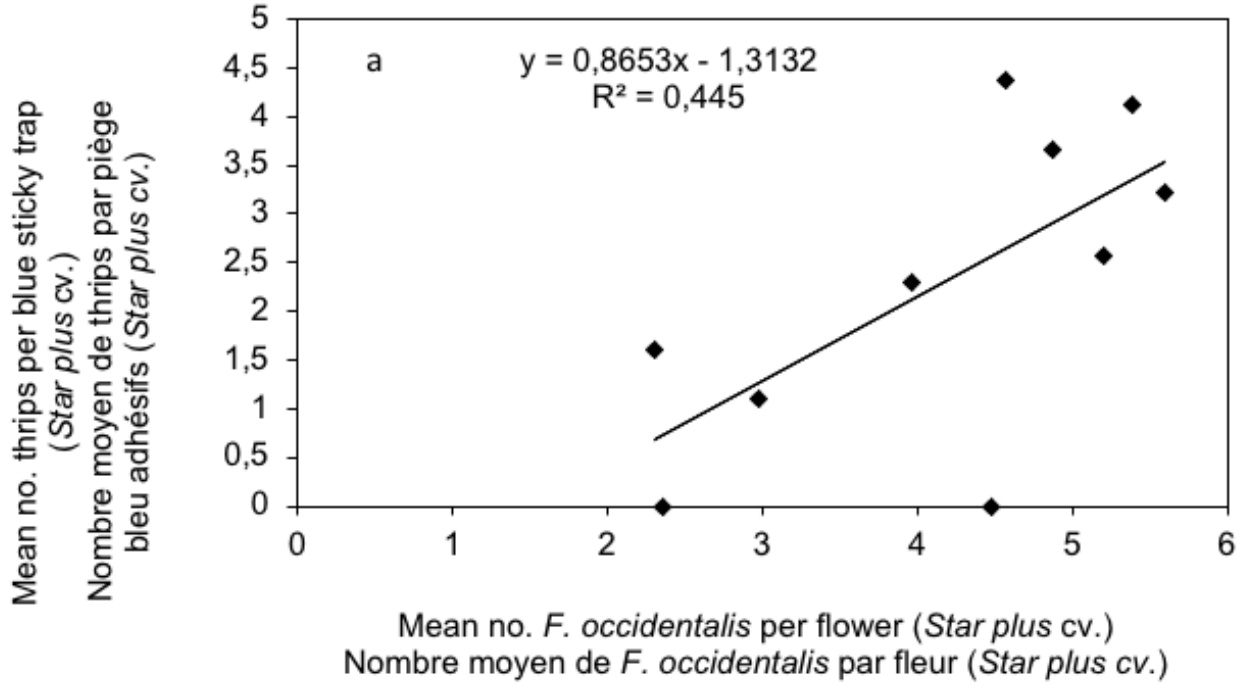


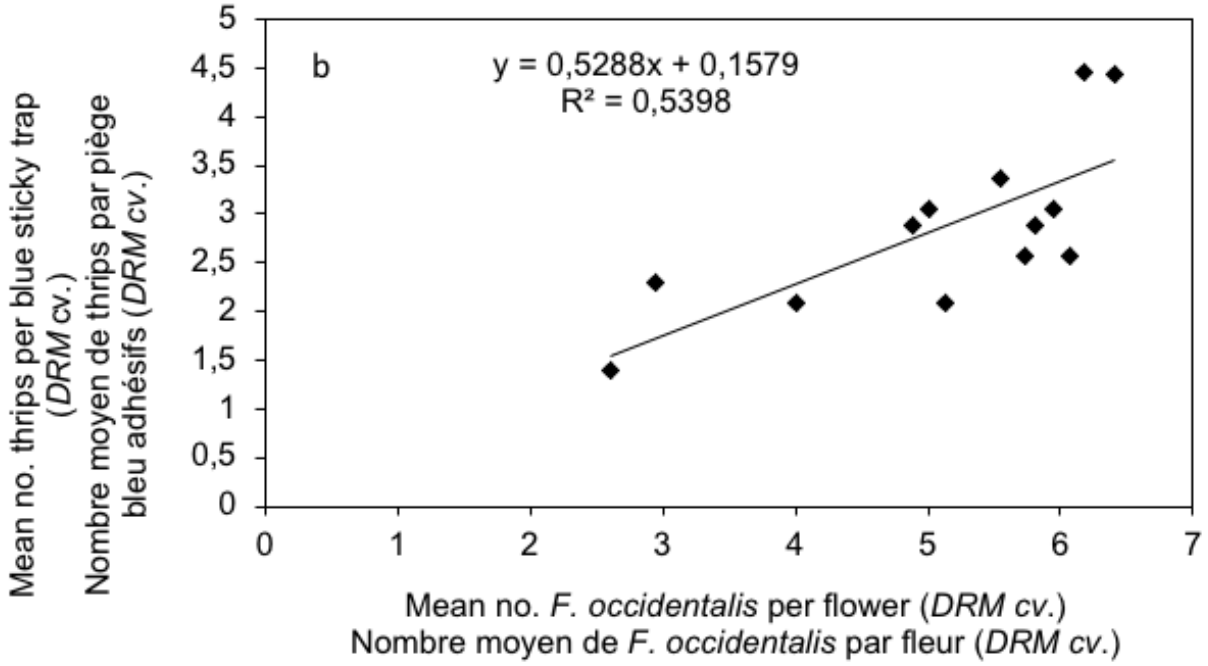
Figure 2: Comparison between seasonal mean numbers of *Frankliniella occidentalis* collected on flowers and obtained from shaking leaves on the different melon cultivars.

No statistical significance was observed between abundance of western flower thrips population among flowers ($F = 1.12$, $P = 0.343$) and leaves ($F = 0.43$, $P = 0.656$) of all cultivars. Excepting for mean numbers of *F. occidentalis* recorded