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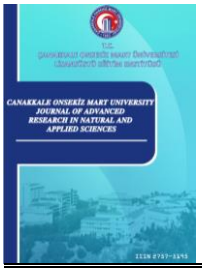

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The Aphid Fauna (Hemiptera:Aphidoidea) and Host Plants of The Büyükada Island (İstanbul, Turkey)

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Abstract – About 5100 aphid (Hemiptera: Aphidoidea) species that feed on different host plants have spread all over the world. About 5000 aphid taxon feed on different plant species. Aphids are small, soft-bodied and one of the sap-feeding insect groups and also can damage almost all plants. Some aphid species are specific to only one host plant, while some feed on numerous host plants. In this study, aphid fauna and host plants of aphids were determined in Büyükada islands of İstanbul was determined in this study. Aphid species were distributed from cultivated plants, wild trees and shrubs in the area. During these study, 150 aphid samples were collected in the area. Apterae and alatae individuals of aphid samples were collected as much as possible from aphid colonies on cultivated and ornamental plants. 43 aphid taxa including two new records Turkey aphid fauna (1 family, 6 subfamilya, 6 tribus ve 23 genus) were determined on 46 different plant species at the end of the study. *Malva neglecta*, *Nerium oleander*, and *Pinus* spp. are the most sampled plant species. *Aphis craccivora*, *Aphis fabae*, and *A. spiracola* are the most determined aphid species in the area. All defined aphid species are the first records for the Büyükada island. Findings of the presented study and other recent studies showed that with the detailed studies, Turkey aphid fauna will be substantially increased thanks to the more detailed local studies.

Keywords *– Aphid, Büyükada, İstanbul, plant, Turkey*

1. Introduction

Aphids are considered remarkable pest that feeds on plant sap and damages them directly by sucking their phloem sap, indirectly by transmitting pathogens around the world. About 5100 aphid species have been identified around the world, and 1600 aphid species are present in Europe (Favret, 2020; Blackman and Eastop, 2020). Preliminary studies related to Turkey aphid fauna date back to twentieth-century (Fahringer, 1922).

Çanakçıoğlu (1975) summarised all studies on aphids and published nearly about 260 aphid species. Remaudière Toros, & Özdemir (2006) listed 417 species and then Toper Kaygın, Görür & Cota (2008), Eser, Görür, Tepecik & Akyıldırım (2008), Görür, Zeybekoğlu, Akyürek, Işık & Akyıldırım (2009), Akyürek, Zeybekoğlu & Görür (2010, 2011), Görür, Akyıldırım Beğen, Olcabey & Akyurek (2012) published 480 aphid taxa including 2 new records from our study area which were *Acyrthosiphon kondoi* Shinji, 1938 and *Eulachnus pumilae* Inouye, 1939. Barjadze, Özdemir & Blackman. (2014) published *Aphis matricariae* Barjadze & Özdemir, 2014 and *Protaphis kvavadzei* Barjadze & Özdemir, 2014 as new records. Moreover,

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Barjadze, Blackman & Özdemir (2015) was defined *Aphis polii* on *Teucrium* sp. from Turkey. Görür, Toper Kaygin, Şenol & Akyildirim Beğen (2015) shown that *Cinara curvipes* (Patch, 1912) was invasive and a new addition for Turkey. Şenol, Akyıldırım Beğen, Görür & Demirtaş (2015a,b) described new records (26 species) and increased the number of the aphid fauna to 532. Kök, Kasap & Özdemir (2016) and Kök & Kasap (2019) added 2 aphid species and the number reached to 534. Görür, Şenol & Akyıldırım Beğen (2019) listed 40 new aphid records to the aphidofauna. Recent reanalysis of the aphid species and determined host plants clearly showed that the number of the aphid taxa in Turkey reached more than 570 (Görür Şenol & Akyıldırım Beğen, 2019; Görür, Şenol, Akyıldırım Beğen & Akyürek, 2020).

