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Determination of the Species of Tephritidae family (Diptera) on Cherry Orchards in Adana Province and Surroundings in Turkey

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ABSTRACT
This study was conducted to determine the species belonging to the Tephritidae (Diptera) family in the cherry cultivations in Adana province and surroundings. Samples were collected with periodic and non-periodical survey from host plants in cherry orchards during 2015-2018. In this study, nine species belonging to Tephritidae family were found. These species were; *Rhagoletis cerasi* (Linnaeus, 1758), *Ceratitis capitata* (Wiedemann, 1824), *Rhagoletis batava* (Hering, 1958), *Carpomya schineri* (Loew, 1856), *Tephritis nigricauda* (Loew, 1856), *Tephritis fallax* (Loew, 1844), *Tephritis dioscurea* (Loew, 1856), *Tephritis hurvitzi* (Freidberg, 1981), *Tephritis divisa* (Rondani, 1871).

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Adana İli ve Çevresi Kiraz Bahçelerinde Tephritidae (Diptera) Familyası Türlerinin Belirlenmesi

ÖZET
Bu çalışma, Kiraz yetiştiriciliği yapılan Adana ili ve çevresinde Tephritidae (Diptera) familyasına bağlı türlerin belirlenmesi amacıyla yürütülmüştür. Örnekler 2015 – 2018 yılları boyunca kiraz bahçesinde bulunan tüm konukçu bitkilerden periyodik ve periyodik olmayan arazi çıkışları ile toplanmıştır. Çalışmada, Tephritidae familyasına ait dokuz tür tespit edilmiştir. Bu türler; *Rhagoletis cerasi* (Linnaeus, 1758), *Ceratitis capitata* (Wiedemann, 1824), *Rhagoletis batava* (Hering, 1958), *Carpomya schineri* (Loew, 1856), *Tephritis nigricauda* (Loew, 1856), *Tephritis fallax* (Loew, 1844), *Tephritis dioscurea* (Loew, 1856), *Tephritis hurvitzi* (Freidberg, 1981) ve *Tephritis divisa* (Rondani, 1871)' dır.

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INTRODUCTION
The fruit flies (Tephritidae) are one of the most economically important pests and largest families of Acalyptrate Diptera with approximately 500 genera, and about 4500 species, specifically, in tropics and subtropics. Most species are phytophagous. Some of them are harmful such as *Rhagoletis cerasi*, *Ceratitis capitata* etc. (White and Elson-Harris, 1992). In Palaearctic Region, and especially in Europe, this family is represented by a few dozens of fruit-feeding species, including the medfly *C. capitata*, the cherry fruit fly *R. cerasi*, but the vast majority of Palearctic species, which belong to the subfamily Tephritinae, feed in flower heads and stems (often forming galls) on plants of the family Asteraceae (Korneyev, 2003). According to Norrbom et al. (1999) and Korneyev and Dirlbek (2000), *Tephritis* Latreille is the sixth largest genus of Tephritidae with about 170 species, and the third largest genus of the subfamily of Tephritinae. The most of the species belonging to genus are Palearctic.

When economically evaluated, fruit flies damage the vegetables and fruits directly, causing quarantine areas under invasion, and having required such fruits to be exposed to quarantine treatment before exportation.

The identification of species belonging to the Tephritidae family, as in other insect groups, is made during the adult stage. The Tephritidae family in Adana has been published in some Diptera studies (Becker, 1913; Séguy, 1930, 1934, 1941, 1949, 1953). Various studies on the Diptera fauna in Turkey were also performed by Giray (1969, 1979), Hayat and

Özbek (1994), Civelek et al. (2000), Çıkman and Uygun (2003), Kütük and Özgür (2003), Civelek (2004), Kılıç (2004). Yaran and Kütük (2016) has been reported the number of fruit flies species as 160. In recent studies, the insect fauna of Turkey in cherry orchards has been investigated (Ulu et al., 1995; Özbek et al., 1996; Özder, 1999; Ulusoy et al., 1999). *R. cerasi* is a common and main pest in cherry. The aim of this study was to provide some data for Tephritidae fauna and also the fauna of cherry orchards in Turkey.