on leaves of *Star plus* in relation to mean thrips collected on *Mimosa* cultivar which was significant ($P = 0.049$).

3.3 Comparison of trapping and thrips collection on plants

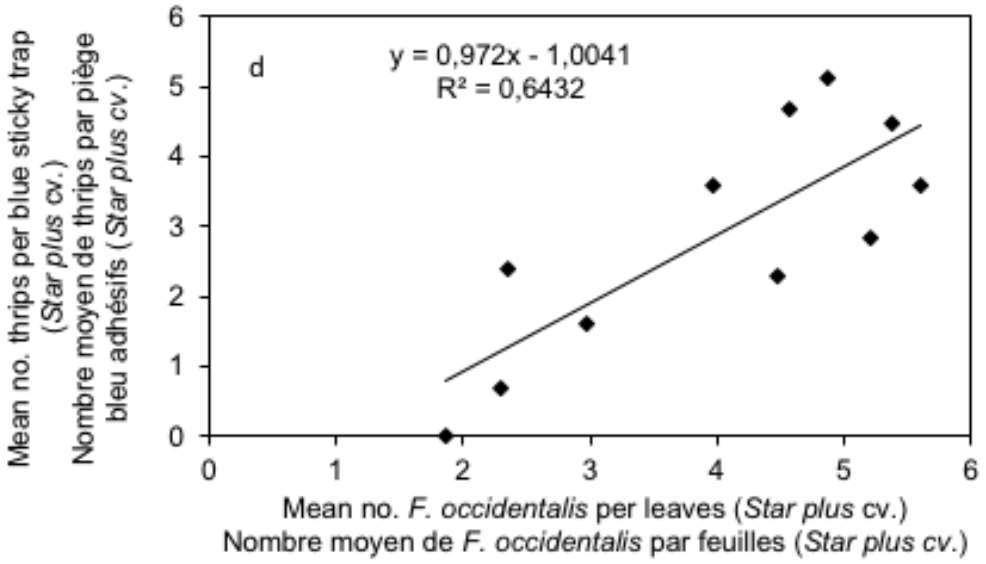
The flowers number of melon crop was low at first and then increased during the growing season. The relationship observed between number of thrips captured in blue sticky traps and the number of *F. occidentalis* sampled on flowers of *Star plus* and *DRM* cultivars was strong.

