A Preliminary Study on The Gallwasp Fauna of Kemaliye (Erzincan, Turkey) and A New Record for Turkey

Kemaliye'nin (Erzincan, Türkiye) Gal Arısı Faunası Üzerine Bir Ön Çalışma ve Türkiye için Yeni Bir Kayıt

Research Article

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ABSTRACT

The members of the Cynipidae (Hymenoptera) family, also known as the gallwasps, induce some of the most structurally complex plant galls. In this study, we have examined the gallwasps and their galls collected from Kemaliye (Erzincan, Turkey) and its surrounding. At the end of the study, 24 species which belong to 5 genera were determined. Moreover, *Andricus moreae* was found to be a new record for Turkey.

Key Words
Cynipidae, Cynipini, Diplolepidini, Turkey

ÖZET

Gal arıları olarak da bilinen Cynipidae (Hymenoptera) familyası üyeleri, yapısal olarak en karmaşık bitki gallerinden bir kısmının oluşumuna neden olmaktadır. Bu çalışmada, Kemaliye (Erzincan, Türkiye) ve çevresinde bulunan gal arıları ve bunların neden olduğu galler incelenmiştir. Çalışma sonunda, beş cinse ait 24 tür tespit edilmiş olup, *Andricus moreae* Türkiye için yeni bir kayıttır.

Anahtar Kelimeler
Cynipidae, Cynipini, Diplolepidini, Turkey

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INTRODUCTION

A pathological growth on a plant, which develops consequent to the parasitic effects of an animal, fungus or even a vascular plant, such as mistletoe, is defined as a gall [1]. Galls morphologically vary from simple leaf rolls and folds to complex formations which have extrafloral nectars, hairs, spines and sticky resines on surface [2]. Cynipidae (Hymenoptera) is the second most species-rich gall inducing group after the gall midges (Cecidomyiidae, Diptera) with approximately 1400 described species and the members of this group induce some of the most structurally complex plant galls [3].

The family Cynipidae consists of six tribes. While five of these tribes are gall inducers, the remaining one tribe includes obligate inquilines that predominately attack the galls induced by other gallwasps. The most species-rich tribe (Cynipini) is of interest having complex cyclical parthenogenetic life cycles and inducing a wide variety of species and generation specific galls on oaks (*Quercus,* Fagaceae) and other Fagaceae. Other less species-rich tribes are associated with herbaceouse plants (tribe Aylacini), Rosaceae (tribe Diplolepidini), mimosoid Fabaceae (tribe Eschatocerini), the genus *Acer* and *Nothofagus* (tribe Pediaspidini) [4].

Three different types of reproduction can be seen among gallwasps, which are sexual, parthenogenetic and heterogonic [3]. Especially those have alternating sexual and parthenogenetic generations must be taxonomically revised [5]. Worldwide genera of the oak cynipid gallwasps have been revised by Melika and Abrahamson (2000) [6]. Recently, some revisions have been made concerning the herb cynipid gallwasps in the western part of Europe [7], and some of the oak cynipid gallwasps in Palaeartic region, especially the genera *Chilaspis* and *Dryocosmus* [8, 9], *Andricus collari* species complex [10], and the genera *Neuroterus* and *Pseudoneuroterus* [11].

Currently, there is an insufficient number of studies concerning gallwasps in Turkey, and also many of them are agricultural oriented instead of faunistic or systematics [12-18].

During the recurrent glacial periods in Pleistocene, Turkey has been a refigium along with some of the southern parts of Europe (south of the Iberian Peninsula, Italy, and Balkans) and Caucasus for many terrestrial animals and plants. There has been a strong isolation between these refigiums since the beginning of Pleistocene period. As a result of this isolation, cynipid gallwasps which spread depending on the distributions of their host plants, have evolved independently in these refigiums [5]. Besides, Turkey is the most eastern and western border where some European and Iranian species are able to spread. Therefore, a comprehensive study on cynipid fauna of Turkey will provide an important information about the distribution and diversification of the cynipid fauna of Western Palaearctic region.