2. Materials and Methods

2.1. Field Introduction

The Princes Islands include nine islands, four of them are large (Büyükada, Heybeliada, Burgazada, and Kınalıada) and 5 of them are smaller (Yassıada, Sivriada, Kaşık Adası, Sedef Adası and Tavşan Adası), placed in the southeast part of the Marmara Sea of Istanbul. Büyükada, the area of this study is the biggest island among them (Figure 1).

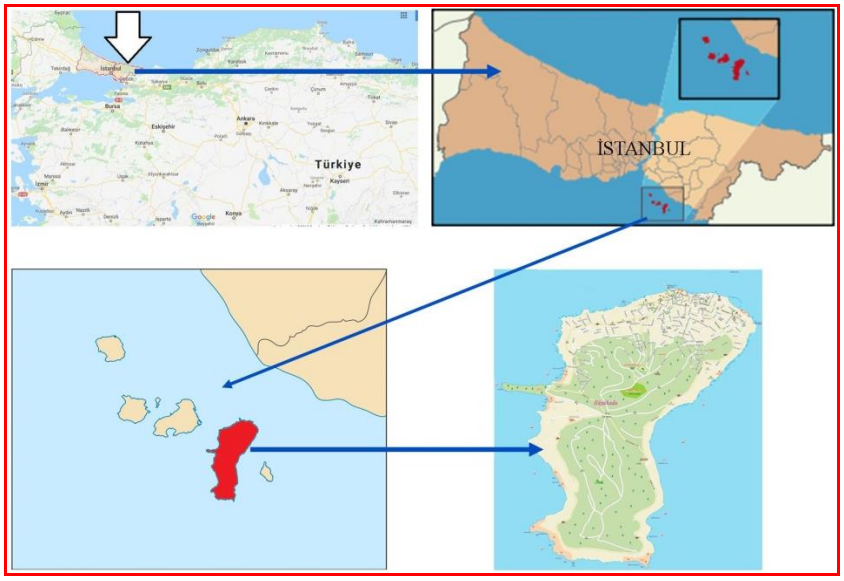

Figure 1. Location of Büyükada Island

The annual average temperature of these Islands is 14.4℃, generally above 25℃ during May-September. The annual average precipitation is about 823.0 mm. The relative humidity is between 73- 77% that decreases to around 65-68% during summer (MGM, 2020). Büyükada island has natural and exotic plant species due to location and climatic types of the area. Blacksea and Mediterranian climatic types are observed in the area (Kaya & Aladağ, 2009). Exotic plants grown throughout the island, especially in the gardens, parks, and even roadsides in residential areas.

2.2. Methods

The field studies were conducted in Büyükada Islands from April to October 2010 (Figure 1). Focused on the sample possible higher amount of all forms (apterae and alatae individuals) on host plants. Specimens were preserved in an eppendorf tube containing 96% alcohol. Samples were picked up from almost all naturally grown and agricultural plants. Collection and preparation of the aphid samples have been carried out in accordance with the methods of Martin (1983). Species were described based on Blackman & Eastop (2020) and Çanakçıoğlu (1975). Systematic status and host plants of the identified aphids were determined

from Blackman and Eastop (2020) and Holman (2009). When defining all aphid samples, all books and papers published about diagnostic characters, determined plant species, origination and recent dispersal area were examined carefully. Definition, taxonomic status and distribution informations controlled by related literature (Holman, 2009; Favret, 2020; Blackman & Eastop, 2020). All collected aphid specimens were kept in the Aphid laboratory of Faculty of Arts and Sciences, Niğde Ömer Halis Demir University.

3. Results and Discussion

150 aphid population were sampled and 43 aphid species (23 genera, 6 tribe) belonging to 6 subfamilies were determined from the study area (Figure 1). Identified taxa were edited alphabetically and listed (Table 1). Photos of some important species were given (Figure 2,3).

Among these identified species, two new records were determined for Turkey and added to a recent checklist of the Turkey aphid fauna (Görür et al., 2012). The first of these is *Acyrthosiphon kondoi* Shinji, 1938 and collected on *Malva* sp. (Malvaceae) second one is *Eulachnus pumilae* Inouye, 1939 and collected on *Pinus brutia* (Pinaceae). All taxonomical name lists, host plants and dates of the determined species from study area were given. Determined species are listed alphabetically.