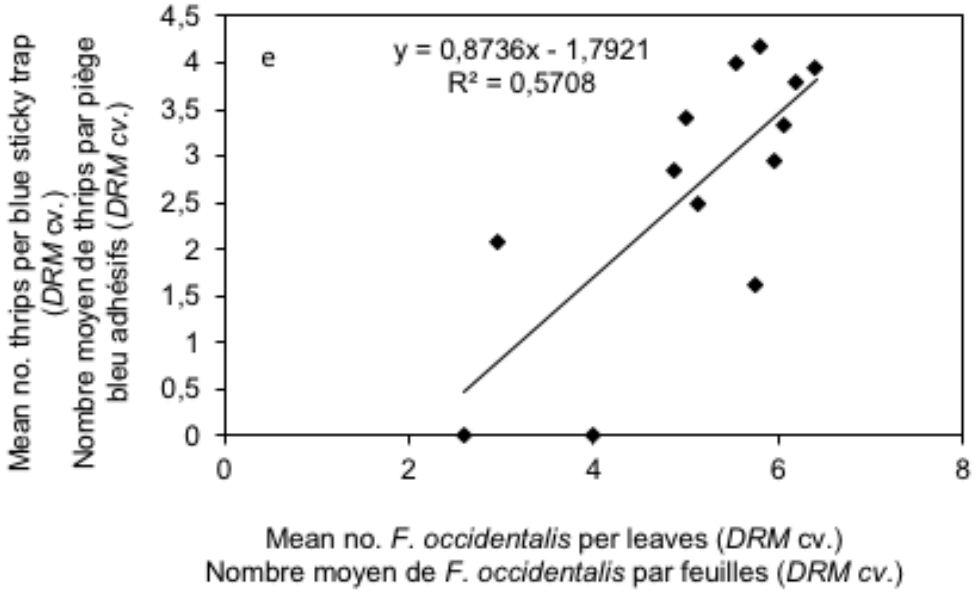




The correlation coefficients recorded for these two cultivars were respectively $R = 0.67$ and $R = 0.74$ for *Star plus* and *DRM* respectively. This relationship was positive, and significantly correlated for both cultivars ($t = 4.94$, $P < 0.001$ and $t = 9.79$, $P < 0.001$ for *Star plus* and *DRM* respectively). For *Mimosa* cultivar, a medium intensity correlation was observed ($R = 0.34$) and this relationship was positive, and significantly correlated ($t = 5.92$, $P < 0.001$) (Figure 3c).

Regarding WFT sampled on leaves by shaking method, the relationship with total number of thrips caught in blue sticky traps was very strong for *Star plus* ($R = 0.80$) (Figure 3d) and *Mimosa* cultivars ($R = 0.89$) (Figure 3f); whereas it was strong for *DRM* cultivar ($R = 0.76$) (Figure 3e). All relationships were positive, and significantly correlated ($t = 3.76$ and $P = 0.004$; $t = 9.39$ and $P < 0.001$; $t = 11.67$ and $P < 0.001$ for *Star plus, DRM* and *Mimosa* respectively).


d
y = 0,972x - 1,0041
R² = 0,6432
Mean no. thrips per blue sticky trap (*Star plus* cv.)
Nombre moyen de thrips par piège bleu adhésifs (*Star plus cv.*)
Mean no. *F. occidentalis* per leaves (*Star plus* cv.)
Nombre moyen de *F. occidentalis* par feuilles (*Star plus cv.*)


e
y = 0,8736x - 1,7921
R² = 0,5708
Mean no. thrips per blue sticky trap (*DRM* cv.)
Nombre moyen de thrips par piège bleu adhésifs (*DRM cv.*)
Mean no. *F. occidentalis* per leaves (*DRM* cv.)
Nombre moyen de *F. occidentalis* par feuilles (*DRM cv.*)

