

The community components associated with two common rose gall wasps (Hymenoptera: Cynipidae: Diplolepini) in Turkey

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Abstract: Rose gall wasps (Hymenoptera: Cynipidae: Diplolepini) are well-known gall-inducing insects on *Rosa* species, and their galls support species-rich communities. During this investigation, gall samples of *Diplolepis fructuum* and *D. rosae*, which are the two most common rose gall wasps in Turkey, were collected in Gümüşhane, Tokat, Sivas, and Erzincan provinces. Fifteen species associated with *D. fructuum* and 12 species associated with *D. rosae* were reared. These community members are mostly primary and secondary parasitoids, along with seed- and gall-tissue-feeders. The association between *Aximopsis collina* and *D. rosae* was determined here for the first time. In *D. fructuum* galls, *Pteromalus bedeguaris*, *Eupelmus urozonus*, and *Torymus bedeguaris*, and in *D. rosae* galls, *P. bedeguaris* and *Periclistus brandtii* were the most common inhabitants among the community members excluding the gall wasps. Additionally, approximate emergence dates of the community members are given.

Key words: Hymenoptera, Cynipidae, *Diplolepis fructuum*, *Diplolepis rosae*, parasitoid, inquiline, community component, new association record

1. Introduction

Gall wasps (Cynipidae), one of the successful groups in Hymenoptera, are known for their ability to induce complex plant galls (Csóka et al., 2005). The species *Diplolepis fructuum* (Rübsaamen, 1895) and *Diplolepis rosae* (Linnaeus, 1758) from this family induce galls on fruits and leaf buds of dog roses (*Rosa* spp.), and are known to be the two most important pests of dog roses in Turkey (Güçlü et al., 2008).

Diplolepis galls, like other cynipid galls, support species-rich communities (Shorthouse, 1973; Stone et al., 2002; Csóka et al., 2005), and this feature makes them model systems for community ecology (Shorthouse, 1973). These communities include gall makers, phytophagous inquilines, primary and secondary parasitoids, and various predators (Stone et al., 2002; Csóka et al., 2005; László et al., 2014).

Anatolia was an important refugium for rose gall wasps and their host plants, as it was for many other terrestrial animals and plants, during the glacial periods in the Pleistocene, along with some of the southern parts of Europe (southern Iberian Peninsula, Italy, and the Balkans) and the Caucasus (Stone et al., 2001; Rokas et al., 2003; Demirsoy, 2008). The results of some important studies on gall wasps have indicated that Anatolia has been

the main speciation center of the gall wasps in the past (Stone et al., 2001; Rokas et al., 2003). In order to make a precise estimation of the communities associated with *Diplolepis* galls in the western Palearctic, it is necessary to perform a comprehensive investigation of the community composition in Anatolia. Therefore, the community compositions associated with *D. fructuum* and *D. rosae* were investigated in Tokat, Gümüşhane, Erzincan, and Sivas provinces, which are some of the most important distribution areas of *Rosa* species in Turkey. The aim of this research was to provide insight into the community components associated with *Diplolepis* species, as well as data for future studies on this subject in Turkey.

2. Materials and methods

Field studies were carried out in April, October, and November 2013, and March and October 2014 in Gümüşhane, Tokat, Sivas, and Erzincan provinces of Turkey. Gall samples of *D. fructuum* and *D. rosae* on *Rosa canina* L. host plants were collected (Table 1). The gall samples were stored in jars and they were kept outdoors to provide external environment conditions. After a 2-month period, the gall specimens were taken into the laboratory and kept at room temperature. During this period and afterwards, the emergence of adult wasps was checked 3

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Table 1. Numbers of gall samples collected from 4 provinces in Turkey (Gümüşhane, Tokat, Sivas, and Erzincan) in the years 2014 and 2015.

		STUDY SITES				Total
		Gümüşhane	Tokat	Sivas	Erzincan	
SPECIES	<i>Diplolepis fructuum</i>	2305	632	1361	899	5197
	<i>Diplolepis rosae</i>	55	21	10	9	95
TOTAL						5292

times a week and the emergence dates were recorded. The emerging adult gall wasps and the other gall inhabitants were preserved in 96% ethanol.

Reared wasp specimens were identified by using the following references: 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). The specimens are deposited in the collection in the Zoology Section, Department of Biology, Faculty of Science, Hacettepe University, Ankara, Turkey.

