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Original article (Orijinal araştırma)

Investigation of thrips (Thysanoptera) species, their population changes and damage rates in vineyards of Mersin Province (Türkiye)[1]

Mersin İli (Türkiye) bağ üretim alanlarında thrips (Thysanoptera) türleri, popülasyon değişimleri ve zarar oranlarının araştırılması

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Abstract

This study was conducted to determine thrips (Thysanoptera) species, their population changes as well as damage rates in vineyard areas in Mersin Province (Türkiye) in 2019 and 2020. Fourteen Thysanoptera species were identified. *Rubiothrips vitis* (Priesner, 1933) (Thysanoptera: Thripidae) was found to be more common (56%). This pest thrips was followed by *Mycterothrips tschirkunae* (Yakhontov, 1961) (Thysanoptera: Thripidae) with the ratio of 23% in total adults. The adult thrips species were collected mostly from fruit (88%). Population changes of the two common thrips species was assessed in the two vineyards in Hacıahmetli and Bağcağız. Population densities of *R. vitis* and *M. tschirkunae* coincided with the mature fruiting period of the vines. Damage ratios on grape fruits due to thrips feeding varied between 10 and 15% in Mersin Province.

Keywords: Damage, population density, thrips, Türkiye, vineyard

Öz

Bu çalışma Mersin İli (Türkiye) bağ alanlarında bulunan thrips (Thysanoptera) türlerinin tespiti, popülasyon değişimleri ve zarar oranlarını belirlemek amacıyla 2019 ve 2020 yıllarında yürütülmüştür. Çalışma sonucunda 14 Thysanoptera türü belirlenmiştir. En fazla tespit edilen tür *Rubiothrips vitis* (Priesner, 1933) (Thysanoptera: Thripidae) (%56) olmuş ve onu *Mycterothrips tschirkunae* (Yakhontov, 1961) (Thysanoptera: Thripidae) (%23) izlemiştir. Thrips erginleri en fazla oranda (%88) meyvelerde örneklenmiştir. Popülasyon takibi Hacıahmetli ve Bağcağız yörelerinde belirlenen iki bağ alanında yürütülmüştür. *Rubiothrips vitis* ve *M. tschirkunae*'nin popülasyon yoğunlukları olgun meyve döneminde yüksek bulunmuştur. Mersin İli genelinde bağlarda thrips beslenmesi nedeniyle üzüm meyvelerinde zarar oranı %10-15 arasında değişmiştir.

Anahtar sözcükler: Zarar, popülasyon yoğunluğu, thrips, Türkiye, bağ

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Introduction

Grapes are an important export crop for Türkiye. According to the data of FAO in 2019, Türkiye is an important country with the sixth place in the ranking made according to the vineyard areas of the countries around the world. Grapes are grown on an area of about 400 kha in Türkiye producing 4 Mt of fruit (FAO, 2019). Mersin Province, located in the eastern Mediterranean Region of Türkiye, has an important place in terms of grape cultivation, and 383 kt of grapes are produced on an area of about 19 kha. Of this, 360 kt was for table grapes, 2 kt dried grapes and 21 kt wine grapes (TUIK, 2020).

There are many harmful factors that reduce the quality and yield in grape production. There are 267 pest species known to occur in vineyards in Türkiye, although these pest species differ with region, 25 to 30 species are common and 8-10 of them are economically important (Öztürk et al., 2005). Among these pests, thrips belonging to the order Thysanoptera constitute a group that causes significant damage (Kaplan & Bayhan, 2018). Thrips cause direct damage to grapevines through their feeding activities and indirectly by carrying pathogen (Bournier, 1970). Thrips, which are seen with the opening of the buds in the spring, continue to cause damage during the vegetative growth. With their stinging and sucking mouth structures, they first scratch the plant tissue (needle of mandible) and then suck the sap (needles of maxilla), causing silvery spots, scar tissues and necrosis. They suck fluid from the flowers, stems and buds, and cause them to fall, thus keeping the clusters sparse and reducing yield. In the unripe grape period, the tissues around the wound open while laying eggs on the grape florets turn white and adversely affect the quality of grapes. Both larvae and adult thrips cause scars on grapes, decreasing market value of the grapes (Roditakis & Roditakis, 2007).

