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RESEARCH ARTICLE Open Access

Cinara (Hemiptera: Aphidoidea) species distributed in Turkey and their host plants

Türkiye'de dağılım gösteren *Cinara (Hemiptera: Aphidoidea)* türleri ve konak bitkileri

Hayal AKYILDIRIM BEĞEN[a*], Gazi GÖRÜR[b], Özhan ŞENOL[b]

[a] Health Services Vocational School, Artvin Coruh University, Artvin, Turkey

[b] Department of Biotechnolgy, Faculty of Art and Science, Niğde Ömer Halisdemir University, Niğde, Turkey

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**Corresponding author*:
e-mail: h.akyildirim@artvin.edu.tr
ORCID:0000-0003-2028-5827

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ABSTRACT

This study has been carried out between 2009 and 2018 in order to determine *Cinara* species and their host plants distributed in some region of Turkey. *Cinara* belongs to Eulachnini tribes and Lachninae subfamily, which in the light of the latest molecular studies have turned out to be the basal group for the other aphids. Aphids of the *Cinara* genus (Hemiptera: Aphidoidea) includes about 200 species in the World and infest lignified parts, branches, trunks, roots and leaves of Pinaceae (especially *Pinus, Cedrus, Abies* and *Picea*)and Cupressaceae trees. *Cinara* species were identified according to the host plants where they colonize. Turkey distribution of this genus unknown exactly because of lack of enough studies on aphids. In the earlier studies, only 23 *Cinara* species were known from Turkey. As a result of these studies, 29 *Cinara* species collected on different plant species (*Pinus* spp., *Cedrus* spp., *Juniperus* spp., *Cupressus* spp., *Plathyclaudus* spp., *Picea* spp. and *Abies nordmanniana)* in the areas and 7 of them are new records for Turkey. The number of *Cinara* species occurring in Turkey has risen to 30 with these studies. Their world and Turkey distribution, host plants and population density were given.

ÖZ

Bu çalışma 2009 - 2018 yılları arasında, Türkiye'nin bazı kısımlarında dağılmış *Cinara* türlerini ve konak bitki türlerini belirlemek amacıyla yapılmıştır. *Cinara* cinsi afit türleri Eulachnini tribusu ve Lachninae altfamilyasına ait olup, son yapılan moleküler çalışmalar ile diğer afit türlerinin alt grubunu oluşturduğu belirlenmiştir. Dünya üzerinde yaklaşık 200 tür içerirler ve Pinaceae (özellikle *Pinus, Cedrus, Abies* ve *Picea*) ve Cupressaceae ağaçlarının odunlaşmış kısımları, dal gövde ve iğne yaprakları üzerinden beslenirler. Bu türlerin teşhisleri konak olarak kullandıkları bitkilere göre yapılmaktadır. Bu cins ile ilgili daha önce yapılan çalışmalarda Türkiye için 23 türün varlığı belirtilmiş fakat Türkiye dağılımları tam olarak verilmemiştir. Bu çalışma sonucunda, alandan farklı bitki türleri (*Pinus* spp., *Cedrus* spp., *Juniperus* spp., *Cupressus* spp., *Plathyclaudus* spp., *Picea* spp. ve *Abies nordmanniana)* üzerinden 29 *Cinara* türü tespit edilmiştir ve bu türlerin 7 'si Türkiye için yeni kayıt olarak verilmiştir. Bu çalışmalar ile Türkiye'deki *Cinara* cinsine ait afit türü sayısı 30'a yükselmiştir. Türkiye ve Dünya dağılımları, konak bitkileri ve populasyon yoğunlukları verilmiştir.

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1. INTRODUCTION

Subfamily Lachninae consist of species belonging to *Cinara* genus that use conifers as a host plant especially Pinaceae and Cupressaceae (Blackman & Eastop, 2019). *Cinara* (Aphididae: Lachninae) is one of the largest genera in aphis with about 200 species (Favret, 2019). *Cinara* belongs to Eulachnini tribes and Lachninae subfamily, which in the light of the latest molecular studies have turned out to be the basal group for the other aphids (Ortiz-Rivas & Martinez-Torres, 2010). *Cinara* species originated from Asia about 50 million

years ago. The ancestors hosted on Angiospermae plants migrated to the conifers and showed the host change (Meseguer et al., 2015). These species are monophyletic species in Aphididae (Heie, 1987; Normark, 2000). Aphis belong to the *Cinara* genus generally feed on leafy and woody part of Pinacae and Cupressaceae (*Pinus, Abies, Larix, Picea* and *Cedrus* spp. (trunks, branches or roots) and might cause permanent damage to the host plant including wrapping and drying (Blackman & Eastop, 2019). The number of species is still increasing due to expansion of the warm climate species i.e. *Cinara tujafilina* (Del Guercio) (Durak & Borowiak-Sobkowiak, 2013). *Cinara* species have similar morphological and biological characters, any species feed on different host plant can be separated from each other according to small morphological differences according to their identification keys. As genus *Cinara* is very large group that consist of a lot of species differed from each other only with small morphological features, having complex life cycle and close relationships with their host plants, it is difficult to identify them accurately by performing traditional identification keys based on morphology. Therefore, taxonomic situations and diagnosis are complex (Favret & Voegtlin, 2004a, 2004b).