3. Results and discussion

From 7 families belonging to the order Hymenoptera, 15 species associated with *D. fructuum* and 12 species associated with *D. rosae* were reared. These community members are mostly primary and secondary parasitoids, along with seed- and gall-tissue-feeders. The association

between *Aximopsis collina* (Zerova, 1984) and *D. rosae* was determined here for the first time. Another species in this study, *Entedon* sp., belongs to a genus that mostly comprises the parasitoid species on phytophagous coleopterans (Askew, 1991). It is not included here in the discussion on community composition because of insufficient evidence for its association with *Diplolepis* galls. More detailed studies are required to be certain of the relationship between *Entedon* sp. and *D. fructuum*.

3.1. The community members associated with *Diplolepis fructuum*

A total of 14,256 adult gall wasps and 14,165 associated hymenopterans were obtained from 5197 *D. fructuum* galls collected from 4 study sites (Table 2). The relative abundances of these gall-associated community members, which constitute 50% of the total number of the adult insect samples, are shown in Figure 1. Accordingly, *Pteromalus*

Table 2. Individual numbers of species reared from *Diplolepis fructuum* galls.

	Gümüşhane	Tokat	Sivas	Erzincan	TOTAL
<i>Torymus bedeguaris</i>	1101	59	1073	203	2436
<i>Glyphomerus stigma</i>	342	18	193	75	628
<i>Megastigmus rosae</i>	14	10	42	2	68
<i>Eupelmus urozonus</i>	934	387	771	386	2478
<i>Pteromalus bedeguaris</i>	1307	129	765	678	2879
<i>Aximopsis collina</i>	62	32	51	113	258
<i>Eurytoma caninae</i>	371	183	297	108	959
<i>Eurytoma rosae</i>	245	116	393	110	864
<i>Eurytoma pistaciae</i>	19	16	312	21	368
<i>Sycophila biguttata</i>	82	9	37	6	134
<i>Stepanovia eurytomae</i>	299	139	599	108	1145
<i>Entedon</i> sp.	3	5	5	3	16
<i>Exeristes roborator</i>	97	13	250	56	416
<i>Orthopelma mediator</i>	1355	14	134	27	1530
<i>Periclistus brandtii</i>	1	-	-	1	2
<i>Diplolepis fructuum</i>	6910	509	5400	1437	14256

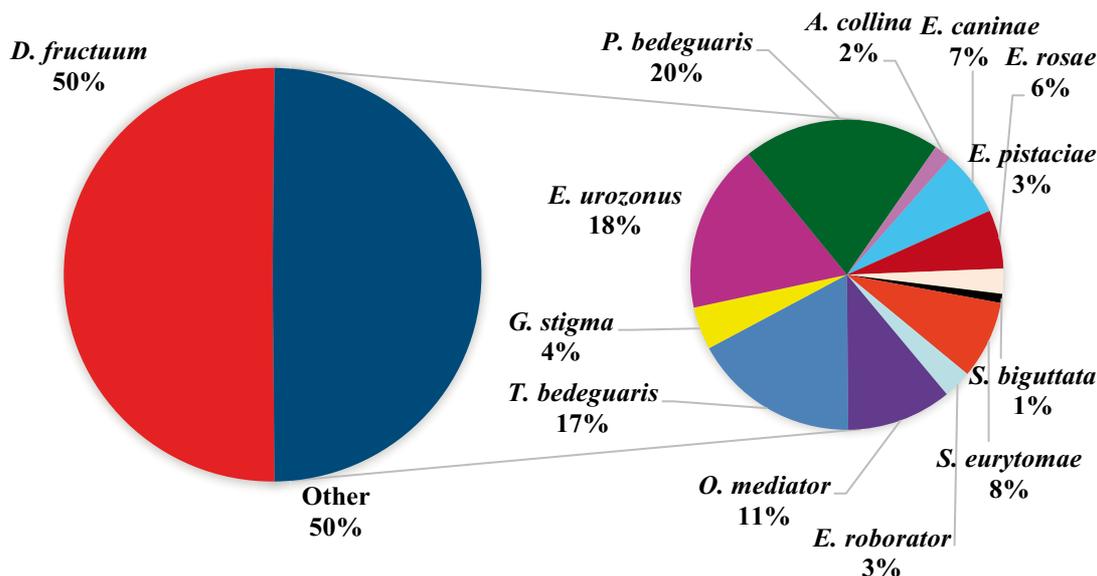


Figure 1. Relative abundances of the community members in *Diplolepis fructuum* galls (community members that have less than 1% abundance were not included in the graph).