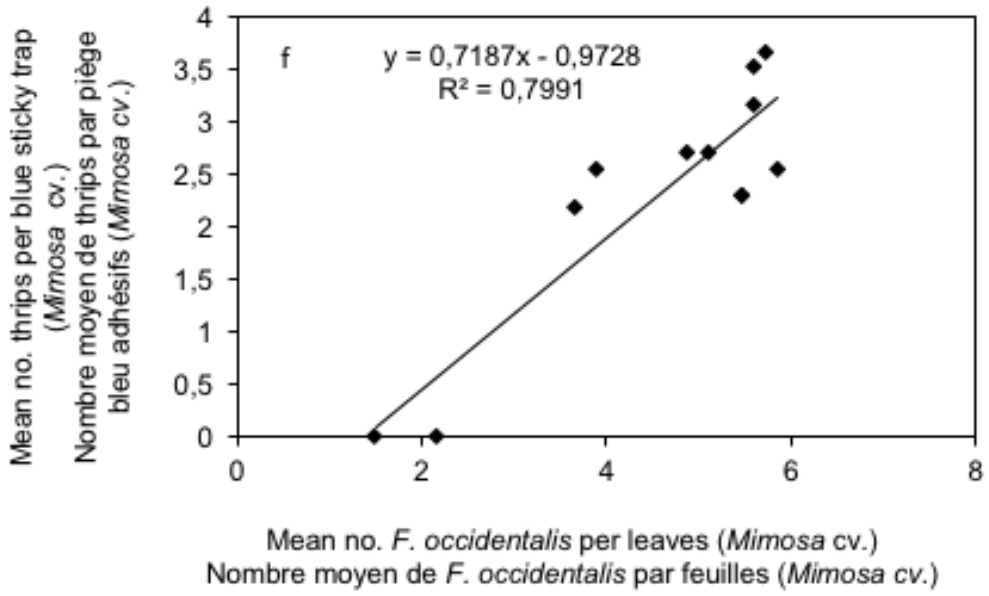
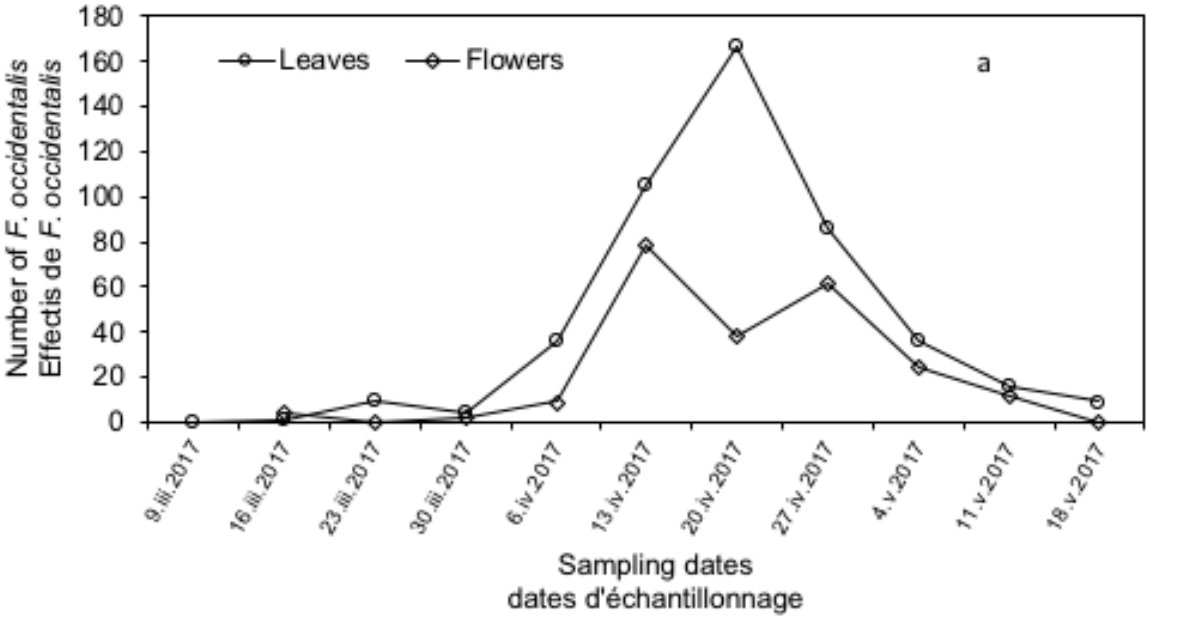