The aphid studies carried out in recent years and the aphid fauna of our country has been shown to be represented by approximately 3 families, 141 genera and more than 550 species (Remaudiere et al., 2006; Akyıldırım et al., 2013; Görür et al., 2012; 2014; Şenol et al., 2014; Görür et al., 2018).

The species of *Cinara* (Lachnidae), which were identified in the study, are found on plant species in the families of Pinaceae and Cupressaceae and these plant species are generally distributed in the Northern Hemisphere. Most of the *Cinara* species in the world (150 species) have been found in North America and 30 species in Europe and Mediterranean and 25 species in Far East. Turkey distribution of this genus was not sufficiently known because of the limited number of studies related with this group. 23 *Cinara* species have been listed from Turkey (Remaudiere et al., 2006; Toper Kaygın et al., 2008; Akyürek et al., 2010).

The aim of the paper was to give information about aphid species belonging to *Cinara* genus and their host plants, distributions and population structures in Turkey.

2. MATERIAL AND METHOD

2.1 Research area

Research areas are located in different region of Turkey. Studies were carried out from the Eastern Black Sea (Trabzon, Rize, Artvin) between 2009-2010, Niğde in 2010, İstanbul- Princes Islands in 2010 and Inner-West Anatolia (Kütahya, Uşak, Afyonkarahisar) regions between 2012-2014, Eastern Anatolia region (Adıyaman, Şanlıurfa, Malatya) between 2016-2018 (Figure 1). The host plant used by *Cinara* species distribute densely in Inner-West Anatolia.

Figure 1. Locations of the study areas.

2.2 Specimen collection

Aphid specimens were transferred into ependorf tubes containing 95% ethanol by means of a soft, fine-tipped brush. The samples were usually made over dense colonies and about 5-10 specimens were taken from a population in an ependorf tube, the label number is written. General information (date, locality, host) of the sample was written. Voucher specimens were deposited in Biotechnology laboratory of Niğde Ömer Halisdemir University.

2.3 Preparation of specimens

Samples (indicating each separate collection from different colonies, whether from the same host plant or different host plants) were processed in a laboratory according to the methods of Martin (1983).

2.4 Morphological studies and identification

The species were diagnosed according to Blackman and Eastop (2019) and Quednau (1999, 2003) and their taxonomic statuses were checked in accordance with recently evaluated sources and literatures (Favret, 2019; Nieto Nafria, 2019). Approximately 600 colonies were collected from seven different host genera (*Pinus* spp., *Cedrus* spp., *Picea* spp., *Abies nordmanniana, Plathyclaudus* spp., *Cupressus* spp., *Juniperus* spp.) and

their diagnoses were made using host-specific diagnostic keys. Diagnosis was made with the Olympos BX-53 microscope.

Slides of identified samples were deposited in the Biotechnology Department of Niğde Ömer Halisdemir University. Worldwide distribution, biology and host plants were taken mainly from the previous literature for each newly recorded species.

3. RESULTS

As a result of this study, a total of 29 taxa of *Cinara* genus belonged to Hemiptera were determined from different part of Turkey. These species use seven host plant genera (Table 1). Depending on the plant species collected, dense populations on the branch and on the trunk of the cedar, under the cones and on the needle and on the twigs of *Pinus* species were determined. Although extensive sampling was carried out from the Eastern Black Sea (Trabzon, Rize, Artvin), Niğde and Inner-West Anatolia (Kütahya, Uşak, Afyonkarahisar) regions, a limited number of sampling was done in the Eastern Anatolia region (Adıyaman, Şanlıurfa, Malatya) and İstanbul-Princes Islands in Turkey.

The dispersion of the plant taxa that were defined in the study area according to the large taxonomical groups is shown in Table 1.

Table 1. The dispersion of taxa into research areas.