bedeguaris Thomson, 1878, which constituted 20% of the parasitoids and other community members, was the most common and abundant community member after the gall wasp. This is similar to the findings reported by Lotfalizadeh et al. (2006), which indicated that 40% of all parasitoid samples in *D. fructuum* galls were *P. bedeguaris*. The 2 other most common gall-associated species were *Eupelmus urozonus* Dalman, 1820 (18% of the community members other than gall wasp) and *Torymus bedeguaris* (Linnaeus, 1878) (17% of the community members other than gall wasp), respectively. These findings are similar with those of previous studies on *Diplolepis mayri* (Schlechtendal, 1876) and its associated community in Turkey (Zerova and D'yakonchuk, 1976; Kılınçer, 1983; Bayram et al., 1998; Özbek et al., 1999). However, considering their gall morphologies, the samples from these previous studies are likely to be *D. fructuum* instead of *D. mayri* as Güçlü et al. (2008) indicated.

Emergence periods of the community members in the *D. fructuum* galls are shown in Table 3.

3.2. The community members associated with *Diplolepis rosae*

A total of 117 adult gall wasps and 989 associated hymenopterans were obtained from 95 *D. rosae* galls collected from 4 study sites (Table 4). The relative abundances of these gall-associated community members, which constitute 90% of the total number of adult insect samples, are shown in Figure 2. Accordingly, *P. bedeguaris*, which constitutes 29% of the parasitoids and other community members, was the most common

and abundant community member after the gall wasp, as in the *D. fructuum* galls. It is remarkable that the inquiline *Periclistus brandtii* (Ratzeburg, 1831), which was represented by only 2 individuals in *D. fructuum* galls, was the second most common species in *D. rosae* galls (26% of the community members other than gall wasp). It was followed by *Orthopelma mediator* (Thunberg, 1822) and *Glyphomerus stigma* (Fabricius, 1793). *Orthopelma mediator* is known to be the most common parasitoid species in *D. rosae* galls in Europe (Shorthouse and Brooks, 1998), and *G. stigma* is known to be an ectoparasitoid, especially on *D. rosae* and *P. brandtii*, and sometimes on *Eurytoma rosae* Nees, 1834 (Rizzo and Massa, 2006). The high parasitoid pressure on *D. rosae* galls was also reported in previous studies. Stille (1984) remarked that *P. brandtii* was the most dominant species in *D. rosae* galls (36.7% of all samples). In this same study, *P. brandtii* was followed by *O. mediator* (29.7% of all gall inhabitants). It can be seen that *O. mediator*, *P. brandtii*, *T. bedeguaris*, *G. stigma*, and *P. bedeguaris* were the dominant species in *D. rosae* galls in our study, and other species were represented by far fewer numbers (Table 4). Unlike the other studies mentioned above, Rizzo and Massa (2006) stated that there were no *P. brandtii* samples in the *D. rosae* galls that they examined; they suggested that this species is less likely to be found in Mediterranean countries, with support from relevant literature. Our results differ from those of Rizzo and Massa (2006) in this regard. However, the results may be more similar if a study were carried out in the Mediterranean region of Anatolia.

Table 3. Emergence periods of community members in the *Diplolepis fructuum* galls.

		MONTHS												
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
SPECIES	<i>Diplolepis fructuum</i>			■	■	■	■							
	<i>Pteromalus bedeguaris</i>			■	■	■	■			■	■			
	<i>Eupelmus urozonus</i>			■	■	■	■			■	■			
	<i>Torymus bedeguaris</i>			■	■	■	■	■		■	■			
	<i>Orthopelma mediator</i>			■	■	■	■			■	■			
	<i>Stepanovia eurytomae</i>			■	■	■	■							
	<i>Eurytoma caninae</i>					■	■	■						
	<i>Eurytoma rosae</i>					■	■	■						
	<i>Glyphomerus stigma</i>					■	■	■	■					
	<i>Eurytoma pistaciae</i>					■	■	■						
	<i>Exeristes roborator</i>			■	■									
	<i>Aximopsis collina</i>					■	■	■						
	<i>Sycophila biguttata</i>					■	■	■						
	<i>Megastigmus rosae</i>				■									
	<i>Perclistus brandtii</i>						■							

Table 4. Individual numbers of species reared from *Diplolepis rosae* galls.

