

Thrips (Thysanoptera) species associated with ornamental plants in the Çukurova region of Turkey

Ekrem ATAKAN¹

¹ Çukurova Üniversitesi Ziraat Fakültesi Bitki Koruma Bölümü, Adana

Sorumlu Yazar/Corresponding Author: eatakan@cu.edu.tr

ORCID: 0000-0001-7352-4815

Makale Bilgisi/Article Info
Derim, 2019/36(2):146-153
doi:10.16882/derim.2019.518502

Araştırma Makalesi/Research Article
Geliş Tarihi/Received: 28.01.2019
Kabul Tarihi/Accepted: 10.09.2019



Abstract

Some thysanopteran (thrips) species are recognized as pests of ornamentals. They cause typical feeding damage by scarring petals, flowers buds or leaves; thus resulting in a decrease at market values of ornamentals. However, thrips composition and importance on ornamental plants in Turkey are not well-understood. Thysanopteran species on ornamentals grown in the parks, home gardens and greenhouses in the Çukurova region of Turkey were investigated during years 2013-2014. Thrips were collected by shaking the plants onto the white tray. Thrips were slide-mounted and identified. In this work, 62 plant species belonging to 35 plant families were investigated for thrips. A total of 1875 thrips adults were extracted from a total 256 plant samples. A total of 23 thysanopteran species belonged to 3 families of order Thysanoptera were determined: Aeolothripidae (6 species), Phlaeothripidae (5 species) and Thripidae (12 species). *Haplothrips tamaricinus* Priesner was the first time detected in Turkey. Ornamentals belonged to family Asteraceae were more attractive to thrips, bearing relatively high species numbers and high numbers of adult thrips. Majority of thrips were collected from multi-flowering ornamentals. Only *Frankliniella occidentalis* (Pergande) was recorded on the ornamentals grown commercially in greenhouses, infesting most of herbaceous plant species with flowers. The most notable species were in descending order *F. occidentalis*, *Neohydathothrips samayunkur* (Kudo) and *Thrips tabaci* Lind. The thrips fauna was dominated by *F. occidentalis*, this thrips being found in 51.17% of the samples and consisting 81.47 % of the specimens. The second major species *N. samayunkur* comprised 5.07% of the samples and accounted for 7.72% of the specimens.

Keywords: Thysanoptera; Ornamentals; Çukurova region; Turkey

Türkiye'nin Çukurova Bölgesi'nde süs bitkilerinde saptanan thrips (Thysanoptera) türleri

Öz

Bazı thrips (Thysanoptera) türleri süs bitkisi zararlısı olarak bilinmektedirler. Thripsler, yapraklar, çiçekler ve çiçek tomurcuklarında beslenerek yaralanmalara böylelikle ürünün ticari değerinin azalmasına neden olmaktadır. Ülkemizde süs bitkilerinde thrips kompozisyonu ve bunların önemleri yeterince bilinmemektedir. Çukurova Bölgesi'nde park, ev bahçeleri ve seralarda yetiştirilen süs bitkilerinde Thysanoptera türleri 2013-2014 yılında araştırılmıştır. Thripsler, beyaz renkli kap içerisine bitkilerin silkelmesiyle toplanmıştır. Thripslerin preparatları yapılmış olup, teşhis edilmişlerdir. Bu çalışmada 35 bitki familyasına bağlı 62 bitki türü thripsler yönünden araştırılmışlardır. Toplam 1875 thrips ergini 256 bitki örneğinden elde edilmiştir. Thysanoptera takımının 3 familyasından 23 thrips türü tanımlanmıştır: Aeolothripidae (6 tür), Phlaeothripidae (5 tür) ve Thripidae (12 tür). *Haplothrips tamaricinus* Priesner Türkiye için yeni kayıttır. Asteraceae familyasına bağlı bitki türleri yüksek sayıda thrips tür sayısı ve yüksek sayıda ergin içererek, thripsler için oldukça cazbeci bulunmuştur. Thripslerin çoğunluğu bol çiçekli bitkilerden toplanmıştır. Seralarda çiçekli süs bitkilerinde sadece *Frankliniella occidentalis* (Pergande) bulunmuştur. En yaygın türler sırasıyla *F. occidentalis*, *Neohydathothrips samayunkur* (Kudo) ve *Thrips tabaci* Lind' dir. *F. occidentalis* toplam örneklerin %51.17'sinde ve toplam bireylerin %81.47'sinde bulunarak dominant thrips türü olmuştur. İkinci yaygın tür, *N. samayunkur* örneklerin %5.07'sinde, toplam bireylerin ise %7.72'sinde kaydedilmiştir.