Kemaliye is located on the Anatolian Diagonal which separates the eastern and western parts of Turkey by a certain division (Figure 1), and therefore has a very interesting topography and plant composition which combines various faunistic and floristic components of Anatolia (such as Mediterranean, Pontic, Eucsin, Turano-Eremial, Alpine and even African). The main reason of determining Kemaliye as a study site is because numerous biogeographic elements are represented in such a narrow area. In this study which was carried out in Kemaliye and its surrounding, it was aimed to contribute to the knowledge about cynipid fauna of Turkey, and also to the further studies concerning this subject.

MATERIALS AND METHODS

During the study, field trips were made on September and November of 2007, and May, June, July, September and October of 2008 (Figure 1), and cynipid gall specimens which develop on host plants from the genus *Quercus* (Fagaceae) and the species *Rosa canina* (Rosaceae) were collected. Gall specimens were placed into jars due to their sizes and they were kept under ambient temperature conditions to provide the emergence of adult gallwasps. The emerging adult gallwasps were preserved in 95% ethanol. For the identification of specimens, both gall and adult gallwasp morphologies were used.

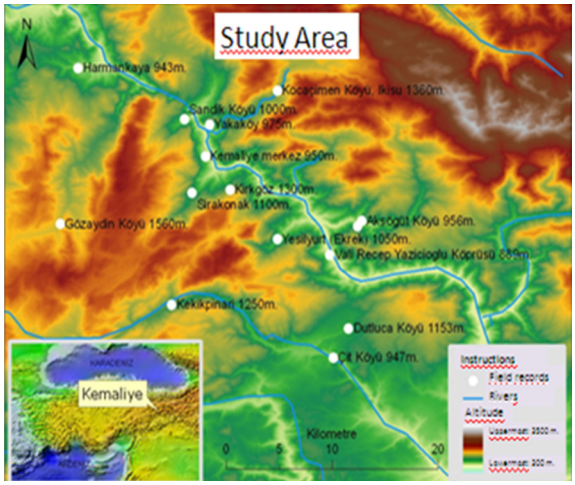

Figure 1. Study sites in Kemaliye (Erzincan, Turkey) and its surrounding.

RESULTS AND DISCUSSION

At the end of this study, a total of 24 species which belong to the tribes Cynipini and Diplolepidini were determined (Table 1). Both gall and adult gallwasp morphologies were used for determining 18 of these species, while the remaining 6 species were identified only due to the gall morphology. All of the adult wasp specimens from the tribe Cynipini were found to be a part of the asexual generation. The reason why we were not able to find any specimens which belong to the sexual generation was that the sexual generation galls are morphologically simpler and smaller than the asexual generation galls, and their development period is too short for their collection, and also

Table 1. List of the gall wasp species and their host plants determined in this study.