The thrips species and their economic importance have been reported by the previous studies conducted in the vineyard production areas in Türkiye (Kaplan et al., 2016; Kaplan & Bayhan, 2017, 2018). The Ministry of Agriculture technical staff report indicates that thrips are problem in vineyards of Mersin Province particularly in locations Mut and Tarsus. In addition, some grape producers in the region have reported that thrips are harmful and they use pesticides. There is no study yet on the current status and damage patterns of pest thrips species in the region. In this context, it is necessary to determine the thrips species, their population changes and degree of damage, that is, their economic importance in vineyards cultivated in these areas. Composition of thrips species and degree of thrips damage in vineyards may differ from region to region. For example, Özsemerci (2007) reported that *Rubiothrips vitis* (Priesner, 1933) (Thysanoptera: Thripidae) was the most common species among 31 thrips species detected in vineyards of Manisa Province (Türkiye), while *Haplothrips globiceps* Bagnall, 1934 (Thysanoptera: Phlaeothripidae) was reported as the most common species among 19 thrips species identified in vineyards of Mardin Province (Türkiye). Doğanlar & Yiğit (2002) found *Retithrips syriacus* (Mayet, 1890) (Thysanoptera: Thripidae) as a common thrips species seriously damaging grapevines grown in the home gardens in Hatay Province (Türkiye). Sezginalp (2006) determined that *Thrips tabaci* Lindeman, 1889 (Thysanoptera: Thripidae) and *Frankliniella occidentalis* (Pergande, 1895) (Thysanoptera: Thripidae) are common in the vineyards of Bursa Province (Türkiye). This study aimed to determine the Thysanoptera species and to obtain basic information about the damage status of the thrips in the vineyards in Tarsus and Mut Districts of Mersin Province.

Materials and Methods

Detection of Thysanoptera species in vineyards

In the vineyard areas of Mut and Tarsus districts of Mersin Province (Figure 1), in 2019, non-periodic surveys for thrips were performed according to the phenological (shoot, flowering, fruit formation, harvest period and leaf fall) periods of the vineyards between the awakening of the buds in the vines in April-

October. Fifty-five surveys were conducted. Field surveys were performed in the morning as much as possible and as many vineyards were sampled as possible.

Figure 1. The locations where thrips species are sampled in vineyard areas of Mersin Province (Türkiye) in 2019.

In order to represent the vineyard area in thrips sampling, 30 grapevines were randomly selected for sampling and each grapevine were shaken into the white container with 34 × 23 × 7 cm for 5-10 s. The fallen thrips were collected with the help of a fine brush or the suction tube, and they were put in the plastic Eppendorf tubes (2 ml) containing 60% ethanol. The label information of the samples taken (the place of collection, date, geographic coordinates and phenology of the vineyards sampled) were recorded. The locations where Thysanoptera species were sampled are given in Figure 1 and coordinates of the vineyards surveyed in Table 1.

Thrips samplings

Two vineyards were selected in Hacıahmetli and Bağcağız, Mut District of Mersin Province in 2019. Insecticide and acaricide were not used in the selected vineyards during the sampling periods. Only bluestone (copper preparation) was applied in vineyards in Hacıahmetli, and no other chemical application was made in the other vineyard. Thirty shoots and 30 ripe grapes were sampled from both vineyards between 11 June and 8 October at weekly intervals, especially in the morning in 2019. Shoots and grapes were tapped onto a white plastic container for 5-10 s. Thrips were collected with the help of fine brush or suction tube. Sample individuals were placed in the plastic tubes containing 60% ethanol. Collected samples were prepared and recorded.

The vineyard (1667 m^2) in Hacıahmetli was 24 km away from the district center of Mut, at 36°40’03" N and 33°36’02" E, and at an altitude of about 1100 m and a slope of 25-30% from north to south. There are pine groves to its east and south, and vineyards to its west and north. The soil structure is low in yield under arid conditions, moderately stony and permeable. The vineyard was about 25 years old, and was planted to cv. Göğüzüm. The vineyard in Bağcağız, where the population study was conducted, was 18 km away from the center of Mut at 36°41’04" N and 33°32’27" E, with an area of 1024 m^2, at an altitude of about 900 m and slope of 15-20% from east to west. There was a forest in the east, apricot orchard in the west and bare land in the north. The soil was infertile under arid conditions, moderately stony and permeable. The vineyard was about 25 years old, and also planted to cv. Göğüzüm.