Anahtar Kelimeler: Thysanoptera; Süs bitkileri; Çukurova Bölgesi; Türkiye

1. Introduction

Thrips are very tiny insects, spreading widely worldwide. They have a wide range of habitats

through forest, grassland scrub, desert, and most cultivated crops. Order Thysanoptera comprises phytophagous and carnivorous species (Lewis, 1997). Of the nearly 5.000

species know, only ten hundred are crop pests, according to that literature. Early damage signs associated with thrips are disturbed terminals of plants, deformed young leaves, scarred petals, buds, or leaves, and tiny greenish-black fecal specks on leaves and petals. Infested flowers by thrips are not capable to open and damaged flowers become discolored. The western flower thrips (WFT) is one of the most destructive pest thrips in greenhouse crops including ornamentals worldwide (Cloyd, 2009). WFT has great importance because it attacks various organs of ornamentals and also transmits two important viral diseases that can be very destructive by killing plants such as tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INSV) (Daughtrey et al., 1997). Only WFT can transmit INSV to ornamentals.

The western flower thrips first introduced to Turkey in 1993 by its detection on some vegetable and ornamental crop plants grown in greenhouses (Tunç and Göçmen, 1994). After its introduction, this pest thrips has widely spread over most parts of Turkey and it has created serious problems associated with feeding damage to arable crops and transmitting the TSWV, which is very problematic especially on peppers and tomatoes grown in plastic tunnels or open fields in the region. In previous works thrips species, by excluding WFT, were detected on various ornamentals such as *Thrips tabaci* Lindeman (Tunç 1991; Tunç, 1992 a, b). Recently thrips composition including WFT and onion thrips has been investigated on ornamentals grown in the central parks located at Adana province, Turkey (Atakan, 2010 a; Atakan, 2011). *Neohydathothrips samayankur* was the first time detected in Turkey on *Tagetes* spp (Atakan, 2010 b). Thrips species are known as quarantine pests worldwide. Who does not know presence of the invasive thrips species such as *Echinothrips americanus* and *Thrips palmi* in Turkey. Thrips were surveyed in only two central parks of Adana province, Turkey (Atakan, 2010 a, Atakan, 2011). Thrips species on the seasonal ornamental plant being sold by the shops in the region is not known. Furthermore, knowledge of Thysanoptera composition and also invasive pest thrips damaging ornamentals grown in greenhouses and home gardens in the region is not yet known. Findings of this current study may

contribute to integrated pest thrips management deployed on ornamentals in the region.

2. Material and Method

2.1. Material

2.1.1. Thrips samplings

Thrips collections were carried out on ornamental plants from parks, home gardens and greenhouses in the Çukurova region of Turkey (mainly Adana province). Thrips were sampled from ornamental plants at irregular intervals during 2013-2014. The number of samples taken from represent plant species varied from 1 to 10, depending on plant densities in sample areas. Thrips were sampled by beating plants onto a white tray measuring 37 × 28 × 7 cm for five seconds. Thrips individuals were collected by help of fine brush and put into small vials (2 ml) contenting 60% ethyl alcohol.

2.2. Method

2.2.1. Thrips identification

Thrips samples with the vials were transported to the laboratory and then maintained in AGA solution (10 parts 60% ethyl alcohol, one part glacial acetic acid and one part glycerin) to clear bodies for one day. Thrips were kept in 10% a solution of NaOH until specimens become light appearance. They were slide-mounted on Hoyer medium. Extracted larval thrips were not considered for identification. Thrips counting and identifications were carried out under a stereomicroscope with X45 magnifications. Slide-mounted thrips (adults) were identified by using the keys given by zur Strassen (2003) and Mirab-balou et al. (2012).

2.2.2. Analysis

Data associated with thrips identified were pooled over sampling years because, in general, thrips numbers were less and their population trends in numbers were similar. Monthly numbers of common thrips species were evaluated in only Balcalı location (Adana province). Data were pooled over plant species, sampling date and years. Because population trends of thrips on sampled ornamentals were

similar and their numbers on ornamentals were generally low. Host index: To analyze the distribution pattern of a given species on plant species a simple host index was used. Host index was calculated by dividing a total number of individuals of a given thrips species on the host species to total numbers of samples from the host species.

