

1-1-2016

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The community members associated with rose gall wasp *Diplolepis fructuum* (Rübsaamen, 1895) (Hymenoptera: Cynipidae) in Tokat Province of Turkey

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Received: 14.05.2015 • Accepted/Published Online: 09.10.2015 • Final Version: 07.04.2016

Abstract: Field studies were carried out in April, October, and November 2013 and March and October 2014 in Tokat Province of Turkey. Gall specimens of *Diplolepis fructuum* (Rübsaamen, 1895) (Hymenoptera: Cynipidae) on host plants from the genus *Rosa* were collected. Thirteen species from six families were reared. Among them, *Eurytoma caninae* Lotfalizadeh & Delvare, 2007 and *Aximopsis collina* (Zerova, 1984) are new records for Turkey. The most common parasitoids are *Eupelmus urozonus* Dalman, 1820 and *Stepanovia eurytomae* (Nees, 1834), respectively.

Key words: *Diplolepis fructuum*, parasitoid, new record, community members

1. Introduction

The genus *Rosa* is a common plant group in Europe, Asia, the Middle East, and North America (Nilsson, 1997). There are approximately 100 rose species throughout its distribution area, and of them 27 species have been reported in Turkey, mostly in East, North, and Northeast Anatolia (Güçlü et al., 2008). Tokat Province is among the main centers of rose hip production in Turkey (Ercisli, 2005). One of the most interesting plant–insect interactions, gall formation, frequently takes place on host plants from the genus *Rosa*, besides many other plant groups. Rose gall wasps (Hym.: Cynipidae, Diplolepidini) are well-known gall-inducing insects group on *Rosa* species. Rose gall wasps consist of two genera that contain the inducers of some of the most striking plant galls. These two genera are *Liebelia* Kieffer, 1903 and *Diplolepis* Geoffroy, 1762 (Melika, 2006), and there is no record of the genus *Liebelia* in Turkey. On the other hand, six species from the genus *Diplolepis* have been reported in Turkey (Güçlü et al., 2008; Katılmış and Kıyak, 2008, 2010; Mete and Demirsoy, 2012; Azmaz and Katılmış, 2014).

Like other cynipids, *Diplolepis* galls support species-rich communities that contain phytophagous inquilines, parasitoids, and hyperparasitoids, along with the gall-inducer (Stone et al., 2002).

The larvae of *Diplolepis* are attacked by parasitoids from 11 genera and inquilines from the genus *Periclistus* (Shorthouse, 2010), and the common effect of these

attackers can cause nearly 90% of mortality for the gall-inducer (Shorthouse, 1993; Stone et al., 1995).

There are a number of studies concerning rose gall wasps and their associated communities (Askew, 1960; Schröder, 1967; Nordlander, 1973; Shorthouse, 1973; Zerova and D'yakonchuk, 1976; Nieves-Aldrey, 1981; Brooks and Shorthouse, 1998; Shorthouse and Brooks, 1998; Lalonde and Shorthouse, 2000; Lotfalizadeh et al., 2006, 2007; László and Tóthmérész, 2011; Lotfalizadeh et al., 2012). There are also some studies related to this subject in Turkey (Kilinçer, 1983; Doğanlar, 1984, 1990; Doğanlar and Çam, 1991; Bayram et al., 1998; Özbek et al., 1999; Çoruh et al., 2004; Güçlü et al., 2008; Katılmış and Kıyak, 2011), but there is no overall knowledge about the rose gall wasp communities of this area.

The most common rose gall wasp in Turkey, *Diplolepis fructuum*, can cause damage on almost all rose hips. The species *Diplolepis eglanteriae*, *D. rosae*, *D. spinosissima*, and *D. nervosa* induce galls on the leaves or leaf buds, and *D. mayri* on flower buds, but they are uncommon (Güçlü et al., 2008). According to the historical review of Pujade-Villar and Plantard (2002), *D. fructuum* was previously considered as a geographic race of *D. mayri*. Later, its validity was confirmed by molecular (Plantard et al., 1998) and morphological (Pujade-Villar and Plantard, 2002) studies. Güçlü et al. (2008) indicated that the specimens identified as *D. mayri* in previous studies in Turkey are likely to be *D. fructuum*. Hereafter, these previous records will be mentioned as *D. fructuum* in this study.