Table 1. Geographic coordinates of the vineyards where thrips surveys were performed in Mersin Province (Türkiye) in 2019

No	Location	Coordinates	No	Location	Coordinates
1	Mut-Bağcağız	36°41'04" N, 33°32'27" E	17	Mut-Kıravga	36°47'11" N, 33°10'33" E
2	Mut-Cumhuriyet	36°38'56" N, 33°26'43" E	18	Mut-Kültür	36°38'21" N, 33°26'33" E
3	Mut-Cumhuriyet	36°38'60" N, 33°26'46" E	19	Mut-Meydan	36°38'57" N, 33°26'03" E
4	Mut-Cumhuriyet	36°39'00" N, 33°26'46" E	20	Mut-Meydan	36°38'54" N, 33°26'03" E
5	Mut- Cumhuriyet	36°38'56" N, 33°26'44" E	21	Mut-Sakız	36°37'43" N, 33°17'55" E
6	Mut- Deveci	36°38'11" N, 33°25'37" E	22	Mut-Yatırtaş	36°38'08" N, 33°25'40" E
7	Mut- Deveci	36°38'11" N, 33°25'40" E	23	Mut-Yatırtaş	36°38'08" N, 33°25'39" E
8	Mut-Doğancı	36°38'25" N, 33°26'28" E	24	Tarsus-Gaziler	36°55'54" N, 34°51'39" E
9	Mut-Güllük	36°38'30" N, 33°26'35" E	25	Tarsus-Sucular	36°57'24" N, 34°48'41" E
10	Mut-Güllük	36°38'30" N, 33°26'33" E	26	Tarsus-Sucular	36°57'49" N, 34°49'31" E
11	Mut-Güllük	36°38'32" N, 33°26'34" E	27	Tarsus-Sucular	36°57'14" N, 34°48'44" E
12	Mut-Güllük	36°38'35" N, 33°26'34" E	28	Tarsus-Sucular	36°58'01" N, 34°49'43" E
13	Mut-Güllük	36°38'34" N, 33°26'33" E	29	Tarsus-Takbaş	36°56'52" N, 34°49'20" E
14	Mut-Hacıahmetli	36°40'03" N, 33°36'02" E	30	Tarsus-Ulaş	36°59'13" N, 34°47'27" E
15	Mut-İbrahimli	36°41'37" N, 33°37'34" E	31	Tarsus-Ulaş	36°59'05" N, 34°47'31" E
16	Mut-Kelceköy	36°38'52" N, 33°27'57" E	32	Tarsus-Ulaş	37°00'21" N, 34°46'12" E

Thrips identification

Thrips samples were placed in the plastic tubes (2 ml) with AGA (10 parts 60% ethanol, 1 part glycerin and 1 part glacial acetic acid) liquid (Lewis, 1973). Thrips samples, which were kept in this liquid for 2 days, were taken again into tubes containing 60% ethanol. The preparation of microscope slides for the specimens were made according to Mound & Kibby (1998). In temporary preparations, thrips were kept in 10% sodium hydroxide until slight color change appear on their bodies on a hot plate at 48°C for nearly 1 h, then specimens were washed in 96% ethanol, they were prepared in the Hoyer medium. Adult and larval thrips species were identified to species by the second author using published keys (Priesner, 1951; Nakahara, 1994; zur Strassen, 2003; Masumoto & Okajima, 2006; Minaei & Mound, 2008; Vierbergen et al., 2010; Mirab-Balou et al., 2012).

Determination of thrips damage

In the vineyards at Hacıahmetli and Bağcağız rates of thrips infestation were assessed and also the symptoms of thrips damage recorded. After the buds bust and the shoots began to grow (from the appearance of the leaves to the appearance of the clusters), 30 shoots and 10 bunches of grapes were examined for possible thrips damage in each vineyard in 2019. For this, shoots were examined along a row of the vineyard. Shoots with thrips and shoots with thrips damage were recorded separately. The number of infected shoots recorded and the number of damaged shoots were added separately and proportioned to the total number of shoots (Bora & Karaca, 1970). In 2019, 10 grape clusters were taken randomly from each vineyard in the fixed trial areas (Hacıahmetli and Bağcağız). In 2020, 10 vineyards, 5 in each region (Mut and Tarsus), were sampled (Table 2), and 10 unripe/ripe grape clusters samples were taken from each vineyard. The samples of grape clusters were brought to the laboratory of Mut District Directorate of Agriculture of the Ministry of Agriculture and Forestry, and grapes were examined for the thrips damage.

Table 2. Geographic coordinates of the vineyards where thrips damage detection were performed in Mersin Province (Türkiye) in 2019 and 2020

No	Location	Coordinates	No	Location	Coordinates
1	Mut-Bağcağız	36°41'04" N, 33°32'27" E	6	Tarsus-Sucular	36°58'01" N, 34°49"43" E
2	Mut-Hacıahmetli	36°40'03" N, 33°36'02" E	7	Tarsus-Sucular	36°57'49" N, 34°49'31" E
3	Mut-İlice	36°41'47" N, 33°11'55" E	8	Tarsus-Ulaş	36°59'13" N, 34°47'27" E
4	Mut-İlice	36°41'39" N, 33°11'54" E	9	Tarsus-Ulaş	36°58'55" N, 34°47'46" E
5	Mut-İlice	36°41'32" N, 33°11'49" E	10	Tarsus-Ulaş	36°59'14" N, 34°47'23" E