f
y = 0,7187x - 0,9728
R² = 0,7991
Mean no. thrips per blue sticky trap (*Mimosa* cv.)
Nombre moyen de thrips par piège bleu adhésifs (*Mimosa cv.*)
Mean no. *F. occidentalis* per leaves (*Mimosa* cv.)
Nombre moyen de *F. occidentalis* par feuilles (*Mimosa cv.*)

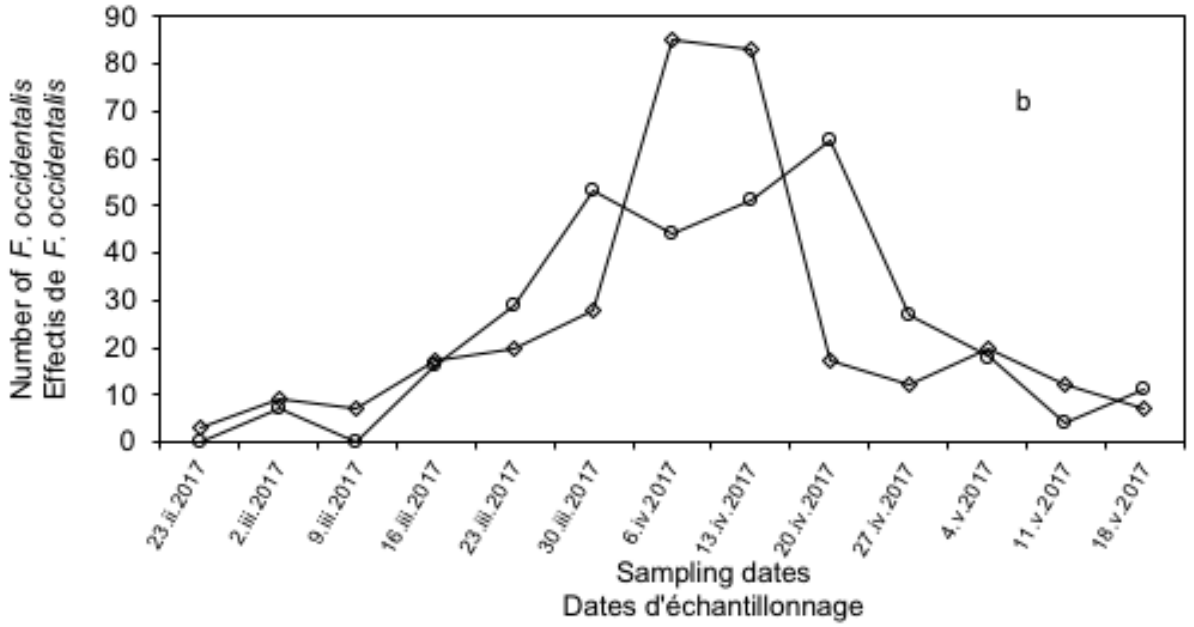
Figure 3: Relationship between mean numbers of thrips per flowers and leaves with mean thrips number caught in blue sticky traps on melon cultivars (*Star plus, DRM* and *Mimosa*)

Globally, there was a positive correlation between WFT issued from flowers samples and leaves shaking with captured thrips in blue sticky traps.