	Gümüşhane	Tokat	Sivas	Erzincan	TOTAL
<i>Torymus bedeguaris</i>	105	14	13	-	132
<i>Glyphomerus stigma</i>	83	19	30	9	141
<i>Eurytoma rosae</i>	6	-	2	-	8
<i>Eurytoma caninae</i>	1	-	-	1	2
<i>Aximopsis collina</i>	-	-	-	2	2
<i>Eurytoma pistaciae</i>	-	1	-	-	1
<i>Pteromalus bedeguaris</i>	263	15	5	3	286
<i>Eupelmus urozonus</i>	7	2	-	1	10
<i>Stepanovia eurytomae</i>	-	1	-	-	1
<i>Exeristes roborator</i>	1	-	-	-	1
<i>Orthopelma mediator</i>	77	1	73	-	151
<i>Perclistus brandtii</i>	254	-	-	-	254
<i>Diplolepis rosae</i>	101	-	15	1	117

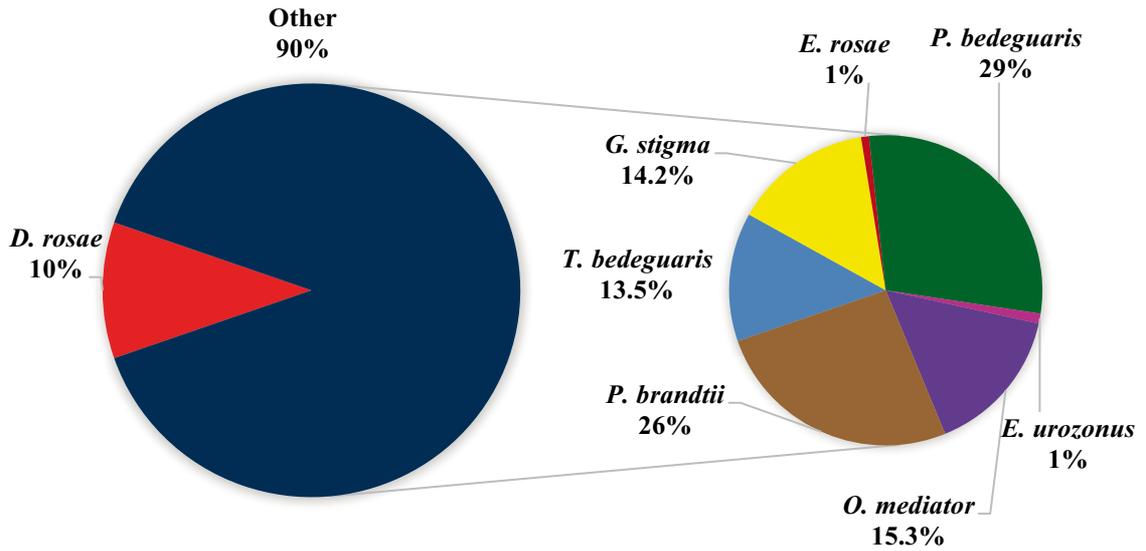


Figure 2. Relative abundances of community members in *Diplolepis rosae* galls (community members that have less than 1% abundance were not included in the graph).

Emergence periods of the community members in the *D. rosae* galls are shown in Table 5.

Here, *D. fructuum* was observed to be very common on dog roses (*Rosa* spp., *Rosa canina* in this study), as mentioned by Güçlü et al. (2008). During the study, a total of 5197 *D. fructuum* galls were collected, and 14,256 gall

wasps were obtained from these samples; these numbers were limited to 95 galls and 117 gall wasps for *D. rosae*. Considering this, and taking into account the parasitoid and inquiline abundances in 2 communities associated with these gall wasps (50% for *D. fructuum*, and 90% for *D. rosae*), it may be thought that future studies that focus

Table 5. Emergence periods of community members in *Diplolepis rosae* galls.

		MONTHS											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
SPECIES	<i>Diplolepis rosae</i>			■	■	■	■						
	<i>Pteromalus bedeguaris</i>				■	■	■			■	■		
	<i>Eupelmus urozonus</i>					■							
	<i>Torymus bedeguaris</i>			■	■	■	■			■	■		
	<i>Orthopelma mediator</i>			■	■	■				■	■		
	<i>Stepanovia eurytomae</i>					■							
	<i>Eurytoma caninae</i>					■							
	<i>Eurytoma rosae</i>					■							
	<i>Glyphomerus stigma</i>					■	■	■					
	<i>Periclistus brandtii</i>					■	■	■	■	■			
	<i>Eurytoma pistaciae</i>					■							
	<i>Exeristes roborator</i>			■									
	<i>Aximopsis collina</i>						■						

on the limiting effects of parasitoid and inquiline pressure on *D. rosae* population may give interesting results.

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