3. Results and Discussion

3.1. Composition, frequency and abundance

A total of 23 Thysanoptera species were recorded (Table 1). The species identified are listed with their overall frequency (total number of samples where a given species was present) and abundance (total number of individuals collected for a given species). In this current study, *Haplothrips tamaricinus* Priesner was the first time detected in Turkey. All major species were belonging to the family Thripidae. The species representing Aeolothripidae and Phlaeothripidae were the less common. The most notable species present at least 10% of

samples, were in descending order *Frankliniella occidentalis* (Pergande) *Thrips tabaci* Lind. and *Neohydathothrips samayunkur* (Kudo). The thrips fauna was dominated by *F. occidentalis*, this thrips being found in 51.35% of the samples and consisting 81.47 of the specimens. The second major species *N. samayunkur* comprised 27.66% of the samples and accounted for 7.72% of the specimens. *T. tabaci* constituted 22.52% of the samples and comprised 2.44% of the specimens. The dominance of other identified species in total samples and specimens were ranged between 1-5 or less than 1%. The thrips species were collected mainly from the flowering ornamental plants. Very few thrips were found on the leaves of ornamental plants surveyed. *F. occidentalis* was more common on many ornamental plants. Pollens and nectars from flowers increase the fecundity and growth of most female thrips individuals. The number of thrips on ornamental plants present in the open shops was very low due to product circulation of seasonal flowering ornamentals and intensive spraying of pesticides. *Frankliniella occidentalis* dominated the thrips dwelling the ornamentals

Table 1. List of identified thrips species with their overall frequency and overall abundance on ornamental plants in Çukurova region of Turkey during 2013-2014 (*: Predatory thrips species)

Family/species	Overall frequency		Overall abundance	
	Total no found in samples	%	Total no found in individuals	%
Aeolothripidae				
<i>Aeolothrips collaris</i> *	3	1.17	4	0.21
<i>Aeolothrips ericae</i> *	5	1.95	9	0.48
<i>Aeolothrips gloriosus</i> *	1	0.39	1	0.05
<i>Aeolothrips propongus</i> *	1	0.39	1	0.05
<i>Scolothrips longicornis</i> *	1	0.39	1	0.05
<i>Melanthrips pallidior</i>	1	0.39	1	0.05
Thripidae				
<i>Frankliniella occidentalis</i>	131	51.17	1526	81.47
<i>Frankliniella intonsa</i>	7	2.73	28	1.49
<i>Isoneurothrips australis</i>	1	0.39	1	0.05
<i>Microcephalothrips abdominalis</i>	8	3.12	11	0.58
<i>Neohydathothrips samayankur</i>	13	5.07	144	7.72
<i>Neohydathothrips gracilicornis</i>	1	0.39	1	0.05
<i>Pezothrips kellyanus</i>	8	3.12	13	0.69
<i>Thrips major</i>	17	6.64	39	2.08
<i>Thrips meridionalis</i>	2	0.78	3	2.08
<i>Thrips minutissimus</i>	1	0.39	2	0.10
<i>Thrips tabaci</i>	24	9.37	45	2.44
<i>Thrips vulgatissimus</i>	1	0.39	1	0.05
Phlaeothripidae				
<i>Haplothrips aculeatus</i>	2	0.78	1	0.05
<i>Haplothrips gowdeyi</i>	18	7.03	9	0.48
<i>Haplothrips hispanicus</i>	1	0.39	3	0.16
<i>Haplothrips reuteri</i>	11	4.29	9	0.48
<i>Haplothrips tamaricinus</i>	3	1.17	19	1.01

in total samples and specimens. Most of the collected and identified species are polyphagous and commonly found on various arable crops in the region such as *T. tabaci*, *Thrips major* Uzel and *Haplothrips* species, by excluding *Microcephalothrips abdominalis* (Crawford) and *N. samayunkur* which both are often recorded in ornamentals. *F. occidentalis* also dominates thrips fauna being found on summer vegetables and field crops and also some temperate fruits such as nectarines and plums in the region. Dominancy of *F. occidentalis* is likely due to having a rapid reproduce rate and a high level of insecticide resistance (Immaraju et al., 1992; Robb et al., 1995; Zhao et al., 1995). *Frankliniella occidentalis* is native to western North America but since international agricultural trade flows have increased very rapidly and *F. occidentalis* introduced and established in many countries and it becomes a cosmopolitan pest thrips. Presently this thrips has been established in more than 60 countries (Kirk and Terry, 2003). *Neohydathothrips samayunkur* and *M. abdominalis* were relatively more common on *Tagetes* species in the open fields. Similarly, *M. abdominalis* is more common on *Tagetes* (Vierbergen et al., 2006). *Neohydathothrips samayunkur* was the first time detected in Turkey in 2006 on *T. patula* plants which were seriously damaged by these thrips in a local area (Atakan, 2010b). Many individuals of *F. occidentalis* were extracted from the plants situated in the greenhouse, due to warm months. Greenhouses can provide more favorable climatic conditions to continue their survival even in the winter months in the Çukurova region.