	Species	Host plant
1	*Andricus caputmedusae* (Hartig , 1843)	*Quercus pubescens*
2	*Andricus coriarius* (Hartig, 1843)	*Quercus infectoria*
3	*Andricus curtisii* (Müller, 1870)	*Q. pubescens* and *Q. infectoria*
4	*Andricus foecundatrix* (Hartig, 1840)	*Q. pubescens*
5	*Andricus grossulariae* Giraud, 1859	*Q. infectoria*
6	*Andricus lucidus* (Hartig, 1843)	*Q. pubescens*
7	*Andricus megalucidus* (Melika, Stone, Sadeghi and Pujade-Villar, 2004)	*Q. infectoria*
8	*Andricus polycerus* (Giraud, 1859)	*Q. infectoria*
9	*Andricus quercustozae* (Bosc, 1792)	*Q. infectoria*
10	*Andricus stefanii* (Kieffer, 1897)	*Q. infectoria*
11	*Andricus sternlichti* (Bellido, Pujade-Villar & Melika, 2003)	*Q. pubescens*
12	*Andricus tomentosus* (Trotter, 1901)	*Q. infectoria*
13	*Andricus truncicolus* (Giraud, 1859)	*Q. pubescens*
14	*Andricus moreae* (Graeffe, 1905)	*Q. infectoria*
15	*Cynips cornifex* Hartig, 1843	*Q. infectoria*
16	*Cynips quercusfolii* (Linnaeus, 1758)	*Q. pubescens* and *Q. infectoria*
17	*Neuroterus quercusbaccarum* (Linnaeus, 1758)	*Q. infectoria*
18	*Neuroterus lanuginosus* Giraud, 1859	*Q. brantii*
19	*Neuroterus numismalis* (Geoffroy, 1785)	*Q. pubescens* and *Q. infectoria*
20	*Trigonaspis synaspis* (Hartig, 1841)	*Q. pubescens*
21	*Diplolepis fructuum* (Rübsaamen, 1895)	*Rosa canina*
22	*Diplolepis rosae* (Linnaeus, 1758)	*R. canina*
23	*Diplolepis eglanteriae* (Hartig, 1840)	*R. canina*
24	*Diplolepis spinosissimae* (Giraud, 1859)	*R. canina*

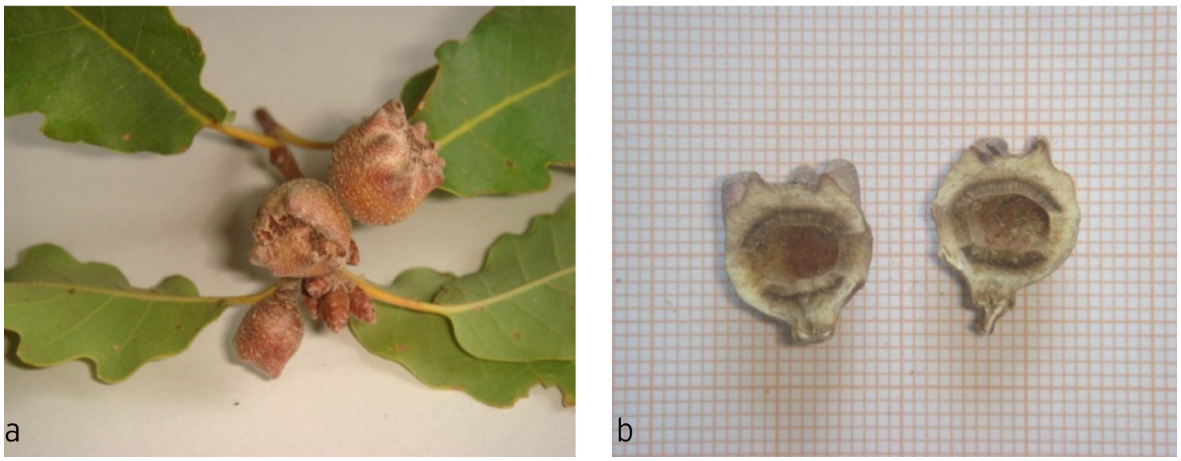

Figure 2. a) Asexual generation gall of *Andricus moreae*, b) longitudinal section view of the asexual generation gall of *Andricus moreae*.

the cryptic sexual generations were reported to be very common among this group [19]. We also found that all of the specimens from the tribe Diplolepidini were females. We thought that it might be because of the secondary sex loss which is also a very common situation in this group [20, 21] or because of insufficient amount of samples.

The species *Andricus foecundatrix*, *A. moreae*, *Neuroterus lanuginosus*, *N. numismalis* from the tribe Cynipini, and the species *Diplolepis eglanteriae* and *D. spinosissimae* from the tribe Diplolepidini were identified only due to their gall morphology. Although it is known that many of the gallwasps induce species specific and morphologically different galls, we thought that these identifications which only gall morphology was used must be confirmed in future studies by also examining the adult morphology.