3.4 Population changes of *Frankliniella occidentalis*

Adults of *F. occidentalis* on leaves and flowers were observed from February to March (Figure 4).


Leaves
Flowers
a
Number of F. occidentalis
Effectis de F. occidentalis
0
20
40
60
80
100
120
140
160
180
9.iii.2017
16.iii.2017
23.iii.2017
30.iii.2017
6.iv.2017
13.iv.2017
20.iv.2017
27.iv.2017
4.v.2017
11.v.2017
18.v.2017
Sampling dates
dates d'échantillonnage


b
Number of F. occidentalis
Effectis de F. occidentalis
0
10
20
30
40
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90
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2.iii.2017
9.iii.2017
16.iii.2017
23.iii.2017
30.iii.2017
6.iv.2017
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Sampling dates
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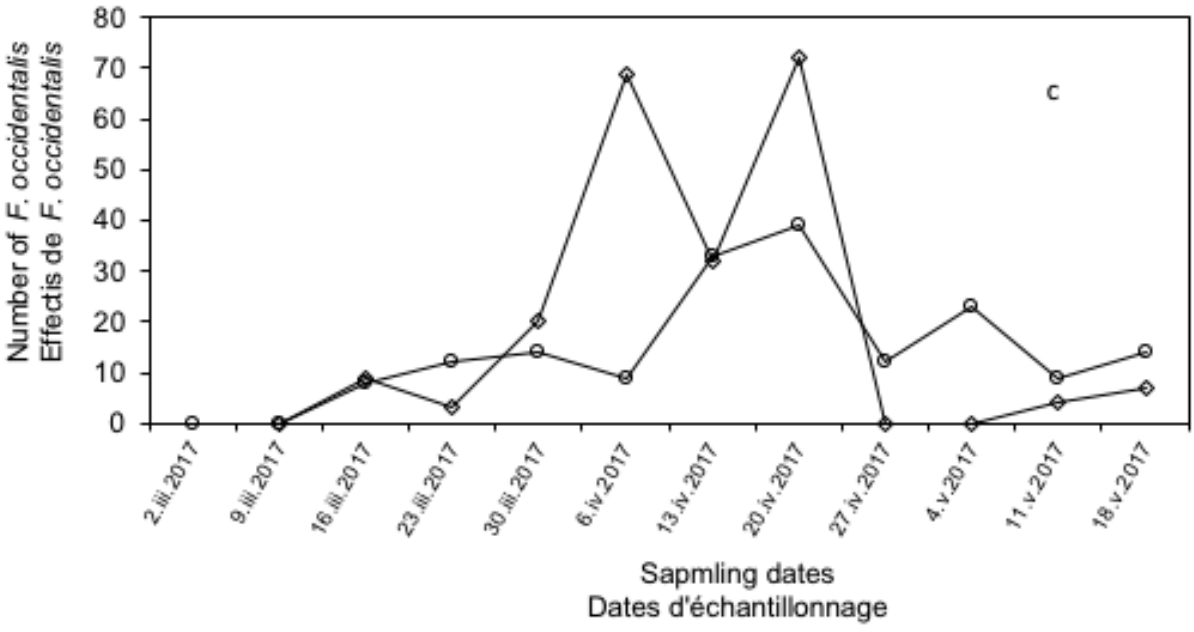
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Figure 4: Population changes of *Frankliniella occidentalis* on leaves and flowers of melon cultivars, (a) *Star plus*, (b) *DRM* and (c) *Mimosa*.