	Species	Host plant (s)	Localities
1	*Cinara cedri*	*Cedrus* spp.	Collected from all localities
2	*C. confinis*	*Cedrus* spp.	Malatya, Afyonkarahisar, Kütahya
3	*C. curvipes*	*Cedrus* spp., *Abies* spp.	Malatya, Afyonkarahisar
4	*C. indica*	*Cedrus* spp.	Malatya, Afyonkarahisar
5	*C. intermedia*	*Cedrus* spp.	Malatya
6	*C. laportei*	*Cedrus* spp.	Afyonkarahisar
7	*C. acutirostris*	*Pinus* spp.	Niğde, Kütahya
8	*C. brauni*	*Pinus* spp.	Malatya, Afyonkarahisar, Kütahya, Uşak
9	*C. maghrebica*	*Pinus* spp.	Malatya, Şanlıurfa, Adıyaman, Afyonkarahisar, Kütahya, Usak, Trabzon
10	*C. nuda*	*Pinus* spp.	Malatya
11	*C. palaestinensis*	*Pinus* spp.	Afyonkarahisar
12	*C. pilicornis*	*Pinus* spp.	İstanbul-Adalar, Artvin, Trabzon, Rize
13	*C. pineti*	*Pinus* spp.	Malatya
14	*C. pini*	*Pinus* spp.	Afyonkarahisar, Uşak, Trabzon
15	*C. pinihabitans*	*Pinus* spp.	Kütahya, Niğde
16	*C. pinimaritimae*	*Pinus* spp.	Afyonkarahisar, Kütahya, Uşak, Trabzon
17	*C. piniphila*	*Pinus* spp.	Afyonkarahisar, Kütahya
18	*C. pinivora*	*Pinus* spp.	Malatya, Afyonkarahisar, Kütahya, Uşak, Artvin
19	*C. pruinosa*	*Pinus* spp., *Picea* spp.	Princess Island-İstanbul, Trabzon
20	*C. schimitscheki*	*Pinus* spp.	Malatya, Adıyaman, Afyonkarahisar, Kütahya, Uşak
21	*C. setosa*	*Pinus* spp.	Kütahya
22	*C. watanabei*	*Pinus* spp.	Afyonkarahisar, Kütahya, Uşak
23	*C. tujafilina*	*Plathyclaudus* spp. *Cupressus* spp.	Collected from all localities
24	*C. fresai*	*Plathyclaudus* spp.	Afyonkarahisar
25	*C. cupressi*	*Cupressus* spp.	Afyonkarahisar
26	*C. oxycedri*	*Juniperus* spp.	Kütahya
27	*C. juniperi*	*Juniperus* oxycedrus	Trabzon
28	*C. juniperensis*	*Juniperus* spp.	Kütahya
29	*C. wahluca*	*Juniperus* spp.	Kütahya

Family: Aphididae Latreille, 1802
Subfamily: Lachninae Herrich-Schaeffer, 1854
Tribe: Eulachnini Baker, 1920
Genus: *Cinara* Curtis, 1835
Subspecies: *Cinara* subgen. *Cedrobium* Remaudiere, 1954
Subspecies: *Cinara* subgen. *Cinara* Curtis, 1835
Subspecies: *Cinara* subgen. *Cupressobium* Börner, 1940

3.1 *Cinara* species on *Pinus* spp. and *Picea* spp.

As a result of the sampling and performing diagnostic keys in order to determine the species of genus *Cinara* that uses *Pinus* and *Picea* species as hosts and to determine similarities and differences between species, 16 species belonging to the genus *Cinara* (*Cinara acutirostris, C. brauni, C. maghrebica, C. nuda, C. palaestinensis, C. pilicornis, C. pineti, C. pini, C. pinihabitans, C. pinimaritimae, C. piniphila, C. pinivora, C. pruinosa, C. schimitscheki, C. setosa* and *C. watanabei*) were determined (Table 1 and Figure 2). General characteristics of these species given as follows;

***Cinara* (*Cinara*) *acutirostris* Hille Ris Lambers, 1956;**
Host Plants: *Pinus nigra* and *Pinus pinea*
Parts of plant they feed: Bottom of the needle leaf or on the branches
World wide distribution: Palaearctic (Remaudiere et al., 2006;Holman,2009; Blackman & Eastop, 2019)
Turkey distribution: Konya (Nieto Nafria, 2019)
Collected samples: Sampling over 3 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *brauni* Börner, 1940;**
Host Plants: *Pinus nigra*
Parts of plant they feed: New shoots.
World wide distribution: Palaearctic (Holman, 2009; Blackman & Eastop, 2019; Nieto Nafria, 2019)
Turkey distribution: Ankara, Bartın, Bursa, Çankırı, stanbul, Konya and Muğla (Toper Kaygın & Çanakçıoğlu, 2003; Toper Kaygın et al., 2008; Tuatay, 1999)
Collected samples: Sampling over 24 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *maghrebica* Mimeur, 1934;**
Synonyms: *Cinara maghrebica* subsp. *maghrebica* Mimeur, 1934; *Cinara maghrebica* subsp. *garganica* Binazzi, 1983
Host Plants: *Pinus* spp. (*P. canariensis, P. halepensis, P. pinaster, P.pinea*)
Parts of plant they feed: Dense colonies on young branches
World wide distribution: Palaearctic (Blackman & Eastop, 2019; Holman 2009)
Turkey distribution: Samsun and Trabzon (Akyürek, 2006; Görür et al., 2009a, 2009b)
Collected samples: Sampling over 39 populations on *Pinus* spp. (Table 1)