Evaluation of data

In total, 783 thrips specimens (adult and larvae) were examined. The frequency of identified thrips species, their total numbers and percentages in total adult were calculated (Table 3). The numbers of individuals of thrips species in different phenological periods of the grapevine in the sampling locations and also their percentages found in different plant organs were also evaluated (Table 4). Percentage of damaged fruits was found by dividing the total number of damaged fruits recorded individually with the total number of fruit (Bora & Karaca, 1970). In 2020, data collected on thrips damage rate from five vineyards in each district were combined; thus, the damage rates were evaluated on a district basis.

Results and Discussion

Thrips species

The frequency, total numbers and percentages of thrips species collected and identified from the sampling locations are shown in Table 3. In Mut and Tarsus, between April and October 2019, 55 surveys were conducted to determine the thrips species in the vineyards, and as a result, 783 thrips individuals (adults) were collected. *Rubiothrips vitis* (Priesner, 1933) was the most common thrips species with 444 specimens and it constituted 57.0% of the total adult thrips. The second most collected species was *Mycterothrips tschirkunae* (Yakhontov, 1961) with its 183 specimens and it constituted 23.3% of the total adult individuals. As a result of the study conducted in the surveyed vineyard areas in 2019, 14 thrips species, one from the family Aeolothripidae, 12 from the family Thripidae and one other from the family Phlaeothripidae, are new records for the vineyards of Mersin Province.

Thysanoptera species detected as a result of this study showed parallelism with the Thysanoptera species detected in previous studies. However, in addition to the thrips species detected in previous studies, vineyards in different locations of Mersin province, *Thrips euphorbiae* Knechtel, 1923, *Thrips hawaiiensis* (Morgan, 1913) and *Thrips pillichi* Priesner, 1924 species from the family Thripidae were recorded the first time in very low numbers in 2019. *Haplothrips globiceps* and *Anaphothrips vitis* Priesner, 1933 were determined in the vineyard areas of the southeastern and eastern Anatolia regions of Türkiye (Günaydın, 1972; Maçan, 1984; Kaplan & Çınar, 1998). Although *A, vitis* is not a registered thrips species in the Thysanoptera Checklist for Türkiye (Tunç & Hastenpflug-Vesmanis, 2016), Cengiz (1974) detected 25 thrips species in the vineyards of İzmir and Manisa Provinces, Türkiye, they reported that *A. vitis,* together with *Drepanothrips reuteri* Uzel, 1895 (Thysanoptera: Thripidae) and *H. globiceps*, was more intense. Karagöz (1987), found that *Haplothrips reuteri* (Karny, 1907) and *R. vitis* were common in vineyards of Aydın Province (Türkiye). Özsemerci (2007) determined 31 thrips species in the seedless vineyards in Manisa Province and reported that *R. vitis, H. globiceps*, *H. reuteri* and *Aeolothrips collaris* were denser. Kaplan et al. (2016) detected 19 thrips species in the vineyard areas of Mardin Province and he also found that *H. globiceps* species was more common.

Table 3. Frequency of the sampled Thysanoptera species, numbers of adults and their ratios in total adult individuals (%) in Mersin Province (Türkiye) in 2019

Species	Frequency	Total no of species	Ratio (%)
Aeolothripidae			
Aeolothrips collaris Priesner, 1919*	4	4	0.5
Thripidae			
Drepanothrips reuteri Uzel, 1895	11	29	3.7
Frankliniella occidentalis (Pergande, 1895)	12	24	3.0
Mycterothrips tschirkunae (Yakhontov, 1961)	44	183	23.3
Neohydatothrips sp.	2	2	0.3
Rubiothrips vitis (Priesner, 1933)	75	444	56.0
Thrips major Uzel, 1895	1	2	0.3
Thrips meridionalis (Priesner, 1926)	1	2	0.3
Thrips euphorbiae Knechtel, 1923	1	2	0.3
Thrips hawaiiensis (Morgan, 1913)	1	2	0.3
Thrips tabaci Lindeman, 1889	21	29	3.7
Thrips pillichi Priesner, 1924	1	1	0.1
Thrips physapus Linnaeus, 1758	1	2	0.3
Phlaeothripidae			
Haplothrips globiceps (Bagnall, 1934)*	20	57	7.2
Total	**195**	**783**	**100**

* Predatory thrips

Distribution of thrips species according to plant phenology of grapevine

The distributions of thrips species according to plant phenology (shoot/leaf, fruit and harvest-postharvest period) in the vineyard areas of Mut and Tarsus are shown in Table 4. Fourteen thrips species and 783 adult thrips individuals were identified in both districts. In Mut, 679 thrips individuals were detected, and the most common species was *R. vitis* (369 specimens). The second most collected species in Mut was *M. tschirkunae* with its 181 specimens collected. In Tarsus, *R. vitis* was the most common Thripidae species with 75 specimens, and *F. occidentalis* (17 specimens) was the second most collected species.