On *Star plus* cultivar leaves (Figure 4a), an increase trend of *F. occidentalis* was registered from the beginning to mid April corresponding to peak numbers of western flower thrips. The temperature recorded during this period was between 21.7-29.2°C and 15-49% relative humidity. This number is decreasing until the end season, corresponding to crop yellowing and drying. The temperature recorded at this time was quite high (35.7-37.2°C) with a decrease in relative humidity (26-35%).Similar trend was observed on *DRM* and *Mimosa* cultivars (Figure 4b, c), with an optimum in mid April. However, *F. occidentalis* number on *Star plus* cultivar noted at this peak was greater than that on the other cultivars. Regarding temperatures and relative humidity recorded during this period, they were respectively 21.2-34.7°C and 12-32% before and 38.2-40.2°C / 10-28% after this date in greenhouse with *DRM* cultivar. In *Mimosa* greenhouse, 30.0-33.7°C / 10-39% were recorded before and 40-43°C / 10-45% after this date.
About *F. occidentalis* population changes on melon flowers, the number of western flower thrips was low on the cultivar *Star plus* at the beginning of cultivation then reached maximum numbers in mid April. However, after this date the number of thrips has decreased until crop season end. Temperature and relative humidity registered before and after this date was between 21.7-41.5°C/ 15-31%; 29.2-37.2°C/ 26-49%, respectively. On flowers of *DRM* cultivar, *F. occidentalis* numbers were slightly higher at the beginning of cultivation, continued to increase until they reached its maximum beginning of April then decreased up to the season end (Figure 4b). Recorded temperature and relative humidity were situated between 21.2-32.7°C/ 12-26% before this date and 38.2-41.7°C/ 10-32% after this date. For *Mimosa* cultivar (Figure 4c), the number of western flower thrips increased until a mid April peak, then declined towards the crop end. The recorded temperature and humidity were respectively 30.0-33.7°C/ 11-39% before mid April and 40.0-53.2°C/ 10-45% after this date.

4 DISCUSSION

Knowing thrips species occurring an agro-ecosystem is fundamental in building pest control programs (Mirab-balou *et al.*, 2017). Here, six thrips species were determined on melon crop, including two species of economic concern, namely *F. occidentalis* and *T. tabaci*. They cause significant direct damages to plants in addition to tospovirus transmission (Reitz, 2009; Gill *et al.*, 2015) and they were recorded on several plant species (Lee *et al.*, 2001).
The WFT abundance was more important compared to onion thrips (*T. tabaci*) and was predominant on all melon cultivars while *T. tabaci* was observed on *Mimosa* cultivar only. *F. occidentali*s was dominant on french bean in Kenya (Kasina *et al.*, 2009), cucumber in Korea (Park *et al.*, 2009), on cucumber and pepper crops at Bejaia (east coast of Algeria) (Oudjiane *et al.*, 2018) and on tomato and pepper/ chili pepper at Biskra (Laamari & Houamel, 2015). Five thrips species were found in coastal and sub-coastal part of Algiers, including *F. occidentalis, O. loti* (Benmessaoud-Boukhalfa *et al.*, 2010). Also, Razi *and colleagues* (2013) listed seven thrips species on broad bean in different region of Biskra. According to these studies, four species are in common, namely *F. occidentalis*, *O. loti*, *A. intermedius* and *M. fuscus*. However at Zeralda (west coast of Algiers), the two economically important pests *F. occidentalis* and *T. tabaci* were observed in tomato greenhouse (Djebara *et al.*, 2018).
The thrips abundance differed according to melon cultivars: higher on *DRM* and weaker on *Star plus* cultivars possibly related to the preceeding tomato crop. The latter was removed in December and replaced by melon since January. Also, the thrips number may be increased with flower occurrence (Elimem & Chermiti, 2009). In Biskra, farmers usually allowed 1 to 3 melon fruits per plant in maximum to develop. It would be interesting to remove excess of flowers to reduce thrips number. In addition, the WFT also used flowering weed species to infest crops. Katayama (2006) suggested that suppressing flowering weeds in spring should be an effective thrips control approach.