***Cinara nuda* (Mordvilko, 1895);**
Host Plants: *Pinus* spp.
Parts of plant they feed: Trunk and basal parts of older branches of young trees
World wide distribution: Europe and Kazakhstan (Blackman & Eastop, 2019)
Turkey distribution: Malatya (Görür et al., 2018)
Collected samples: Sampling over 1 population on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *palaestinensis* Hille Ris Lambers, 1948;**
Synonyms: *Cinara* (*Cinara*) *palaestinensis apulica* Binazzi, 1983; *Cinara* (*Cinara*) *palaestinensis palaestinensis* Hille Ris Lambers, 1948
Host Plants: *Pinus halepensis, P. brutia, P. sylvestris*
Parts of plant they feed: Dense colonies on new shoots
World wide distribution: Palaearctic (Blackman & Eastop, 2019; Holman 2009)
Turkey distribution: İstanbul, Muğla, Mersin, Eskişehir, Trabzon, Adana, İçel, Afyonkarahisar (Görür et al., 2014; Toper Kaygın & Çanakçıoğlu, 2003)
Collected samples: Sampling over 2 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *pilicornis* (Hartig, 1841);**
Synonyms: *Aphis abietis* Walker, 1848; *Lachnus flavus* Mordvilko 1894; *Lachnus hyalinus* Koch, 1856; *Lachnus macrocephalus* Buckton, 1881; *Lachnus pinicola* Kaltenbach, 1843
Host Plants: *Pinus* spp., *Picea* spp., *Tsuga* spp.
Parts of plant they feed: Under needle leaves
World wide distribution: Cosmopolit except for Afrika (Holman, 2009)
Turkey distribution: İstanbul, Artvin, Trabzon, Giresun, Ankara, Niğde and Konya (Çanakçıoğlu, 1975; Tuatay, 1999; Toper Kaygın & Çanakçioğlu, 2003; Görür, 2004a; Görür, 2004b; Altay & Uysal, 2005; Blackman & Eastop, 2019)
Collected samples: Sampling over 2 populations on *Pinus* spp. (Table 1)

***Cinara pineti* (Fabricus, 1781);**
Synonyms: *Lachnus pineti* Koch, 1855
Host Plants: *Pinus* spp.
Parts of plant they feed: Young shoots, branches and under needle leaves
World wide distribution: Neoarctic (Holman, 2009)
Turkey distribution: Malatya (Görür et al., 2018)
Collected samples: Sampling over 1 population on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *pini* (Linnaeus, 1758);**
Synonyms: *Cinara nuda* auct.nec Mordvilko, 1895; *Aphis nuda* subsp. *pini* Börner, 1952; *Aphis nudapini* DeGeer, 1773; *Lachniella oblonga* Del Guercio, 1909; *Lachnus pineti* Hartig, 1839; *Cinara* (*Cinara*) *polyseta*; *Lachnus taeniatus* Koch, 1856; *Lachnus toeniatus* Schouteden, 1900; *Aphis nuda-pini* De Geer, 1773.
Host Plants: *Pinus* spp.

Parts of plant they feed: Young shoots, branches and under needle leaves
World wide distribution: Palaearctic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Bolu-Aladağlar, Antalya, Muğla-Marmaris, İzmir, Çankırı-Ilgaz dağı, Kars-Sarıkamış, Samsun-Alaçam, Çanakkale, Edirne, Kahramanmaraş, Bartın (Tuatay, 1999; Aslan & Uygun, 2005; Toper Kaygın et al., 2008)
Collected samples: Sampling over 3 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *pinihabitans* (Mordvilko, 1895);**
Synonyms: *Lachnus taeniatus* Koch, 1856; *Lachnus toeniatus* Schouteden, 1900.
Host Plants:*Pinus* spp. (*Pinus sylvestris* and *P. mugo* var. *mughus*)
Parts of plant they feed: Shells of 2-8 years thin branches
World wide distribution: Palaearctic and Oriental (Holman 2009;Blackman & Eastop, 2019)
Turkey distribution: Niğde Kütahya (Görür et al., 2014)
Collected samples: Sampling over 3 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *pinimaritimae* (Dufour, 1833);**
Synonyms: *Cinara excelsae* Hille Ris Lambers, 1948; *Cinara maritimae* Eastop ve Hille Ris Lambers, 1976; *Lachnus pineti* (Koch, 1855); *Aphis pini* subsp. *maritimae* (Dufour, 1833); *Lachnus pinicola* (Kaltenbach, 1843).
Host Plants: *Pinus* spp.
Parts of plant they feed: Young shoots and in small groups between the leaves of the needle sheets
World wide distribution: Palaearctic and Neotropical (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Afyonkarahisar, Kütahya, Uşak (Görür et al., 2014)
Collected samples: Sampling over 28 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *piniphila* (Ratzeburg, 1844);**
Host Plants: *Pinus* spp.
Parts of plant they feed: Between needle leaves and shells of branches
World wide distribution: Palaearctic and Oriental (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Afyonkarahisar, Kütahya (Görür et al., 2014)
Collected samples: Sampling over 6 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *pinivora* (Wilson, 1919);**
Synonyms: *Cinara osborni* Tissot, 1944; *Cinara osborniana* Tissot, 1945.
Host Plants: *Pinus* spp. (especially *Pinus edulis*)
Parts of plant they feed: Under cones and on needle leaves
World wide distribution: Nearctic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Afyonkarahisar, Bartın, Kütahya, Uşak (Görür et al., 2014; Toper Kaygın et al., 2008)
Collected samples: Sampling over 21 populations on *Pinus* spp. (Table 1)