Distributions of thrips species according to plant phenology were also examined; two thrips species were identified in the shoot/leaf period of the vineyards in Mut. In this district, the most common Phlaeothripidae species was *H. globiceps* with its two specimens, while *M. tschirkunae* (1 individual) was found in the second rank. Thirteen Thysanoptera species (527 adults) were collected in the fruiting period of the vineyards. The most common thrips species was *R. vitis* with its 260 specimens. In the harvest-postharvest period of the vineyards, six thrips species (149 adults) were identified, and the most common species was *R. vitis* with its 109 specimens. Two Thysanoptera species (9 individuals) were detected in the shoot/leaf period of the vineyards, and the most common Thripidae species was *F. occidentalis* with eight specimens in Tarsus. Seven Thysanoptera species (88 adults) were detected during fruiting of the grapevines, and the most common species was *R. vitis* with its 71 specimens. In the harvest-postharvest period in the vineyards, a four Thysanoptera species were detected, and *R. vitis* was relatively more common.

The highest frequency (%) based on the total number of thrips species sampled was on fruits (87.7%), followed by harvest-postharvest (8.8%) and shoot/leaf rates (3.5%) (Table 4). Özsemerci (2007) reported that the *R. vitis* was found had high frequency in the vineyards of Manisa Province during bud burst period, and it caused damage to the buds. Kaplan & Bayhan (2018) determined that the *R. vitis* species was first seen in the vineyards of Mardin Province, at low density, from April when the buds began to awaken. In Mersin Province, *M. tschirkunae* was first seen from the shoot elongation period, and it was

recorded intensively during the fruiting period (160 individuals and 87% frequency). Özsemerci (2007) reported that *M. tschirkunae* was first seen in the vineyards of Manisa Province from the shoot elongation, and it was most common in October (harvet-postharvest). *Haplothrips globiceps* was first seen from the shoot elongation period, and it was recorded in high number (50 individuals and 87.7% frequency) during the fruiting period. This species has been recorded in the vineyards in Fars Province, Iran (Minaei & Mound, 2008). In the current study, although there is no data on the pest status *H. globiceps*, Cengiz (1974) reported that *H. globiceps*, like *A. vitis* and *D. reuteri*, feed on both vegetative and fruiting organs of the vines, and therefore this thrips was recognized as harmful. Kaplan (2014) also determined that *H. globiceps* first appeared in the shoot elongation period of grapevines in Mardin Province, and caused serious damage to grapevines in the flowering period. However, Minaei & Mound (2008) reported that 20 *Haplothrips* spp. in Iran, of which *Haplothrips kermanensis* zur Strassen, 1975 and *Haplothrips flavicinctus* (Karny, 1910) are harmful, and *H. globiceps* is a predatory species. According to that study, the feeding behavior of other 10 species was unknown. *Haplothrips globiceps* has been recognized as a predatory thrips in the oak plantations of Iran (Mirab-Balou & Miri, 2021). *Drepanothrips reuteri* was found intensively during the fruiting period (25 individuals and 86% frequency) in the surveyed vineyard areas, and it continued to exist until the end of the harvest (Table 4). Özsemerci (2007) reported that *D. reuteri* is first seen in the vineyards of Manisa Province in May (shoot/leaf period), and it was detected at high density in July-September (the fruiting period).

Table 4. Distribution (%) of sampled Thysanoptera species according to regions and plant phenology in Mersin Province (Türkiye) in 2019

Species	Mut			Tarsus			
	Shoots/leaves	Fruits	Harvest	Shoots/leaves	Fruits	Harvest	Total
Aeolothripidae							
Aeolothrips collaris	0	3	0	0	1	0	4
Thripidae							
Drepanothrips reuteri	0	24	3	0	1	1	29
Frankliniella occidentalis	0	4	3	8	9	0	24
Mycterothrips tschirkunae	1	158	22	0	2	0	183
Neohydatothrips sp.	0	2	0	0	0	0	2
Rubiothrips vitis	0	260	109	0	71	4	444
Thrips major	0	2	0	0	0	0	2
Thrips meridionalis	0	2	0	0	0	0	2
Thrips euphorbiae	0	0	0	0	2	0	2
Thrips hawaiiensis	0	2	0	0	0	0	2
Thrips tabaci	0	17	8	1	2	1	29
Thrips pillichi	0	1	0	0	0	0	1
Thrips physapus	0	2	0	0	0	0	2
Phlaeothripidae							
Haplothrips globiceps	2	50	4	0	0	1	57
Total	3	527	149	9	88	7	783