Blue sticky traps allowed early detection of thrips in greenhouses, even before first captures by direct sampling methods. According to Natwick *et al.* (2007), blue sticky traps were already found to be sensitive in detecting thrips presence prematurely on crops such as lettuce and onion. Rodriguez-Saona *et al.* (2010) found white sticky traps more effective than blue traps in New Jersey blueberries due to higher attractiveness corresponding to white blueberries flowers coinciding with thrips flight activity. However, Abdul Alim *et al.* (2018) showed that monitoring thrips in persimmon orchards with yellow sticky traps was more appropriate. Changes in air temperature also influenced *T. tabaci* density on sticky traps (Rodriguez-Saona *et al.*, 2010; Szostek & Schwartz, 2015). In this study, the low number of arthropods in early season may be due to low temperatures and host plants lack in the field (Summers *et al.*, 2010).

On flowers, the numbers of *F. occidentalis* were not significant on all cultivars. The difference was significant between leaves of *Star plus* and *Mimosa* cultivars while *Mimosa* and *DRM* cultivars attracted less *F. occidentalis* than *Star plus*. Similarly, Messelink & de Kogel (2005) recorded a significant difference in *F. occidentalis* populations among chrysanthemum cultivars. On cotton, Khan *et al.* (2014) revealed that genotypes differed in their response to thrips population. Likewise, *T. tabaci* densities on onion were similar on all cultivars at the beginning and then vary according to the cultivars (Malik *et al.*, 2010). The number of thrips on plants depends not only on cultivars but also with fertilization rate and water (Schuch *et al.*, 1998).

According to Broughton & Harrison (2012), the monitoring effectiveness of trapping as tool was dependent on number of thrips caught in traps with the number of thrips collected on crops.

In this study, significant relationship between number of all thrips catches on blue sticky traps and number of WFT recovered from blossom and issued from melon leaves occurred. Then, a strong and positive correlation was reported between thrips caught in sticky traps and collected on onion crop (MacIntyre-Allen *et al.*, 2005) and was higher in dry season on Mango orchard panicles (Aliakbarpour & Rawi, 2011). Likewise, the same relation was revealed by Muvea *et al.* (2014) with thrips captured on colored sticky traps and thrips infesting French bean leaves and flowers (destructive methods) and tapping (non destructive methods). In Western Australia on deciduous fruit trees, Broughton & Harrison (2012) recorded poor correlation between thrips catches in traps and tapping samples. In tomato crops, Covaci *et al.* (2012) indicated no correlation between sticky traps and tapping method of leaves.

According to statistical analysis, the difference between thrips density on the three cultivars was not significant, but it seems that changes were not similar on the leaves unlike the flowers. Essentially one to two peaks were recorded during the cropping season. These numbers were registered in April, where temperature and humidity did not exceed 37.5°C and 35.7% respectively. Arif *et al.* (2006) and Malik *et al.* (2010) pointed out that *T. tabaci* population got their peak in August on onion cultivars. In Tunisia, Elimem & Chermiti (2009, 2013) recorded the maximum number of *F. occidentalis* in June on roses and during April and May for citrus orchard. No injury due to thrips was observed *in situ* on all melon cultivars assuming that economic threshold has not been reached.

5 CONCLUSIONS

The melons cultivar used in this study (*Star plus*, *DRM* and *Mimosa*) were the most cultivated cucurbits at Biskra. There was no real program of thrips control in vegetable crops and cucurbits particularly. This should be among the priorities due to the presence of insect virus vectors such as thrips transmitted tospoviruses. This study allowed the reporting of six thrips species including two of economic importance. The blue sticky trap is important tool in greenhouses allowing early detection of thrips presence which confirmed earlier studies. A positive and strong relationship between thrips abundance was determined on blue sticky traps and thrips recovered from flowers and leaves shaking. The general trend of thrips on different cultivars was weak at first and important towards crop end when temperatures increased from spring. This allowed planning thrips control on melon crops at Biskra without insecticide treatments abuse in an integrated pest management program.

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