3.2. Host plants of thrips, distribution index on ornamental plant species

In this work, 62 plant species belonging to 35 plant families were investigated for thrips during 2013-2014 (Table 2). *Frankliniella occidentalis* was a major thrips being found on 47 plant species of total 64 plant species. *Thrips tabaci* was detected on 18 plant species of total 64 plant species. *Thrips major* and *M. abdominalis* were recorded from 8 and 5 plant species of total 64 plant species, respectively. Although *N. samayunkur* was the second thrips in total samples and specimens, these thrips were found on only 6 plant species. In previous work done in Adana province, 30 plant species were

sampled and *F. occidentalis* visited flowers of most ornamental plants grown in the two central parks (Atakan, 2010 a). When compared to that study, in the current study, thrips numbers on ornamentals were generally low. The reason of this is may be frequent pesticide applications done against pest insects including thrips on the ornamentals grown commercially. Only *F. occidentalis* infesting most of the herbaceous plants species with flowers was recorded on ornamentals grown commercially in greenhouses, during 2013-2014. Overall, high numbers of *F. occidentalis* were found on *Dahlia* sp. (104 specimens), *Caryophyllus* (288 specimens), *Portulaca grandiflora* (moss rose) (162 specimens) and *Zinnia elegans* (zinnia) (94 specimens). *Neohydathothrips samayunkur* was detected frequently on *Tagetes erecta* (marigold) (34 specimens) and *Tagetes patula* (French marigold) (98 specimens). Twenty one plant species sampled were infested by only *F. occidentalis*. *Frankliniella occidentalis* collected mainly from herbaceous plant species while the most number of *T. major* was recorded from *Abelia grandiflora* (glossy abelia) which is annual and shrub plant species and flowering at most parts of the season. No thrips were extracted from *Schefflera arboricola* (schefflera), *Viburnum tinus* (guelder rose), *Kalanchoe calandiva* (kalanchoe) *Ocimum basilicum* (sweet basil) and *Pittosporum* (wheeleri) which all were without flowers. *Pezothrips kellyanus* Bagnall known as a destructive pest thrips species of citrus was found 5 plant species, mostly on *Lantana camara* (lantana). The higher host indices for *F. occidentalis*, *T. tabaci*, *T. major* and *N. samayunkur* were calculated in *Z. elegans*, *Pelargonium*, *Rosa* spp. and *T. erecta*, respectively (Table 3). Based on the percentage of specimens in total number of specimens collected on a given ornamental species and host index, *F. occidentalis* predominated the thrips fauna on *Vinca*, *Euroyps*, *Z. elegans*, *Begonia tuberhyllorida* (tuberous begonia), *Bougainvillae spectabilis* (bougainvillae), *P. grandiflora*, *Rosa* spp. and lantana. No thrips damage due to thrips feeding on ornamental plant species sampled in this study was observed in open fields but there was heavy thrips damage on *Dianthus* spp. grown in greenhouses where adult and larval *F. occidentalis* were the most abundant. During the sampling time minute pirate bugs spp. (Hemiptera: Anthocoridae)

Table 2. Host plant list and total numbers of the identified thrips species in Çukurova region of Turkey during 2013-2014