Population changes of thrips species

This study was conducted in two vineyards in Hacıahmetli and Bağcağız locations in 2019 (Figures 2 and 3). Population fluctuation of *R. vitis* and *M. tschirkunae*, which were more common species, were examined in the weekly survey. Population fluctuation of thrips species according to plant phenology in the vineyard in the Hacıahmetli are shown in Figure 2. *Rubiothrips vitis* was first seen on 25 June (0.53 individuals/unripe fruit) and it was detected in all samples during the growing season. This harmful thrips species reached the highest density (0.60 individuals/fruit) on 23 July. The average population density of the pest species varied between 0.20-0.46 thrips individuals between 6 August and 10 September, and the

population density was found to be quite low in the samples taken after 17 September (Figure 2). The first adults (males and females) of *M. tschirkunae* were recorded on 11 June (0.03 individuals/shoot). The population density of this harmful thrips species varied between 0-0.03 individuals/unripe fruit. *Mycterothrips tschirkunae* reached the highest density (0.5 individuals/ripe fruit) on 2 July (during fruiting). After that date, the population was variable with an average density from 9 July to 3 September of 0.06-0.43 individuals (Figure 2). The combined average population densities of other thrips species during the unripe fruiting period of the vineyard were low, varying from 0 to 0.10 individuals/unripe fruit (Figure 2).

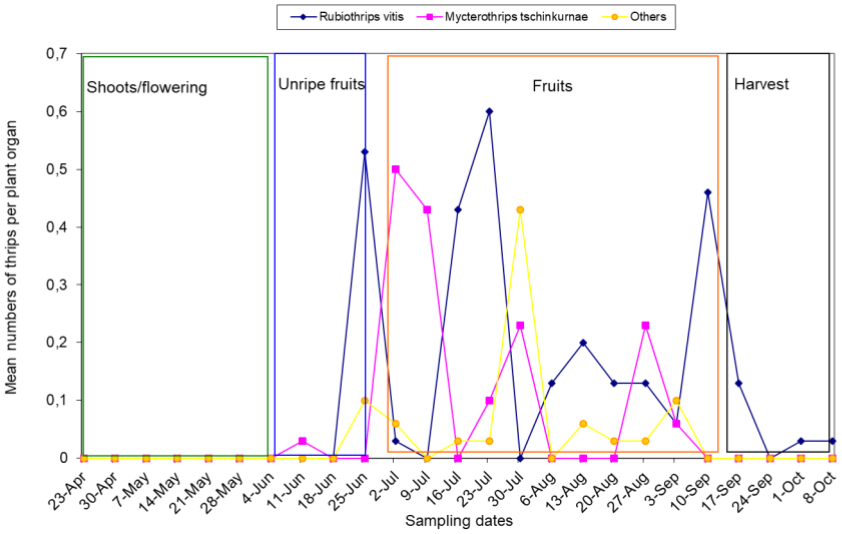

Figure 2. Mean number (adults) of two Thysanoptera species according to plant phenology in the vineyard in Hacıahmetli in Mersin Province (Türkiye) in 2019.

Population fluctuation of thrips species according to plant phenology in the vineyard in Bağcağız location in 2019 are given in Figure 3. *Rubiothrips vitis* started to be seen on 18 June (0.33 individuals/unripe fruit). This harmful thrips species reached its highest density (0.36 individuals/ripe fruit) on 10 September. This species had varying population densities throughout the season, with an average density of 0.26-0.36 individuals from 18 June to 10 September.