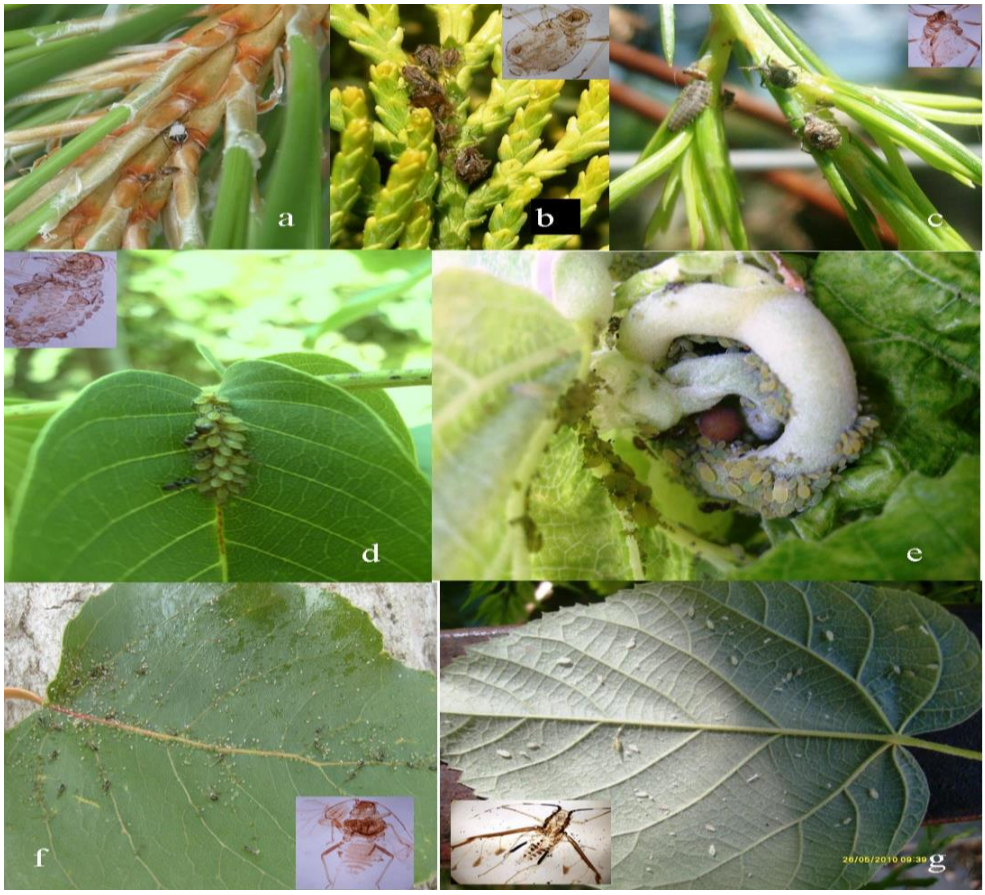

Figure 2. Aphid species on host plants (a- *Cinara brauni* on *Pinus* sp.*;* b- *Cinara tujafilina* on *Platycladus orientalis*;c- *Cinara maghrebica* on *Pinus* sp. ;d- *Panaphis juglandis* on *Juglans regia* ;e- *Patchiella reaumuri* on *Tilia* sp. ;f- *Chaitophorus populialbae* on *Populus nigra*; g- *Eucallipterus tiliae* on *Tilia* sp.)