***Cinara pruinosa* (Hartig, 1841);**
Host Plants: *Pinus* spp. and *Picea* spp.
Parts of plant they feed: Woody twigs and base of trunk and on roots
World wide distribution: Palearctic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Princess Island and Trabzon (Akyıldırım, 2010; Görür et al., 2009a)
Collected samples: Sampling over 2 populations on *Picea* spp. (Table 1)

***Cinara* (*Cinara*) *schimitscheki* Börner, 1940;**
Synonyms: *Cinara kosarowi* Tashev, 1962
Host Plants: *Pinus* spp. (Especially *Pinus nigra, P. nigra* subsp. *pallasiana, P. mugo, P. pinea, P. tabulaeformis, P. massoniana* and *P. leucodermis*)
Parts of plant they feed: Under cones and on needle leaves
World wide distribution: Palaearctic and Oriental (Holman 2009; Blackman & Eastop, 2019).
Turkey distribution: Afyonkarahisar, Bartın, Kütahya, Uşak, Niğde (Görür et al., 2014; Toper Kaygın et al., 2008)
Collected samples: Sampling over 45 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *setosa* (Börner, 1950);**
Host Plants: *Pinus* spp. (*Pinus mugo* and *Pinus nigra* var. *pallasiana*)
Parts of plant they feed: Needle leaves
World wide distribution: Palaearctic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution:Kütahya (Görür et al., 2014; Şenol et al., 2015)
Collected samples: Sampling over 2 populations on *Pinus* spp. (Table 1)

***Cinara* (*Cinara*) *watanabei* Inouye, 1970;**
Host Plants: *Pinus* spp.
Parts of plant they feed: 3-5-year branches of mature trees or in the trunk of young trees
World wide distribution: Palaearctic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Afyonkarahisar, Kütahya, Uşak (Görür et al., 2014)
Collected samples: Sampling over 34 populations on *Pinus* spp. (Table 1)

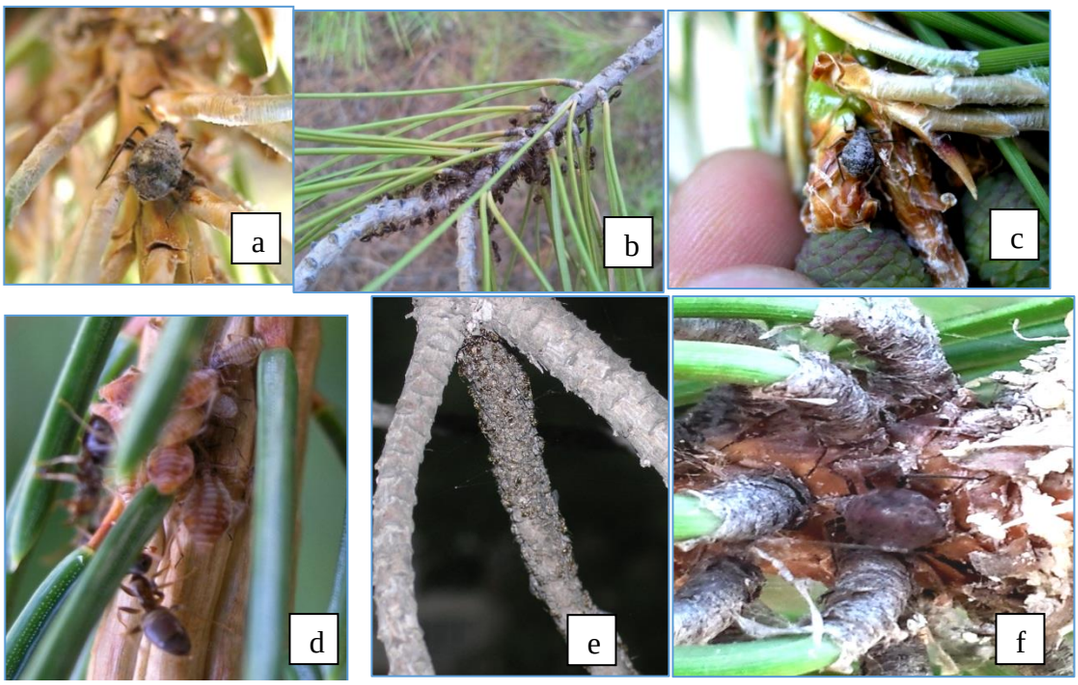

Figure 2. Some important *Cinara* species on *Pinus* spp. (a: *C. schimitscheki;* b: *C. maghrebica;* c: *C. pinivora;* d: *C. pilicornis;* e: *C. pini;* f: *C. pinimaritimae)*

3.2 *Cinara* species on *Cedrus* spp. and *Abies* spp.