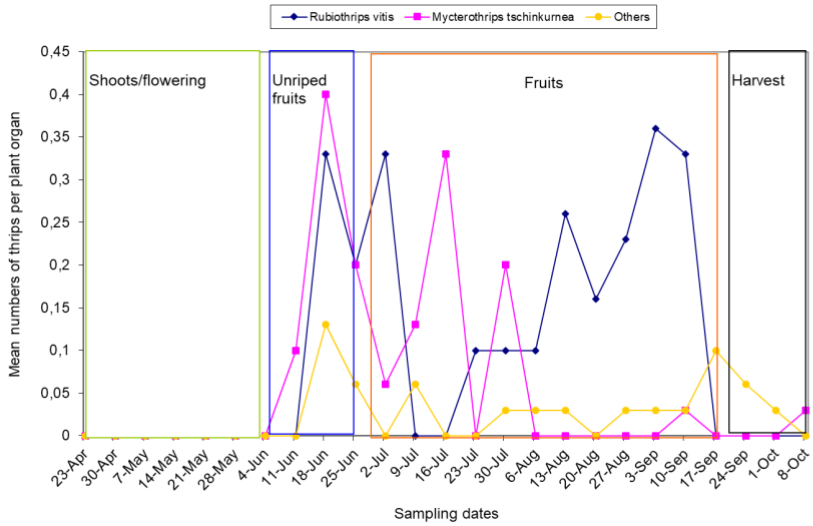

Figure 3. Mean number (adults) of two Thysanoptera species according to plant phenology in the vineyard in Bağcağız in Mersin Province (Türkiye) in 2019.

Mycterothrips tschirkunae was first seen during the unripe fruiting period. The pest thrips reached its highest density (0.40 individuals/unripe fruit) on 18 June. After that date, its population varied with an average population density between 0.20-0.33 individuals from 25 June to 30 July (Figure 3). In both locations (Hacıahmetli and Bağcağız), no thrips were found between 23 April and 11 June. This was thought to be due to unsuitable plant phenology or it being on other host plants, and thus it may have not yet moved into the vineyards.

Thrips damage symptoms in vineyards

Damage views due to thrips on grapevine leaves and fruits are shown in Figure 4. Thrips, which are first seen with the opening of the buds of vines in the spring, continue their damage during vegetative growth. At the beginning of the vegetative period in the vineyards, the pest thrips feeds by sucking on the lower surface of the leaves, and as a result, it forms a light yellow halo spots which eventually turn brown. As a result of intensive thrips feeding, the leaves may dry out. Thrips caused damage of black and brown spots on the fruits, and then these spots expand forming wounds. The brown spots get bigger and covered the florets in the cluster of fruits during the period of fall. Following this period, these spots caused cracking in the florets, finally the fruits to rot and thus the fruit-quality loss in the cluster (Figure 4). In the study conducted by Yokoyama (1977) in the USA, it was found that thrips lay eggs on the newly forming florets and cause injuries in the tissues where the eggs are deposited. Lewis (1997) reported that in table grapes, *T. tabaci* caused silvery or bronze colored spots on the florets in the fruit ripening period. In vineyards in Türkiye, similar damage symptoms on berries have been reported (Özsemerci, 2007; Kaplan, 2014).

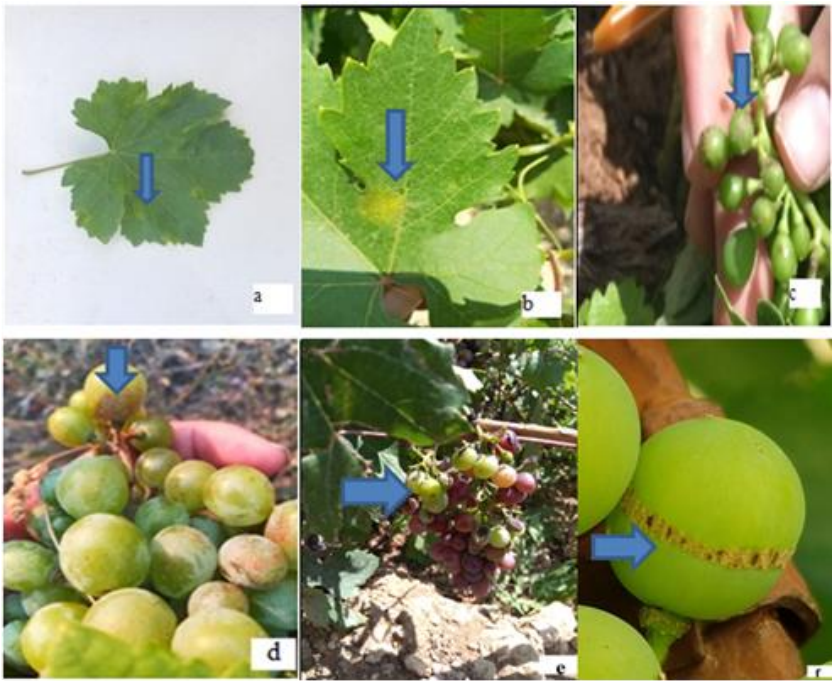

Figure 4. Damage symptoms due to the thrips attacks on grape leaves (a & b), unripe fruits (c & d) and matured fruits (e & f) in Mersin Province (Türkiye) in 2019.

Determination of thrips damage

The rate of damage (%) caused by the thrips in the vineyards in Hacıahmetli and Bağcağız are given in Table 5. The percentage of damage in Hacıahmetli and Bağcağız (when all clusters are included) was determined as 14.8 and 13.8%, respectively (Table 5). The damage in the vineyards in Mut and Tarsus (when all clusters were included) was 14.2 and 9.9%, respectively (Table 6).