Family	Scientific name	F.o	F.i	T.tb	T.ma	M.ab	N.s	P.k	
Alliaceae	<i>Tulbaghia violaceae</i>	48	0	0	0	0	0	0	
Amaranthaceae	<i>Celosia</i> sp.	7	0	1	0	0	0	0	
	<i>Gomhrena globosa</i>	0	0	0	0	0	0	0	
Apocynaceae	<i>Vinca</i> sp.	47	0	0	0	0	1	0	
	<i>Nerium oleander</i>	7	0	0	1	0	0	0	
	<i>Theventia perviciana</i>	9	0	2	0	0	0	0	
Araceae	<i>Spathiphyllum</i> sp.	2	0	1	0	0	0	0	
Araliaceae	<i>Schefflera arboricola</i>	0	0	0	0	0	0	0	
	<i>Ageratum houstonianum</i>	3	0	1	0	0	0	0	
	<i>Anthemis cretia</i>	6	0	1	0	0	0	0	
	<i>Bidens</i> sp.	24	0	0	0	0	0	0	
	<i>Coreopsis grandiflora</i>	1	0	0	0	0	0	0	
	<i>Chrysanthemum</i> sp.	14	0	0	0	0	0	0	
	<i>Dahlia</i> sp.	104	3	0	0	0	0	0	
	<i>Dimorphotheca sinuata</i>	1		1	0	0	0	0	
	<i>Gazania</i> sp.	32	1	1		2	0	1	
	<i>Euryops pectinatus</i>	14	0	4	3	4	8	0	
	<i>Matricaria</i> sp.	63	0	0	0	0	0	0	
Asteraceae	<i>Tagetes erecta</i>	86	0	6	0	19	6	0	
	<i>Tagetes patula</i>	11	0	0	0	0	98	0	
	<i>Zinnia elegans</i>	94	0	0	0	1	0	0	
	Balsaminaceae	<i>Impatiens</i> sp.	3	2	2	0	0	0	0
	Begoniaceae	<i>Begonia tuberhyllorida</i>	15	0	1	0	0	0	0
Bignoniaceae	<i>Campis radicans</i>	90	0	0	0	0	0	0	
	<i>Lonicera periclymenum</i>	2	0	0	0	0	0	0	
Caprifoliaceae	<i>Abelia grandiflora</i>	3	0	1	24	0	0	0	
	<i>Viburnum tinus</i>	0		0	0	0	0	0	
Caryophyllaceae	<i>Dianthus caryophyllus</i>	288	21	0	0	0	0	0	
	<i>Dianthus chinensis</i>	27	0	1	0	0	0	0	
Convolvulaceae	<i>Ipomea purpurea</i>	0	0	0	0	0	0	0	
Crassulaceae	<i>Kalanchoe calandiva</i>	0	0	0	0	0	0	0	
Fabaceae	<i>Bauhinia purpurea</i>		0	0	6	0	0	0	
Geraniaceae	<i>Pelargonium</i> sp.	64	7	0	0	0	0	0	
Gesneriaceae	<i>Saintpaulia ionantha</i>	7	0	0	0	0	0	0	
Hydrangeaceae	<i>Philadelphus coronarius</i>	1	0	0	0	0	0	0	
Labiaceae	<i>Coleus</i> sp.	1	0	0	0	0	0	0	
	<i>Ocimum basilicum</i>	2	0	0	0	0	0	0	
Lamiaceae	<i>Salvia splendens</i>	21	0	0	0	0	0	0	
	<i>Cuphea hyssopifolia</i>	0	0	0	0	0	0	0	
Lytraceae	<i>Lagerstroemia</i> sp.	2	0	0	0	0	0	0	
	<i>Hibiscus rosea-chinensis</i>	10	0	1	5	0	0	9	
Malvaceae	<i>Hibiscus syriacus</i>	21	0	0	0	0	0	0	
	<i>Ficus</i> sp.	0	0	0	0	0	0	0	
Moraceae	<i>Bougoinvilla spectabilis</i>	6	0	1	1	0	0	0	
	<i>Mirabilis jalapa</i>	1	0	0	0	0	0	0	
Nyctanginaceae	<i>Jasminum</i> sp.	1	0	0	0	0	0	0	
	<i>Ligustrum</i> sp.		0	1	0	0	0	0	
	<i>Fuchsia</i> sp.	4	0	0	0	0	0	0	
Oleaceae	<i>Gaura lindheimeri</i>	3	0	0	0	0	0	0	
Onagraceae	<i>Pittosporium</i> sp.	0	0	0	0	0	0	0	
Pittosporaceae	<i>Antirrhinum</i> sp.	2	0	0	0	0	0	0	
Plantaginaceae	<i>Plumbago auriculata</i>	2	0	0	0	0	0	0	
Plumbaginaceae	<i>Portulaca grandiflora</i>	144	0	0	0	0	0	0	
Portulacaceae									

F.o: *Frankliniella occidentalis*; T.tb: *Thrips tabaci*; T.ma: *Thrips major*; M.ab: *Microcephalothrips abdominalis*; N.s: *Neohydathothrips samayunkur*; P.k: *Pezothrips kellyanus*.

Table 2. Host plant list and total numbers of the identified thrips species in Çukurova region of Turkey during 2013-2014 (cont.)

Family	Scientific name	F.o	F.i	T.tb	T.ma	M.ab	N.s	P.k
Ranunculaceae	<i>Ranunculus asiaticus</i>	3	1	0	0	0	0	0
Rosaceae	<i>Rosa sp.</i>	36	1	3	4	1	2	3
Rubiaceae	<i>Pentas lanceolata</i>	2	0	0	0	0	0	0
	<i>Paeonia sp.</i>	5	0	0	0	0	0	0
Scrophulariaceae	<i>Russelia equisetiformis</i>	4	0	0	1	0	0	0
Solanaceae	<i>Brugmansia sp.</i>	1	0	0	0	0	0	0
	<i>Petunia hybrida</i>	3	0	0	0	0	0	0
Verbenaceae	<i>Lantana camara</i>	8	1	4	3	0	2	2
	<i>Verbana officinalis</i>	1	0	0	0	0	0	0

F.o: *Frankliniella occidentalis*; T.tb: *Thrips tabaci*; T.ma: *Thrips major*; M.ab: *Microcephalothrips abdominalis*; N.s: *Neohydathothrips samayunkur*; P.k: *Pezothrips kellyanus*.