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In this paper, we aimed to contribute to the literature on the fauna associated with *D. fructuum* in Turkey.

2. Materials and methods

The galls of *Diplolepis* mature in mid-August and the larvae enter the overwintering prepupal stage (Shorthouse and Leggo, 2002). Collected galls are supposed to be mature in order to let the larvae feed and grow into adults; therefore, spring and autumn are proper seasons for collecting (Shorthouse, 2010). Accordingly, gall specimens of *Diplolepis fructuum* (Hym.: Cynipidae) on host plants from the genus *Rosa* were collected in April, October, and November 2013 and March and October 2014 in Tokat Province of Turkey. The gall specimens were stored in jars and kept at room temperature. The emerging adult gall wasps and parasitoids were preserved in 96% ethanol. Reared wasp specimens were identified using the works of Goulet and Huber (1993), Zerova and Seryogina (1999), Lotfalizadeh et al. (2006), Melika (2006), Roques and Skrzypczynska (2003), Yu et al. (2012), and Noyes (2014).

3. Results

Thirteen species from six families were identified, which are mostly parasitoids and hyperparasitoids along with one seed- and one gall tissue-feeder.

3.1. Family Torymidae

3.1.1. *Torymus bedeguaris* (Linnaeus, 1758)

This is a Holarctic species (Shorthouse, 1973), and was reported from *D. rosae*, *D. fructuum*, and *D. eglanteriae* galls in Turkey (Kılınçer, 1983; Bayram et al., 1998). It was also reported from *Dasineura rosarum* (Hardy, 1850) (Diptera: Cecidomyiidae), which is another gall-inducer on *Rosa* spp. (Bayram et al., 1998). Shorthouse (1993) reported this species as a hyperparasitoid on *Orthopelma mediator* (Hym.: Ichneumonidae) and *Periclistus pirates* (Hym.: Cynipidae) in addition to *D. rosarum*.

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 14♀♀, 8♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 1♀, 2♂♂; between Tokat and Aybastı, 40°27'8.8"N, 37°18'7.9"E, 1075 m, 30.x.2013, 2♀, 3♂; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 2♀♀; between Almus and Tokat, 40°20'56.4"N, 36°37'56.8"E, 621 m, 13.x.2014, 2♀♀, 1♂.

3.1.2. *Glyphomerus stigma* (Fabricius, 1793)

A Holarctic species (Shorthouse, 1973), that was reported on *D. fructuum* and *D. rosae* in Turkey (Kılınçer, 1983; Doğanlar, 1984; Bayram et al., 1998). It was also reported as a gall-tissue feeder (Wiebes-Rijks and Shorthouse, 1992).

Materials examined: TOKAT, between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013,

4♀♀, 3♂♂; Turhal, Taşlıçiftlik Village, 40°23'1.8"N, 36°27'45.5"E, 604 m, 24.iv.2013, 1♀, 1♂; Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 1♀; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 2♀♀.

3.1.3. *Megastigmus rosae* Bouček, 1971

This is a Palearctic species and was reported on *D. fructuum* in Turkey (Bayram et al., 1998). However, Roques and Skrzypczynska (2003) and Daneshvar et al. (2009) indicated that this species is a seed-feeder on *Rosa* spp.

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 7♀♀, 2♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 1♂.

3.2. Family Eurytomidae

3.2.1. *Eurytoma caninae* Lotfalizadeh & Delvare, 2007

It is a common species and previously was confused with *Eurytoma rosae* Nees, 1834. Lotfalizadeh et al. (2007) described and compared this species with *E. rosae* in morphological and molecular aspects. It was reported from Iran and France (Noyes, 2014).

Some of the specimens identified as *E. rosae* in previous studies in Turkey are likely to be *E. caninae*. Here we give the first record of this species for Turkey. These specimens were compared with type materials in the Hayk Mirzayans Insect Museum (HMIM), Tehran, Iran.