One of the species which we determined by using gall morphology, *Andricus moreae* (Figure 2. a-b), is a new record for Turkey and it was previously reported from Greece and Iran [22].

In this study, it was aimed to contribute to the further studies concerning this subject. We expect to observe a significant increase in the number of determined species with larger scaled studies conducted in this area. The studies carried out on a number of gallwasp species which have a wide-spread distribution have suggested that these species show the highest genetic diversity around the Eastern Mediterranean and that the Turano-Eremial region was possibly the main speciation center of this group in the past [23,24]. Regarding this, it is thought to be necessary to carry out more systematically detailed studies which examined the gallwasp species distributed in Turkey with the support of genetic and biochemical analyses, and this data should be compared with those of neigboring countries.

ACKNOWLEDGEMENTS

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Appendix

Cynipid gall samples collected in this study.

1a. *Andricus caputmedusae*
(Asexual generation gall)
2a. *Andricus coriarius*
(Asexual generation gall)
3a. *Andricus curtisii*
(Asexual generation gall)

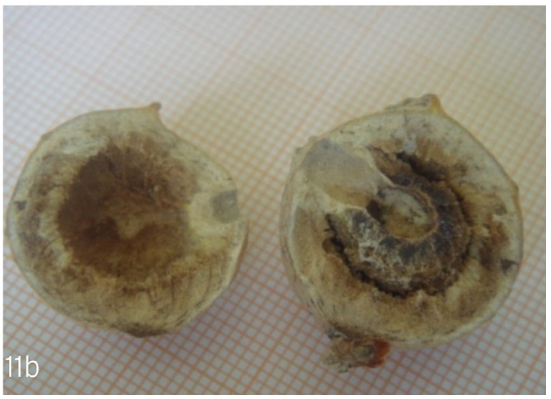
1b. *Andricus caputmedusae*
(Asexual gen. gall, longitudinal section)
2b. *Andricus coriarius*
(Asexual gen. gall, longitudinal section)
3b. *Andricus curtisii*
(Asexual gen. gall, longitudinal section)

4a. *Andricus foecundatrix* (Asexual generation gall)
5a. *Andricus grossulariae* (Asexual gen. gall)
6a. *Andricus lucidus* (Asexual generation gall)

4b. *Andricus foecundatrix* (Asexual generation gall)
5b. *Andricus grossulariae* (Asexual gen. gall and larval chambers)
6b. *Andricus lucidus* (Asexual gen. gall and larval chambers)

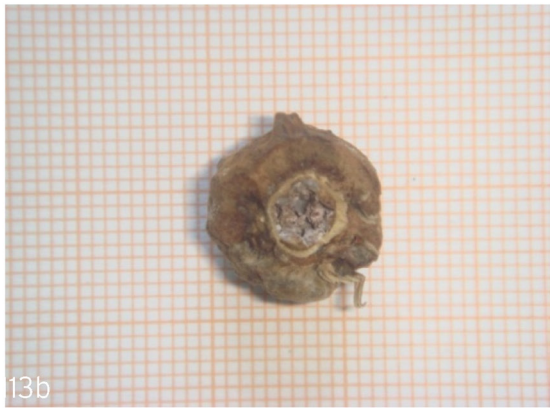
7a. *Andricus megalucidus* (Asexual generation gall)
8a. *Andricus polycerus* (Asexual generation gall)
8c. *Andricus polycerus* (Asexual gen. gall, longitudinal section)

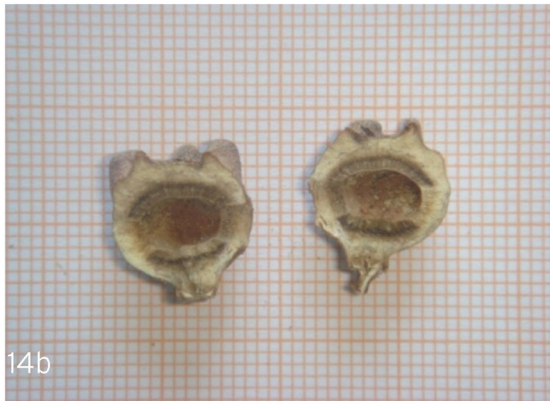
7b. *Andricus megalucidus* (Asexual gen. gall and larval chambers)
8b. *Andricus polycerus* (Asexual gen. gall)
8d. *Andricus polycerus* (Asexual gen. gall, longitudinal section)