MATERIAL and METHODS

The samples were collected from cherry orchards in Adana province and its surroundings during 2015-2018. The adult flies of Tephritidae were collected by insect traps and nets. Traps were set on the trees in the orchards and checked once a week. The insect nets were swung randomly to the adult species seen on the host plants and the insects were collected. All samples were deposited in the Nedim Uygun Biological Control Laboratory in Plant Protection Department of Agriculture Faculty, Çukurova University, Adana, Turkey. The insects were identified by the authors and Associate Professor Dr. Murat Kütük (Gaziantep University, Gaziantep, Turkey).

RESULTS and DISCUSSION

In total, 9 species belonging to 4 genera in 3 subfamilies (Dacinae, Tephritinae and Trypetinae) were determined from Adana provinces. In this paper, the distribution and host plants species of all materials examined were presented and the species were listed in alphabetical order.

Rhagoletis cerasi (Linnaeus) (Figure 1a)

Material examined: Adana: Aladağ, Meydan, 11.V.2017, 2♀♀, Aladağ, Değirmencik, 07.VI.2018, 3♀♀, Aladağ, Yeniköy, 07.VI.2018, 1♀, Feke, 20.V.2017, 2♀♀, Karaisalı, Hacıkırı, 03.VI.2016, 2♀♀, Karaisalı, Kızıldağ, 01.VI.2018, 1♀, Pozantı, Alpu, 17.V.2016, 5♀♀, Pozantı, Alpu, 22.V.2017, 7♀♀, 2♂♂, Pozantı, Fındıklı, 04.VI.2017, 2♀♀, Pozantı, Ömerli, 02.VI.2017, 5♀♀, Saimbeyli, Merkez, 20.V.2017, 3♀♀, Saimbeyli, Merkez, 29.VI.2018, 2♀♀, Saimbeyli, Gürleşen, 29.VI.2018, ♀, Saimbeyli, Obruk, 29.VI.2018, 1♀, Tufanbeyli, 4.VII.2017, 1♀, Tufanbeyli, 29.VI.2018, 3♀♀; Mersin: Çamlıyayla, Fakılar, 16.VI.2016, 5♀♀, Tarsus, Kurtçukuru, 16.VI.2016, 3♀♀; Niğde: Ulukışla, Darboğaz, 27.V.2015, 3♀♀, 1♂, Ulukışla, Darboğaz, 08.VI.2016, 11♀♀, 3♂♂.

Host: *Prunus. avium* L., *P. mahaleb* L., *P. cerasus* L., *P. serotina* Ehrh (Rosaceae) and *Lonicera tatarica* L., *L. xylosteum* L. (Caprifoliaceae) (Hendel, 1927; Afshar, 1937; White and Elson-Harris, 1992; Merz, 1994; Ulusoy et al., 1999).

Distrubition in the world: Canada, Europe, Georgia, Iran, Kazakhstan, Russia, Turkey (Afshar, 1937; Norrbom et al., 1999; Ulusoy et al., 1999; Mohamadzade Namin and Rasoulian, 2009; EPPO, 2017).

Remarks: *R. cerasi* is the most serious pest in cherry orchards in Turkey, causing fruit damage and yield losses. The adult flies emerge from the soil in May to June in Adana. Occurs on cherries and honeysuckles in Turkey. In this study, host of the species is *P. avium.* When the flies are uncontrolled, cherry trees can be infested 100%.