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 26♀♀, 15♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 5♀♀, 4♂; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 1♀, 2♂♂; between Almus and Tokat, 40°20'56.4"N, 36°37'56.8"E, 621 m, 13.x.2014, 2♂♂.

3.2.2. *Eurytoma rosae* Nees, 1834

This species is a common parasitoid of *Diplolepis* and has a wide distribution in the Palearctic (Lotfalizadeh et al., 2006; Noyes, 2014).

It was reported on *D. eglanteriae*, *D. rosae*, and *D. fructuum* in Turkey (Doğanlar, 1984, 1990; Bayram et al., 1998, Özbek et al., 1999).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 3♀♀, 9♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 3♀♀, 1♂; Turhal, Taşlıçiftlik Village, 40°23'1.8"N, 36°27'45.5"E, 604 m, 24.iv.2013, 1♂; between Almus and Tokat, 40°20'56.4"N, 36°37'56.8"E, 621 m, 13.x.2014, 1♀.

3.2.3. *Eurytoma pistaciae* Rondani, 1877

This is a Palearctic species and a hyperparasitoid of *Megastigmus pistaciae* (Noyes, 2014). It was recorded on *D. fructuum*, *D. rosae*, and *Neuroterus macropterus* (Hym.:

Cynipidae) in Turkey (Doğanlar, 1990; Doğanlar and Çam, 1991; Özbek et al., 1999).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 3♀♀, 3♂♂.

3.2.4. *Aximopsis collina* (Zerova, 1984)

It was recorded in Bulgaria, Iran, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan (Noyes, 2014). Lotfalizadeh et al. (2006) indicated that it emerged from *D. fructuum* galls in Iran. This is a new record for Turkey.

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 16♀♀, 10♂♂.

3.2.5. *Sycophila biguttata* (Swederus, 1795)

It attacks both rose and oak galls (Csóka et al., 2005) and is a common species in the Palearctic (Noyes, 2014). It was reported from the galls of *D. fructuum* in Turkey (Doğanlar, 1984, 1990).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 4♀♀; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 1♀.

3.3. Family Eupelmidae

3.3.1. *Eupelmus urozonus* Dalman, 1820

The species has a wide range of host species from the orders Lepidoptera, Diptera, and Coleoptera, besides Hymenoptera (Noyes, 2014), and it is distributed throughout the Holarctic and Australasia (Schröder, 1967; Noyes, 2014). It is also a common species in Turkey (Bodenheimer, 1958; Bayram et al., 1998; Özbek et al., 1999) and was reported on the galls of *D. fructuum* (Bayram et al., 1998; Özbek et al., 1999).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 82♀♀, 47♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 46♀♀, 22♂♂; Turhal, Taşlıçiftlik Village, 40°23'1.8"N, 36°27'45.5"E, 604 m, 24.iv.2013, 5♀♀, 2♂♂; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 10♀♀, 2♂♂; between Almus and Tokat, 40°20'56.4"N, 36°37'56.8"E, 621 m, 13.x.2014, 11♀♀, 5♂♂.

3.4. Family Pteromalidae

3.4.1. *Pteromalus bedeguaris* Thomson, 1878

It is a Holarctic species (Noyes, 2014) and a common parasitoid of *Diplolepis* larvae. Lotfalizadeh et al. (2006) indicated that 40% of the total number of parasitoids emerging from *D. fructuum* galls in Iran belonged to this species. Additionally, it is a hyperparasitoid of *Glyphomerus stigma*, *Orthopelma mediator*, *Periclistus brandtii*, and *Torymus bedeguaris* (Noyes, 2014). It was reported from *D. rosae* and *D. fructuum* in Turkey (Kılınçer, 1983; Bayram et al., 1998; Özbek et al., 1999).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 604 m, 24.iv.2013, 18♀♀, 3♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 3♀♀, 3♂♂; Turhal, Taşlıçiftlik Village, 40°23'1.8"N, 36°27'45.5"E, 604 m, 24.iv.2013, 1♀, 2♂♂; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 1♂.