Eight cedar aphid species has been detected on the Earth and six of them (*Cinara cedri, C. confinis*, *C. curvipes, C. indica, C. intermedia, C. laportei*) have been distributed in Turkey (Blackman & Eastop, 2019). It was observed that *C. cedri* species was the leading species in terms of number or density (Figure 3).

***Cinara* (*Cinara*) *cedri* Mimeur, 1936;**
Host Plants: *Cedrus* spp.
Parts of plant they feed: Shoots and slots of trunk
World wide distribution: Palaearctic, Neoarctic and Neotropic (Holman, 2009; Blackman & Eastop, 2019; Nieto Nafria, 2019)
Turkey distribution: Ankara, Antalya, Bartın, Burdur, Eskişehir, Gaziantep, Hatay, İstanbul, Konya, Kastamonu, Samsun, Tekirdağ (Tuatay, 1999; Ünal & Özcan, 2005; Toper Kaygın et al., 2008)
Collected samples: Sampling over 260 populations on *Cedrus* spp. (Table 1)

***Cinara* (*Cinara*) *confinis* (Koch, 1856);**
Synonyms: *Lachnus abieticola* Cholodkovsky, 1899; *Aphis borealis* Curtis 1828; *Lachniella cilicica* Del Guercio, 1909; *Cinara ciliciea* Ghosh, 1982; *Lachnus lasiocarpae* Gillette ve Palmer, 1930; *Aphis polaris* Curtis 1828; *Lachnus vanduzei* Swain, 1919; *Todolachnus abieticolabulgarica* Pintera, 1959; *Lachniella cilicica cecconii* Del Guercio, 1909.
Host Plants: *Cedrus* spp. and *Abies* spp.
Parts of plant they feed: Shoots and slots of trunk
World wide distribution: Palaearctic and Oriental (Holman, 2009; Blackman & Eastop, 2019; Nieto Nafria, 2019)
Turkey distribution: Ankara, Artvin, Bartın, Bolu, Bursa and Çankırı (Toper Kaygın et al., 2008; Tuatay, 1999; Önder et al., 2011)
Collected samples: Sampling over 6 populations on *Cedrus* spp. (Table 1)

***Cinara* (*Cinara*) *curvipes* (Patch, 1912);**
Host Plants: *Abies* spp., *Cedrus* spp. and *Picea* spp., rarely *Pinus* spp.
Parts of plant they feed: Shoots and branches
World wide distribution: Palearctic (Holman, 2009; Blackman & Eastop, 2019; Nieto Nafria, 2019)
Turkey distribution: Afyonkarahisar, Bartın, Kütahya (Görür et al., 2014; Görür et al., 2015)
Collected samples: Sampling over 2 populations on *Abies* spp. (Table 1)
***Cinara* (*Cinara*) *indica* Verma, 1970;**
Synonyms: *Cinara indica* Verma 1969
Host Plants: *Cedrus* spp.
Parts of plant they feed: Trunk
World wide distribution: Palearctic (Holman, 2009; Blackman & Eastop, 2019)
Turkey distribution: Afyonkarahisar, Malatya (Görür et al., 2014; Görür et al., 2018)
Collected samples: Sampling over 2 populations on *Cedrus* spp. (Table 1)

***Cinara* (*Cinara*) *intermedia* (Pasek, 1954) ;**
Host Plants: *Pinus* spp. and *Cedrus* spp.
Parts of plant they feed: Bark of trunk
World wide distribution: Europe (Blackman & Eastop, 2019)
Turkey distribution: Malatya (Görür et al., 2018)
Collected samples: Sampling over 1 population on *Cedrus* spp. (Table 1)

***Cinara* (*Cedrobium*) *laportei* (Remaudière, 1954);**
Host Plants:*Cedrus* spp.
Parts of plant they feed: Lower branches, shoots and young branches
World wide distribution: Palearctic and Ethiopian (Fabre & Chalon, 2005)
Turkey distribution: Antalya, Burdur, Muğla and Samsun (Akyürek, 2006; Nieto Nafria, 2019)
Collected samples: Sampling over 4 populations on *Cedrus* spp. (Table 1)