Ceratitis capitata (Wiedemann) (Figure 1b)

Material examined: Adana: Aladağ, Meydan, 11.V.2017, 1♀, Aladağ, Değirmencik, 07.VI.2018, 2♀♀, Pozantı, Alpu, 20.VII.2016, 2♀♀, Pozantı, Alpu, 27.VI.2018, 25♀♀, 11♂♂, Saimbeyli, 20.V.2017, 1♀, Saimbeyli, Merkez, 29.VI.2018, 1♀, Saimbeyli, Obruk, 29.VI.2018, 1♀, Tufanbeyli, 04.VII.2017, 2♀♀, Tufanbeyli, 29.VI.2018, 1♀.

Hosts: Larvae on *P. avium, P. persica*, *Pyrus communis* L. and *Malus domestica* Borkh. (Rosaceae). More than 250 plant types.

Distrubition in the world: Africa, Asia, Europe, Central America- Caribbean, South and North America, Spain, Oceania, Turkey (Enkerlin et al., 1989; Fimiani, 1989; Norrbom et al.,1999; EPPO, 2014).

Remarks: This pest began to be seen in traps at the beginning of July at the end of June within the study area (especially above altitudes of 1200 m) and it has been detected the fruit on the tree.

Rhagoletis batava (Hering) (Figure 1c)

Material examined: Adana: Pozantı, Alpu, 08.VI.2017, 2♀♀, Pozantı, Alpu, 04. VII.2017, 1♀, Pozantı, Alpu, 19.VII.2018, 4♀♀.

Hosts: *Hippophae rhamnoides* L., *Rhamnaceae* sp. (Richter, 1970; Baugnée, 2006) and *P. avium*.

Distrubition in the world: Armenia, Belgium, Belarus, Finland, Estonia, Germany, Hungary, Italy, Kyrgyzstan, Latvia, Lithuania, Poland, Russian Federation (European division), Sweden, Switzerland, Spain, The Netherlands and Turkey. Non-European: North-Central Caucasus; Russian Federation and South Siberian mountains: Altai, Tuva (Pakyürek, 2006; Koçak and Kemal, 2013; EPPO, 2017; Stalažs and Balalaikins, 2017).

Remarks: *R. batava* is an economically important pest and aggressive of *H. rhamnoides* in Europe. But, It has been reported that these flies can develop also on several other trees and bushes in natural vegetation, i.e. *Cerasus mahaleb* and *Lonicera* spp., etc. (Anonymous, 2018).

Carpomya schineri (Loew) (Figure 1d)

Material examined: Adana: Pozantı, Alpu, 14.VI.2016, 1♀, Pozantı, Alpu, 25.VII.2018, 1♀.

Hosts: *P. avium*, *Rosa beggerana* Schrenk, *R. canina* L., *R. damascena* Mill., *R. gallica* L., *R. pulverulenta* M.B., *Rosa kokanica* (Regel) Regel et Juz., *R. rubiginosa* L., *R. spinosissima* L., *R. rugosa* Thunb., *R. villosa* L., (Rosaceae) (Hendel, 1927; Kandybina, 1977; Freidberg and Kugler, 1989; Smith and Bush, 1999).

Distrubition in the world: Austria, Bulgaria, Germany, Hungary, Italy, Northern Africa Spain, Slovakia, Switzerland, Spanish Mainland, Turkey, Ukraine (White and Elson-Harris, 1992; Merz, 1994; Korneyev, 2003; Pakyürek, 2006; Koçak and Kemal, 2013).

Remarks: Yellow sticky traps with ammonia capsules (Trece-Pherocon® AM) traps set out to detect the cherry fruit fly (*R. cerasi*) on *P. avium*, single specimens of *C. schineri* were recorded. But the damage *on C. schineri* was not detected. It has been reported that *C. schineri* has damaged only rose berries (Papp, 1994; Surányi and Haltrich, 2006; Tuba, 2009). Studying and observations should be continued on cherries whether it does any damage.