In order to determine the percentage of damage, due to thrips on the grape leaves in Tarsus and Mut in 2020, thrips damage (%) was determined for 100 leaves randomly selected on 30 June and 8 August before the harvesting time. Percentage of thrips damage on grape leaves in Tarsus and Mut were found as 34 and 42%, respectively. Yokoyama (1977), reported that thrips cause 50% damage to the berries in the clusters, and this damage was due to the feeding of thrips larvae as well as adults in California, USA. Özsemerci (2007) reported that thrips species cause damage between 0.04 and 0.60% in seedless grapes in Manisa Province. Roditakis & Roditakis (2007) determined that the most damaging thrips species on grapes were *F. occidentalis*, *T. tabaci* and *D. reuteri*, and they determined the damage rates due to the thrips attacks under the laboratory conditions. In their experiments, they found that *F. occidentalis* caused significant injury (90%) in the first 6 days and 100% in the next 16 days, while *T. tabaci* and *D. reuteri* had caused 77 and 45% damage in the fruits after 16 days, respectively. Kaplan (2014), reported that the damage rate of thrips on grapes ranged from 15.34% to 21% in Mardin Province. Based on the previous studies, degree of damage caused by the thrips in the vineyards varied. This issue may be related to harmful thrips species, grape cultivars, pesticide applications in vineyards and other ecological factors.

Table 5. Percentage of damage, due to thrips feedings in the vineyards in the locations Hacıahmetli and Bağcağız s in Mut district in Mersin Province (Türkiye) in 2019

	Bağcağız			Hacıahmetli		
No of clusters	No of berries in clusters	No of damaged berries	Damage ratio (%)	No of Berries in clusters	No of damaged berries	Damage ratio (%)
1	60	8	13.3	36	7	19.4
2	50	7	14.0	60	10	16.7
3	45	4	8.9	42	8	19.0
4	47	7	14.9	75	9	12.0
5	69	5	7.2	47	1	2.1
6	51	8	15.7	75	5	6.7
7	27	6	22.2	22	3	13.6
8	28	6	21.4	23	7	30.0
9	25	4	16.0	38	11	28.9
10	34	5	14.7	27	5	18.5
Mean	43.6	6	13.8	44.5	6.6	14.8

Table 6. Damage rates (%) due to thrips feeding in the vineyards in Mut and Tarsus districts in Mersin Province (Türkiye) in 2020

	Mut			Tarsus		
No of clusters	No of berries in clusters	No of damaged berries	Damage ratio (%)	No of Berries in clusters	No of damaged berries	Damage ratio (%)
1	57	7	12.3	87	10	11.5
2	69	8	11.6	76	10	13.2
3	69	9	13.0	83	9	10.8
4	77	14	18.2	76	7	9.2
5	74	11	14.9	84	8	9.5
6	66	17	25.8	99	11	11.1
7	74	10	13.5	89	7	7.9
8	80	10	12.5	91	6	6.6
9	83	8	9.6	81	8	9.9
10	75	8	10.7	78	7	9.0
Mean	72.4	10.2	14.2	84.4	8.3	9.9

In the current study, mainly adults (both female and male) of thrips were collected. Few larvae were recorded. Larvae were mostly collected together with adults of *R. vitis*. This species was the main thrips in the vineyards sampled (Table 4). The majority of larvae belonged to this species. In other words, only *R. vitis* could multiply in the vineyards in the Eastern Mediterranean Region of Türkiye. We observed that the thrips damage in the vineyards sampled was mainly due to *R. vitis*. Similar to findings of the current study, Shoukat & Shayesteh (2006) reported that *R. vitis* was a common pest thrips species in both vegetative and fruiting organs of grapevines in vineyards in Western Azarbaijan in Iran.

Conclusions

In this study, harmful grapevine thrips species such as *R. vitis* was identified in important grape production areas of Mersin Province. The damage due to thrips feedings (mainly *R. vitis*) in the vineyards sampled varied between 10-15%. Thrips damage to grapes is, therefore, of potential importance in the grape cultivation in the region. However, further study is needed to clarify pest status of the thrips in the vineyards including an economic analysis of the yield loss due to thrips. Grape growers in the region do not know enough about thrips species and their damage. Probably, pesticides they use against other harmful insects such as the European grapevine moth in the vineyards also suppress sucking pest insects such as thrips. It would be useful to solve the thrips problem in the vineyards in the region within the scope of integrated pest management principles including education of growers about grapevine thrips in the region.

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