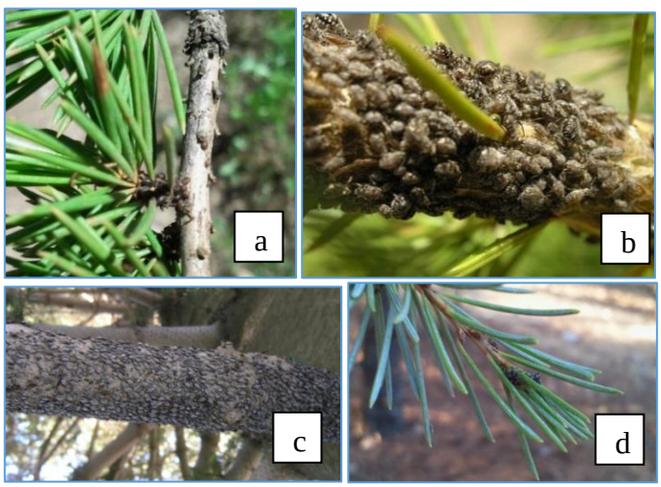

Figure 3. Some important *Cinara* species on *Cedrus* spp. (a: *C. confinis;* b: *C. cedri;* c: *C. curvipes;* d: *C. indica)*

3.3 *Cinara* species on *Plathyclaudus* spp., *Juniperus* spp.and *Cupressus* spp.

Within the scope of this study, 7 species (*C. tujafilina, C. fresai, C. cupressi, C. oxycedri, C.juniperensis, C. juniperi* and *C. wahluca*) belonging to the genus *Cinara* were identified from Cupressaceae plants (*Cupressus* spp., *Plathycladus* spp., *Juniperus* spp.) from different region of Turkey (Figure 4).

***Cinara* (*Cupressobium*) *juniperi* De Geer, 1773;**
Host Plants: *Juniperus* spp.
Parts of plant they feed: Between needle leaves and young end shoots
World wide distribution: Nearctic, North Africa (Holman, 2009; Blackman & Eastop, 2019)
Turkey distribution: Trabzon (Görür et al., 2009a)
Collected samples: Sampling over 1 population on *Juniperus* spp. (Table 1)

***Cinara* (*Cinara*) *juniperensis* (Gillette ve Palmer, 1925);**
Host Plants: *Juniperus* spp.
Parts of plant they feed: Between needle leaves and young end shoots
World wide distribution: Nearctic (Holman, 2009; Blackman & Eastop, 2019)
Turkey distribution:Kütahya (Görür et al., 2014)
Collected samples: Sampling over 1 population on *Juniperus* spp. (Table 1)

***Cinara* (*Cinara*) *wahluca* Hottes, 1952;**
Host Plants: *Juniperus* spp.
Parts of plant they feed: Bottom of the needles leaves, slits of the branches
World wide distribution: Nearctic (Blackman & Eastop, 2019)
Turkey distribution: Samsun (Akyürek et al. 2010)
Collected samples: Sampling over 1 population on *Juniperus* spp. (Table 1)

***Cinara* (*Cupressobium*) *cupressi* (Buckton, 1881);**
Synonyms: *Cinara canadensis* Hottes ve Bradley, 1953; *Cinara cupressivora* Watson ve Voegtlin, 1999; *Lachnus sabinae* Gillette ve Palmer, 1924; *Lachniella tujae* Del Guercio, 1909; *Lachniella juniperi signata* Del Guercio, 1909.
Host Plants: *Plathyclaudus orientalis, Cupressus* spp. and *Juniperus* spp.
Parts of plant they feed on: Thin branches and young shoots
World wide distribution: Palearctic and Oriental (Holman, 2009; Blackman & Eastop, 2019)
Turkey distribution: Bartın, Bolu and Kahramanmaraş (Aslan & Uygun, 2005; Toper Kaygın et al., 2008)
Collected samples: Sampling over 2 populations on *Cupressus* spp. (Table 1)

***Cinara* (*Cupressobium*) *fresai* Blanchard, 1939;**
Synonyms: *Cinara* (*Cupressobium*) *bresai* Toper Kaygın and Çanakçıoglu, 2003; *Cupressobiummaui* Bradley 1965; *Cinara wacasassae* Tissot, 1944.
Host Plants: *Cupressus* spp., *Plathycladus* spp., and *Juniperus* spp., rarely *Cryptomeria* spp.
Parts of plant they feed: Shoots, needle leaves and branches
World wide distribution: Nearctic, Australia, Palearctic (Holman, 2009; Blackman & Eastop, 2019)
Turkey distribution: Adana and Ankara (Tuatay, 1999; Toros et al., 2002)
Collected samples: Sampling over 1 population on *Plathyclaudus* spp. (Table 1)

***Cinara* (*Cupressobium*) *oxycedri* Binazzi, 1996;**
Host Plants: *Juniperus oxycedrus* and *J. oxycedrus* subsp. *macrocarpa*
Parts of plant they feed: Shoots, needle leaves and branches
World wide distribution: Palearktic (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Kütahya (Görür et al., 2014)
Collected samples: Sampling over 1 population on *Juniperus* spp. (Table 1)