Table 3. Host plant indexes of some thrips species on some ornamental plant species in Çukurova region of Turkey during 2013-2014

Plant species	Total no of individuals	No of samples	GI	F.o		T.t		T. m		N.s	
				TN	I	TN	I	TN	I	TN	I
<i>Begonia tuberhyllorida</i>	16.0	6.0	2.6	15.0	2.5	1.0	0.1	-	-	-	-
<i>Bougoinvilla spectabilis</i>	14.0	7.0	2.0	6.0	0.8	-	-	-	-	-	-
<i>Euryops pectinatus</i>	35.0	10.0	14.0	1.5	4.0	0.4	0.4	3.0	0.3	1.0	0.1
<i>Hibiscus rose-chinensis</i>	35.0	9.0	3.8	6.0	0.6	1.0	0.1	-	-	-	-
<i>Lantana camara</i>	35.0	23.0	1.52	21.0	0.9	5.0	0.2	3.0	1.0	-	-
<i>Portulaca grandiflora</i>	162.0	10.0	8.1	162.0	16.2	-	-	-	-	-	-
<i>Rosa spp.</i>	91.0	20.0	4.55	71.0	3.5	-	-	10.0	0.5	2.0	0.2
<i>Tagetes erecta</i>	127.0	11.0	11.5	86.0	7.8	6.0	0.5	-	-	34.0	3.1
<i>Tagetes patula</i>	109.0	8.0	13.6	11.0	1.3	-	-	-	-	98.0	12.2
<i>Zinnia elegans</i>	96.0	7.0	13.7	94.0	13.4	1.0	0.1	-	-	-	-
<i>Vinca sp.</i>	48.0	9.0	5.3	47.0	5.2	-	-	-	-	-	-

F.o: *Frankliniella occidentalis*; T.t: *Thrips tabaci*; T. m: *Thrips major*; N.s: *Neohydathothrips samayunkur*. GI: General index, TN: Total no, I: Index, ⁽⁻⁾ No thrips was found.

which feed on young and adult *F. occidentalis* were encountered with thrips individuals in open fields. In the previous work, *Orius niger* and *Geocoris megacephalus* were extracted from ornamentals with thrips (Mainly *F. occidentalis* and *T. tabaci*) and the ratio of total predatory insect/total thrips was 1:0.6-41 in 2006-2007. These ratios were far below the ratio (predator: prey;1/217) that is considered as being critical value in the suppression of *F. occidentalis* by *Orius insidiosus* (Say) on vegetables grown in greenhouses (Sabelis and van Rijn, 1997). This may show that thrips associated with ornamentals in the open areas may have a considerable predation risk from the predators, mainly predatory bugs. The low population densities of main thrips species on ornamentals in the parks may be an evident for this issue.

3.3. Monthly total numbers of some thrips species on ornamentals

Monthly total numbers of four common thrips species are given in Figure 1. No individuals of

F. occidentalis were detected until May. Its total numbers were relatively higher on host plants in the September-October period. This situation may be due to the presence of host plants with less density. Additionally, there were few flowering ornamentals in that period. *T. tabaci* were mostly detected in January-February and November-December. Total numbers of *T. major* on plants was relatively greater in March than other sampling months. No individuals of *T. major* were recorded in the May-September period. *Neohydathothrips samayunkur* were common in the autumn-winter period in 2013-2014. As compared to previous works associated with thrips visiting ornamentals in the same region (Atakan 2010 a,b), in the current study, seasonal densities of thrips on plants (mainly *F. occidentalis*) were less. This is probably due to less sampling frequency and fewer densities of sampled plant species scattered over the University Campus located in Balcalı district. Hence, no individual of *F. occidentalis* was detected on the ornamentals until May. This case is probably due to lack of suitable host plants of this thrips to survive in