3.5. Family Eulophidae

3.5.1. *Stepanovia eurytomae* (Nees, 1834)

It is a Palearctic species (Lotfalizadeh et al., 2006; Noyes, 2014) and was reported from *D. fructuum* and *D. eglanteriae* in Turkey (Bayram et al., 1998; Özbek et al., 1999).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 39♀♀, 4♂♂; between Tokat and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 65♀♀, 11♂♂; between Almus and Tokat, 40°20'56.4"N, 36°37'56.8"E, 621 m, 13.x.2014, 3♀♀.

3.5.2. *Entedon* sp.

Entedon Dalman, 1820 is a genus that comprises parasitoid species mostly on phytophagous coleopterans (Askew, 1991). In this study, three individuals from this genus were reared; however, these are more likely to be parasitoids of some coleopteran hosts on the same plant rather than *D. fructuum*. More detailed studies are required to be sure about the relation between *Entedon* sp. and *D. fructuum*.

Materials examined: TOKAT, between city center and Niksar, 40°19'49.7"N, 36°40'15.0"E, 682 m, 25.iv.2013, 2♀♀, 1♂.

3.6. Family Ichneumonidae

3.6.1. *Exeristes roborator* Fabricius, 1793

This species is a parasitoid of various coleopteran and hymenopteran larvae, and it is a common species in the Palearctic, Afrotropical, and Oriental regions (Lotfalizadeh et al., 2006; Zwakhals, 2015). It was reported as a parasitoid of oak gall wasps *Biorhiza pallida* and *B. terminalis*, rose gall wasps *D. rosae* and *D. fructuum*, and herb gall wasp *Barbotinia oraniensis* (Talebi et al., 2005; Rizzo and Massa, 2006; Lotfalizadeh et al., 2009).

Materials examined: TOKAT, Zile, Bağlarpınarı Village, 40°18'56.4"N, 36°1'29.8"E, 700 m, 24.iv.2013, 5♀♀, 2♂♂; Güvendik Village, 40°26'14.5"N, 37°19'15.2"E, 803 m, 30.x.2013, 1♂.

4. Discussion

Here, 12 species from six families that are associated with rose gall wasp *D. fructuum* and/or its galls were identified. Another species in this study, *Entedon* sp., is known to be a parasitoid of phytophagous coleopterans (Askew, 1991), and here we cannot make a certain decision about whether

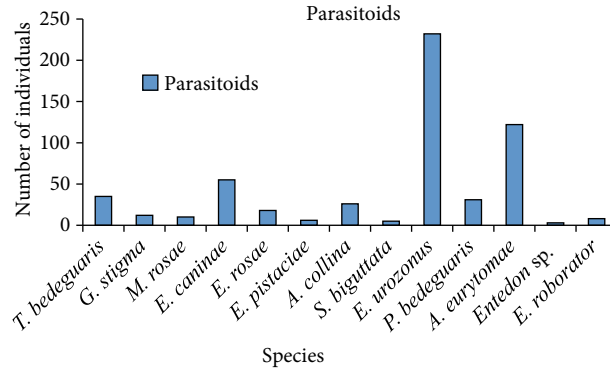


Figure. Parasitoid species associated with *D. fructuum* in this study.

it is a new parasitoid for the community of *D. fructuum* galls or just a neighboring inhabitant on the same plant.

The individual numbers of these species are shown in the Figure. *Eupelmus urozonus* was detected to be the most common parasitoid species (232 individuals) and was followed by *S. eurytomae* (122 individuals).

Among these parasitoid species *E. caninae* and *A. collina* are new records for Turkey. Some of the specimens identified as *E. rosae* in previous studies in Turkey are likely to be *E. caninae*.

Acknowledgments

We express our deepest gratitude to Dr Hosseinali Lotfalizadeh (Iranian Research Institute of Plant Protection, Insect Taxonomy Research Department, Iran, Tehran) for his guidance and assistance during the identification of specimens, his helpful comments and corrections for the improvement of this manuscript, and hosting Özlem Mete during her stay at HMIM. This work was supported by Project No. 013D03601001 of the Hacettepe University Scientific Research Projects Coordination Unit.

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