***Cinara* (*Cupressobium*) *tujafilina* (Del Guercio, 1909);**
Synonyms: *Lachnus biotae* (van der Goot, 1917); *Dilachnus callitris* Froggatt, 1927; *Cinaropsis cupresi* Gomez-Menor, 1962; *Lachnusgreeni* Schouteden 1905; *Cupressobium mediterraneum* Narzikulov, 1963; *Lachnus sabinae* Nevsky, 1929; *Lachniella thujafolia* Theobald, 1914; *Cinara winokae* Eastop, 1972; *Cinara winonkae* Hottes, 1934; *Cinara winonokae* Zhang, Zhang & Zhong, 1993.
Host Plants: *Callitris* spp., *Chamaecypari* spp., *Cupressus* spp., *Juniperus* spp. (except for communis) *Plathycladus* spp. and *Widdringtoria* spp.
Parts of plant they feed: Leafy branches, the lower surfaces of the branches and near trunk
World wide distribution: Australia, Palaearctic and Neotropical (Holman 2009; Blackman & Eastop, 2019)
Turkey distribution: Ankara, Konya, Malatya, Eskişehir, İstanbul, Artvin, Adana and Niğde (Çanakçıoğlu, 1975; Düzgüneş et al., 1982; Tuatay, 1999; Toros et al., 2002; Görür, 2004b)
Collected samples: Sampling over 42 populations on *Plathyclaudus* spp. and *Cupressus* spp. (Table 1)

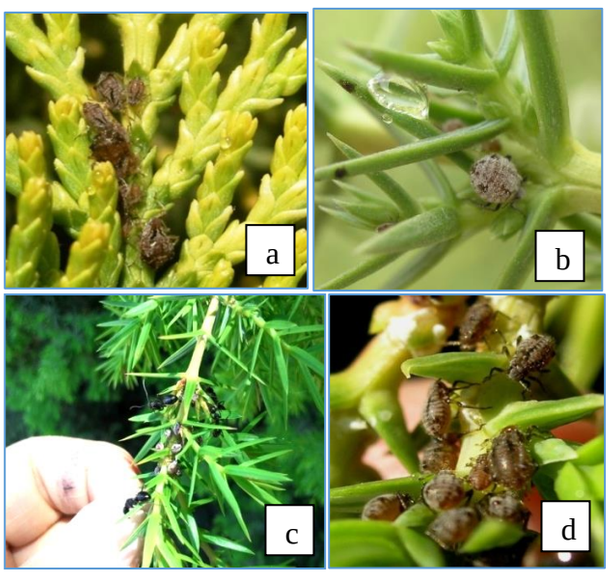

Figure 4. Some important *Cinara* species on *Plathyclaudus* sp. and *Juniperus oxycedrus* (a: *C. tujafilina;* b: *C. juniperensis;* c: *C. cupressi;* d: *C. oxycedri)*

4. CONCLUSIONS AND COMMENTS

Aphids are highly host specific insect and therefore host plant features play an important role on aphids. Turkey has higher plant biodiversity richness and rate of endemic plant is about 34.4%. Gymnospermae richness of our forest is more than Angiospermae (54%) and 50.8% of this plant species are belonging to Pinaceae and 3.6 % are to Cupressaceae families (Seçmen et al., 1998). This Gymnospermae species were found in the studied areas and *Cinara* samples were collected from those which were grown as natural and exotic. Especially in North Hemisphere, *Cinara* aphids distributed densely and use conifers as host plant (Blackman & Eastop, 2019).

Presented results are the first detailed scientific study dealing with *Cinara* genus in Turkey. The total number of *Cinara* aphid species recorded in Turkey is 29. Despite that, it can be considered that this number is much lower compared with records in neighbouring countries (North America has 150 species, Poland 27 species, Italy 26 species) as Turkey has particular geographical, agricultural, climatic and floristic characteristics (Durak et al., 2008).

In these studies, the *Cinara* aphid species distributed in Turkey and host plants were tried to be emphasized. As a result of study, 29 aphid species and 7 plant genera belonging to Pinaceae and Cupressaceaae were determined.

Cinara species infest the same host and only body colour and sheen (some morphological characters) differentiate them from each other. This creates serious identification problems for both species, particularly when they occur in mixed colonies and are often wrongly classified (Heie, 2015). Host plants and localities are considered as the main ecological factor involved in the speciation process of this phytophagous insects. They exhibit a diversity of ecological features that make them good models to explore the importance of ecological specialisation in the diversification of aphids. Most species feed on a single or a few species of conifers, while others are less discriminatory, feeding on several species within a genus (Favret & Voegtlin, 2004a, 2004b).

This data illustrates how neglected is the research areas in terms of faunistic research on *Cinara* aphids. Further

studies should definitely reveal much higher number of *Cinara* aphid taxa and different host plant taxon for Turkey.

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