***Acyrthosiphon euphorbiae* Börner, 1940.**
Examined specimen: Collected on *Euphorbia* sp.on 11.05.2010.
***A. kondoi* Shinji, 1938**
Examined specimen: Collected on *Lathyrus* sp.on 21.05.2010
***A. malvae* (Mosley, 1841)**
Examined specimen: Collected on *Senecio pseudo-orientalis* on 11.05.2010; *Malva* sp. on 14.05.2010.
***Aphis craccivora* Koch 1854**
Examined specimen: Collected on *Citrus* sp. (Family) on 11.V.2010, *Acacia* sp. on 22.06.2010; *Portulacca oleracea, Wistera* sp. on 28.06.2010-02.07.2010.
***A. fabae* Scopoli 1763**
Examined specimen: Sampled on *Hibiscus syriacus* (ağaç hatmi); *Hedera helix* on 10.05.2010 *Polygonum* sp.(çobandeğneği); *Urtica* sp.(ısırgan otu); *Anthemis* sp. on 11.05.2010;
Nerium oleander on 12.05.2010; *Hedera* sp.
Polygonum sp.on 14.05.2010;
***A. gossypii* Glover** 1877
Examined specimen: Collected on *Punica granatum* on 26.05.2010.
***A. hederae* Kaltenbach, 1843**
Examined specimen: Collected on *Hedera helix* 07.07.2010.
***A. molluginis* (Börner, 1950)**
Examined specimen: Collected on *Galium aparine on* 10-11.05.2010.
***A. nasturtii* Kaltenbach, 1843**
Examined specimen: Collected on *Rumex* sp. on 28.06.2010.
***A. nerii* Boyer de Fonscolombe, 1841**
Examined specimen: Found on *Nerium oleander* on 10.05.2010; 11.05.2010; 27.06.2010
***A. pomi* de Geer, 1773**
Examined specimen: Collected on *Pyrus* sp. on 26.05.2010
***A. ruborum* (Börner, 1932)**
Examined specimen: Found on *Rubus* sp. on 27.06.2010.
***A. spiraecola* Patch, 1914**
Examined specimen: Collected on *Cotoneaster franchetti* on 10.05.2010; *Chenopodium* sp. on 11.05.2010; 12.05.2010; *Nerium oleander on* 21.05.2010; *Trifolium* sp. on 22.06.2010; 28.06.2010.
***A. umbrella* (Börner, 1950)**
Examined specimen: Collected on *Malva* sp.on 07.07.2010.
Aulocorthum solani (Kaltenbach, 1843)
Examined specimen: Collected on *Ulmus* sp. on 10.05.2010.
Brachycaudus cardui (Linnaeus, 1758)
Examined specimen: Collected on *Carduus* sp.on 14.05.2010; *Carthamus* sp. on 21.05.2010;
Carduus acanthoides on 26.05.2010.
B. helichrysi (Kaltenbach, 1843)
Examined specimen: Collected on *Cynoglossum* sp.on 12.05.2010 ; 14.05.2010; 21.05.2010;
Lycopersicum esculentum on 02.07.2010.
Brevicoryne brassicae (Linnaeus, 1758)
Examined specimen: Collected on *Bunias orientalis* on 17.05.2010.
Chaitophorus populialbae (Boyer de Fonscolombe, 1841)
Examined specimen: Collected on *Populus nigra* on 21.05.2010.
***Cinara tujafilina* del Guercio, 1909**
Examined specimen:: Collected on *Platycladus orientalis* on 10.05.2010; 21.05.2010.
***C. brauni* Börner , 1940**
Examined specimen: Collected on *Pinus* sp. on 28.06.2010.
***C. maghrebica* Mimeur, 1934**
Examined specimen: Collected on *Pinus* sp. on 26.05.2010 ; 27.06.2010.
***C. pilicornis* (Hartig, 1841)**
Examined specimen: Collected on *Picea* sp. on 27.06.2010.
***C. pruinosa* (Hartig, 1841)**
Examined specimen: Collected on *Picea* sp. on 28.06.2010.
***Drepanosiphum oregonensis* Granovsky, 1939**
Examined specimen:: Collected on *Acer trautvetteri* on 26.05.2010
***Eucallipterus tiliae* (Linnaeaus, 1758)**

Examined specimen: Collected on *Tilia* sp. on 12.05.2010 ; 26.05.2010 28.06.2010.