9a. *Andricus quercustozae*
(Asexual generation gall)
10a. *Andricus stefanii*
(Asexual generation gall)
11a. *Andricus sternlichti*
(Asexual generation gall)

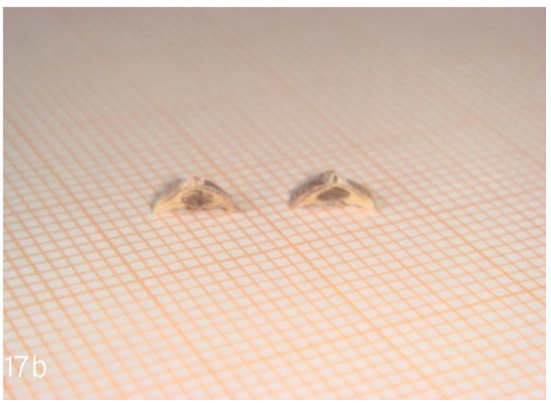
9b. *Andricus quercustozae*
(Asexual gen. gall, longitudinal section)
10b. *Andricus stefanii*
(Asexual gen. gall, longitudinal section)
11b. *Andricus sternlichti*
(Asexual gen. gall, longitudinal section)





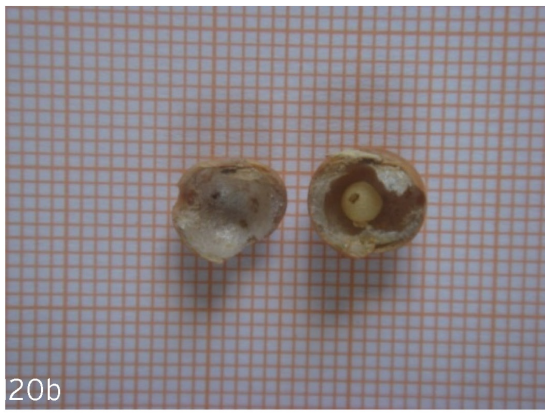
12a. *Andricus tomentosus*
(Asexual generation gall)
13a. *Andricus truncicolus*
(Asexual generation gall)
14a. *Andricus moreae*
(Asexual generation gall)

12b. *Andricus tomentosus*
(Asexual gen. gall, longitudinal section)
13b. *Andricus truncicolus*
(Asexual gen. gall, longitudinal section)
14b. *Andricus moreae*
(Asexual gen. gall, longitudinal section)



15a. *Cynips cornifex*
(Asexual generation gall)
16a. *Cynips quercusfolii*
(Asexual generation gall)
17a. *Neuroterus quercusbaccarum*
(Asexual gen. gall)

15b. *Cynips cornifex*
(Asexual generation gall)
16b. *Cynips quercusfolii*
(Asexual gen. gall, longitudinal section)
17b. *N. quercusbaccarum*
(Asexual gen. gall, longitudinal section)



18. *Neuroterus lanuginosus* (Asexual generation gall)
20a. *Trigonaspis synaspis* (Asexual generation gall)
21a. The multilocular gall of *Diplolepis fructuum*

19. *Neuroterus numismalis* (Asexual generation gall)
20b. *Trigonaspis synaspis* (Asexual gen. gall and larval chamber)
21b. The multilocular gall of *Diplolepis fructuum* and larval chambers

22a. The multilocular gall of *Diplolepis rosae*

22b. The multilocular gall of *Diplolepis rosae*, longitudinal section

23. The gall of *Diplolepis eglanteriae*

24. The gall of *Diplolepis spinosissimae*