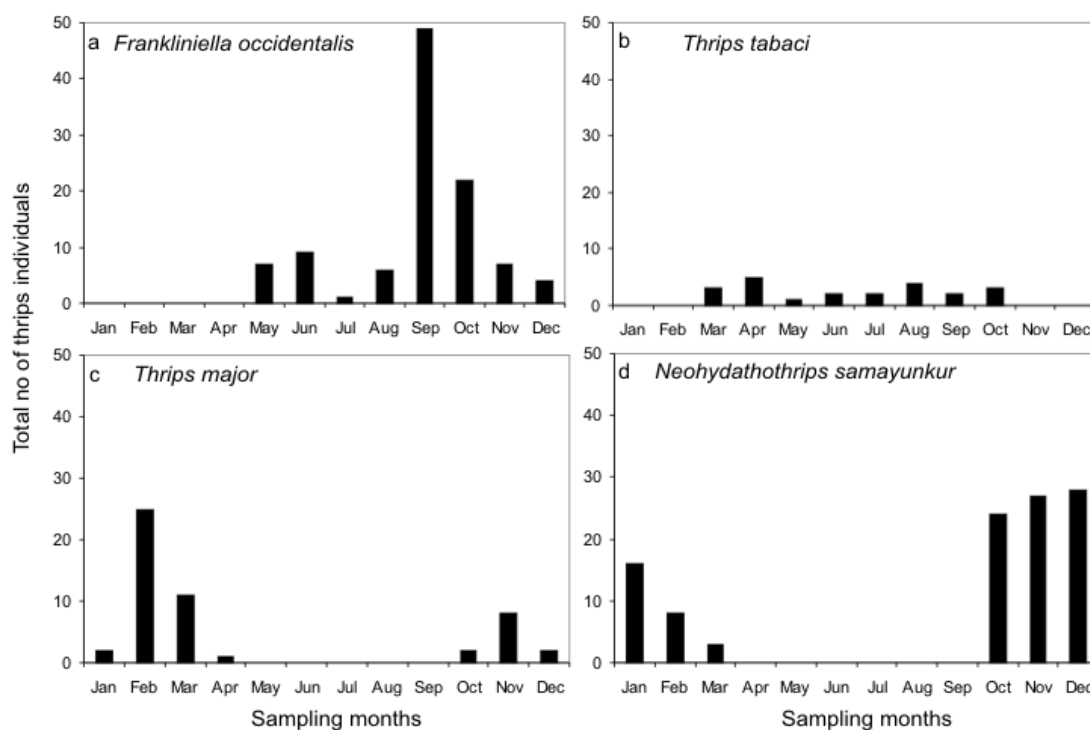


Figure 1. Total numbers of commonly found thrips species on ornamental plants in Çukurova region of Turkey during 2013-2014. Data were pooled over plant species sampled and years; a: *Frankliniella occidentalis*, b: *Thrips tabaci*, c: *Thrips major*, d: *Neohydathothrips samayunkur*

the sampling area during the winter time. However, *F. occidentalis* were dominating the thrips populations on weeds during the winters in the region (Atakan and Uygur, 2005). *F. occidentalis* can reproduce continuously in the greenhouse or outdoors when the temperature is not below 5–6°C in southern Italy or presumably in other Mediterranean areas (Tommasini and Maini, 1995). However, densities of *T. major* were relatively greater in February compared to those found in other sampling months. This might be due to spring migrations of this pest thrips from fruit orchards on which this pest is commonly found in that period (February-March) (Atakan, 2007). Most thrips were caught from the plants in spring and autumn time but their numbers were very few during the summertime. This may be due to a few flowering ornamental species available for thrips in the summer in the sampling locations.

4. Conclusions

Thrips species were inhabiting the flowering ornamental plants in parks, home gardens or in

greenhouses. No or a few thrips were collected from nonflowering plant species during the samplings in the region. *Frankliniella occidentalis* were more common thrips invading the ornamentals grown particularly in greenhouses in the region. Heavy damage of thrips was observed only on *Dianthus* species in a greenhouse. There was no thrips damage on ornamentals grown in open area (i.e. parks, home gardens). This might be due to the presence of the predators. In Turkey, control of the thrips on ornamentals grown in greenhouses is very problematic. Because the visual impact on ornamental plants is important, the grower's tolerance to insect damage (mainly thrips) is quite weak. Greenhouse growers use heavy insecticides from various insecticide groups such as neonicotinoids, pyrethroids, carbamates, and spinosyns against pest thrips at frequent intervals (Cloyd, 2009). It has been noted that ornamental growers in the region have used insecticides against thrips (mainly *F. occidentalis*) at frequent intervals. Heavy use of the pesticides at frequent intervals may cause the occurrence of resistance developments to pesticides by thrips species. Therefore,

integrated pest thrips management strategy could be deployed in greenhouses in the region. This strategy includes the use of biotechnical (such as use of sticky traps, pheromones, and trap plants) and biological control tactics in greenhouses. It is not necessary to use insecticides against thrips on ornamentals grown in open areas in the region; because generalist predators such as predatory bugs *Orius* spp. (Hemiptera: Anthocoridae) control thrips efficiently.