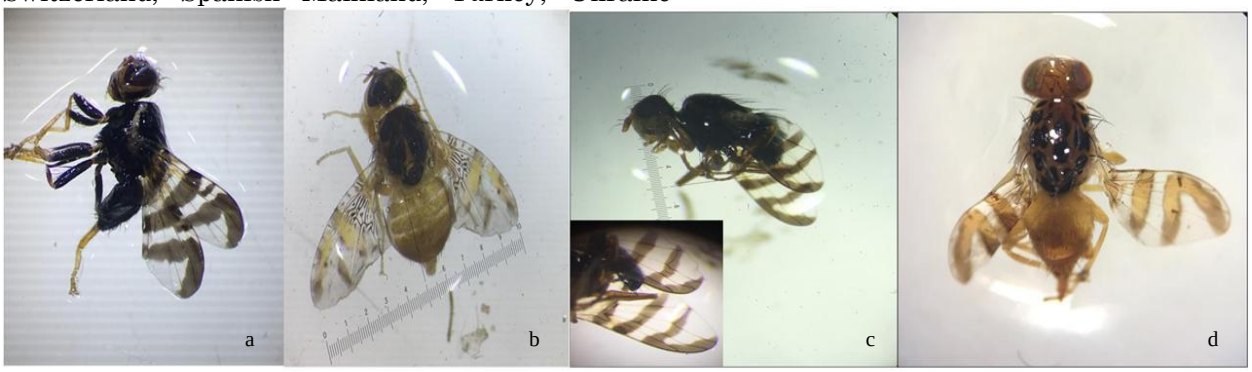

Figure 1. General view of adult fly: (a) *Rhagoletis cerasi*, (b) *Ceratitis capitata*, (c) *Rhagoletis batava*, (d) *Carpomya schineri* (Photos: BÖÇ).

Tephritis nigricauda (Loew) (Figure 2a)

Material examined: Adana: Pozantı, Alpu, 31.V.2017, 3♀♀.

Hosts: *Achillea millefolium* L., *A. ptarmica* L., *Anthemis arvensis* L. (Asteraceae) (Merz, 1994).

Distrubition in the world: Afghanistan, Austria, Estonia, Italy, Latvia, Lithuania, Moldova, Russia, Syria, Switzerland, Ukraine, and Turkey (Foote, 1984; Merz, 1994; Thompson, 1998; Kütük and Özgür, 2003).

Remarks: This species was first recorded from Turkey (Kütük and Özgür, 2003) and was described on Asteraceae. In the previous studies has not been recorded any damage on cherry trees. This species were collected on *P. avium* but the damage on *T. fallax* was not detected.

Tephritis fallax (Loew) (Figure 2b)

Material examined: Adana: Pozantı, Alpu, 08.VI.2017, 1♀.

Host: *Leontodon hispidus* L. (Merz, 1994).

Distrubition in the world: Estonia, Germany, Kazakhstan, Latvia, Lithuania, Poland, Russia, Romania, Sweden, Switzerland, Turkey, and Ukraine (Foote, 1984; Merz, 1994; Thompson, 1998; Özgür and Kütük, 2003).

Remarks: This species were collected on *P. avium* but was not detected any damage on *T. fallax.*

Tephritis dioscurea (Loew) (Figure 2c)

Material examined: Adana: Pozantı, Alpu, 08.VI.2017, 1♀.

Hosts: *Artemisia absinthium* L., *A. crithmifolia* L., *A. millefolium*, *Chrysanthemum corymbosum* L. (Asteraceae) (Hendel, 1927; Merz, 1994; Kütük, 2005).

Distrubition in the world: Armenia, Austria, Azerbaijan, Estonia, Far East, France, Germany, Georgia, Hungary, Kazakhistan, Latvia, Lithuania, Moldova, Russia, Sweden, Switzerland, Turkey and Ukraine (Hendel, 1927; Foote, 1984; Merz, 1994; Thompson, 1998; Kütük, 2005).

Remarks: This species was first recorded from Turkey by Kütük (2005). It has not been detected on cherry as pest, but it has been reported by researchers who indicated that the larvae of *T. dioscurea* damaged the flower heads of Asteraceae.