References

- Atakan, E. (2007). Thrips (Thysanoptera) species occurring on fruit orchards in Çukurova region of Turkey. *Acta Phytopathologica Entomologica Hungarica*, 43(1):235-242.
- Atakan, E. (2010a). Adana ilinde parklardaki süs bitkilerinde yaygın iki thrips (Thysanoptera) türünün ve avcı böceklerin populasyon yoğunlukları. IV. Süs Bitkileri Kongresi Bildiri Özetleri, 20-22 Ekim 2010, Erdemli-Mersin, s.10-11.
- Atakan, E. (2010b). Adana ilinde *Tagetes patula* L.'da zararlı bir thrips türü: *Neohydatothrips samayunkur* (Kudô) (Thysanoptera: Thripidae). *Alatarım*, 9(1):51-57.
- Atakan, E. (2011) Adana kentinde parklardaki bazı süs bitkilerinde bulunan thysanoptera (Thrips) türleri. *Alatarım*, 10(2):79-84.
- Atakan, E., & Uygur, S. (2005). Winter and Spring Abundance of *Frankliniella* spp. and Thrips tabaci Lindeman (Thysan., Thripidae) on Weed Host Plants in Turkey. *Journal of Applied Entomology*, 129(1):17-26.
- Cloyd, R.A. (2009). Western flower thrips (*Frankliniella occidentalis*) management on ornamental crops grown in greenhouses: have we reached an impasse. *Pest Technology*, 1-9.
- Daughtrey, M., Jones, R.K., Moyer, J.W., Daub, M.E., & Baker, J.R. (1997). Tospoviruses strike the greenhouse industry. *Plant Disease*, 81:1220-1235.
- Immaraju, J.A., Paine, T.D., Bethke, J.A., Robb, K.L., & Newman, J.P. (1992). Western flower thrips (Thysanoptera: Thripidae) resistance to insecticides in coastal California greenhouses. *Journal of Economic Entomology*, 85:9-14.
- Kirk, W.D.J. & Terry, L.I. (2003). The spread of the western flower thrips, *Frankliniella occidentalis* (Pergande). *Agricultural and Forest Entomology*, 5:301-310.
- Lewis, T. (1997). Thrips as Crop Pest. CAB International, Wallingford, Oxon OX10 8 DE UK, pp 740.
- Mirab-balou, M., Tong, X., Chen, X. (2012). A new record and description of a new species of the genus Thrips, with an updated key to species from Iran. *Journal of Insect Science*, 12(1):90.
- Robb, K.L, Newman, J., Virzi, J.K., & Parrella, M.P. (1995). Insecticide resistance in western flower thrips. In: Parker, B. L., Skinner, M.; Lewis, T. Thrips Biology and Management. New York: Plenum Press, 1995. p. 341-346.
- Sabelis, M.W., & Van Rijn, P.C.J. (1997). Predation by Insects and Mites. In: Lewis T (ed) Thrips as Crop Pests, CAB International, Wallingfor, Oxon, UK, p. 259-354.
- Tommasini, G.M., & Maini, S. (1995). *Frankliniella occidentalis* and other thrips harmful to vegetable and ornamental crops in Europe (pp. 1-41). In Loomans, A. J. M., van Lenteren J. C., Tommasini, M. G., Maini, S., & Riudavets, J. (Eds.), Biological control of thrips pests. Wageningen Agricultural University Papers, 95.I. Wageningen, the Netherlands.
- Tunç, İ. (1991). Studies on the Thysanoptera of Antalya IV. Thripidae Stephens-3. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi*, 4:11-26.
- Tunç, İ. (1992 a). Studies on the Thysanoptera of Antalya II. Thripidae Stephens (part 1). *Türkiye Entomoloji Dergisi*, 16:33-46.
- Tunç, İ. (1992 b). Studies on the Thysanoptera of Antalya III. Thripidae Stephens (part 2). *Türkiye Entomoloji Dergisi*, 16: 73-86.
- Tunç, İ., & Göçmen, H. (1994). New greenhouse pests, *Polyphagotarsonemus latus* and *Frankliniella occidentalis* in Turkey. *FAO Plant Protection Bulletin*, 42: 218-220
- Vierbergen, G., Cean, M., Szellér, I.H., Jenser, G., Masten, T., & Simala, M. (2006). Spread of two thrips pests in Europe: *Echinothrips americanus* and *Microcephalothrips abdominalis* (Thysanoptera: Thripidae). *Acta Phytopathologica et Entomologica Hungarica*, 41:287-296.
- Zhao, G., Liu, W., Brown, J.M., & Knowles, C.O. (1995). Insecticide resistance in field and laboratory strains of western flower thrips (Thysanoptera: Thripidae). *Journal of Economic Entomology*, 88:1164-1170.
- zur Strassen, R. (2003). Die terebranten Thysanopteren Europas und des Mittelmeer-Gebietes. Anne Bauer Publishing, Keltern, Deutschlands, 271 pp.