Tephritis hurvitzi (Freidberg) (Figure 2d)

Material examined: Adana: Pozantı, Alpu, 08.VI.2017, ♀.

Hosts: *Scorzonera syriaca* Boiss & Blanche and *Tragopogon longirostris* Bisch. (Freidberg and Kugler, 1989).

Distrubition in the world: Europe, Iraq, Iran, Israel, Jordan, Lebanon, Middle Asia, Syria, and Turkey (Norrbom et al., 1999; Korneyev and Dirlbek, 2000; Kütük and Özgür, 2003; Özgür and Kütük, 2003;

Mohamadzade Namin et al., 2010).

Remarks: Most species of *Tephritis* sp. develop the flower heads of Asteracae but this species in stems of Asteraceae cause the emergence of galls (Freidberg, 1984; Merz, 1994). It has not been observed any damage on cherry trees.

Tephritis divisa (Rondani) (Figure 2e)

Material examined: Adana: Pozantı, Alpu, 04.VII.2017, 2♀♀.

Hosts: *Picris echioides* L. (Asteraceae) (Merz, 1994; Kütük, 2005).

Distrubition in the world France, Greece (Crete), Italy, Israel, Switzerland, Spain, and Turkey (Merz, 1994; Thompson, 1998; Kütük, 2005).

Remarks: This species was recorded from Turkey by Kütük (2005) on *P. echioides*. The larvae of *T. divisa* develops in flower head of *P. echioides.* It has not been detected on cherry.

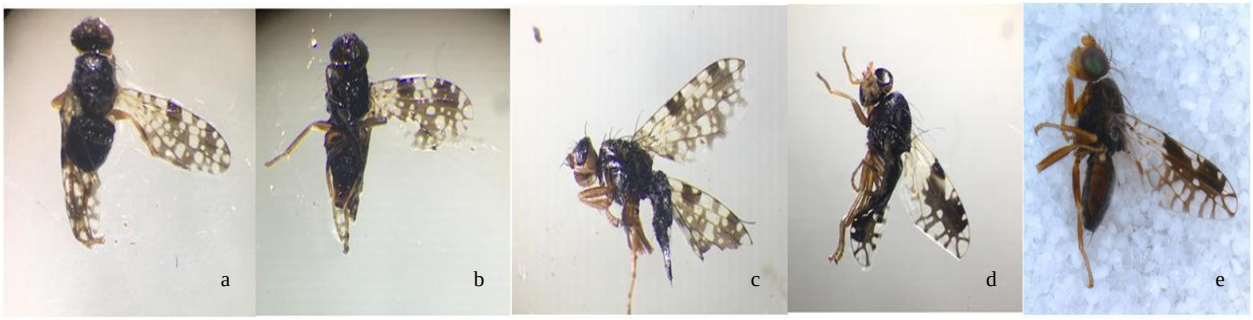

Figure 2. General view of adult fly: (a) *Tephritis nigricauda*, (b) *Tephritis fallax*, (c) *Tephritis dioscurea*, (d) *Tephritis hurvitzi* (Photos: BÖÇ), (e) *Tephritis divisa* (http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=285046).

RESULTS

As a result of this study, nine species belonging to 4 genera (*Rhagoletis*, *Ceratitis*, *Carpomya* and *Tephritis*) have been determined. According to previous studies, *Tephritis* Latreille is common genus with 24 species in Turkey (Kütük, 2006, 2008; Kütük et al., 2012). The results of this study have showed similarities with previous studies and the biodiversity of Adana province and surroundings in Turkey. *R. batava* from these pests is aggressive, economically important pest and a serious threat of its dispersion. It can infest several other trees i.e. *Cerasus mahaleb*, *Lonicera* spp., etc apart from the main host plant (Anonymous, 2018). More studies need to be conducted in order to have better understanding of damage status of this pest on cherry.

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