***Eulachnus pumilae* Inouye, 1939**

Examined specimen: Collected on *Pinus* sp. on 27.06.2010.

***Hyalopterus pruni* (Geoffroy, 1762)**

Examined specimen: Collected on *Prunus domestica* on 12.05.2010.

Liosomaphis berberidis (Kaltenbach, 1843)

Examined specimen: Collected on *Berberis thunbergii* on 12.05.2010.

Lipaphis erysimi (Kaltenbach, 1843)

Examined specimen: Collected on *Brassica nigra* on 21.05.2010.

***Macrosiphum euphorbia* (Thomas, 1878)**

Examined specimen: Collected on *Urtica* sp. on 10.05.2010.

***M. impatientis* Williams, 1911.**

Examined specimen: Collected on *Rosa canina* on 14.05.2010.

***M. rosae* (Linnaeus, 1758)**

Examined specimen: Collected on *Rosa* sp. on 11.05.2010; 12.05.2010; 02.07.2010 ;07.07.2010

***Myzus persicae* (Sulzer**, 1776)

Examined specimen: Collected on *Malva* sp. on 21.V.2010.

***Ovatomyzus chamaedrysi* (Passerini,1879)**

Examined specimen: Collected on *Mentha* sp. on 14.05.2010.

***Panaphis juglandis* (Goeze, 1778)**

Examined specimen: Collected on *Juglans regia* on 07.07.2010.

***Patchiella reaumuri* (Kaltenbach, 1843)**

Examined specimen: Collected on *Tilia* sp. on 10.05.2010.

***Rhopalosiphum padi* (Linnaeus, 1758)**

Examined specimen: Collected on *Hordeum murinum*on 02.07.2010.

***Schizaphis rotundiventris* (Signoret, 1860)**

Examined specimen: Sampled on *Palm* sp.on 22.06.2010; 27.06.2010.

***Sitobion avenae* (Fabricius, 1775)**

Examined specimen: Collected on *Cynodon dactylon* on 07.07.2010.

***S. fragariae* (Walker, 1848)**

Examined specimen: Collected on *Hordeum* sp. on 14.05.2010; *Poa* sp. on 21.05.2010; *Bromus* sp. on 26.05.2010.

***Uroleucon sonchi* (Linnaeus, 1767)**

Examined specimen: Collected on *Chondrilla junce* on 10.05.2010.

***Wahlgreniella nervata* (Gillette, 1908)**

Examined specimen: Collected on *Sonchus* sp. on 07.07.2010.

Figure 3. Determined species on host (a- *Aphis fabae* on *Nerium oleander*;b- *A. molluginis* on *Gallium aparine*;c- *A. nerii* on *Nerium oleander*;d- *Aphis spiraecola* on *Cotoneaster* sp.;e- *Brachycaudus cardui* on *Carduus* sp.;f- *Hyalopterus pruni* on *Prunus domestica*)

Table 1
Determined aphid species and host plants

APHID SPECIES	HOST PLANTS	APHID SPECIES	HOST PLANTS
***Acyrthosiphon euphorbiae* Börner, 1949**	*Euphorbia* sp.	***C. pilicornis* (Hartig, 1841)**	*Picea* sp.
A. kondoi* Shinji, 1938	*Lathyrus* sp.	***C. pruinosa* (Hartig, 1841)**	*Picea* sp.
***A. malvae* (Mosley, 1841)**	*Malva neglecta.* *Senecio pseudo-orientalis*	***Drepanosiphum oregonensis* Granovsky, 1939**	*Acer trautvetteri*
***Aphis craccivora* Koch, 1854**	*Robinia pseudoacacia* *Wistera floribunda* *Lycopersicum esculentum* *Portulaca oleracea*	***Eucallipterus tiliae* (Linnaeaus, 1758)**	*Tilia* sp.
***A. fabae* Scopoli, 1763**	*Hibiscus syriacus* *Hedera helix* *Polygonum* sp. *Urtica dioica* *Anthemis* sp. *Nerium oleander*	***Eulachnus pumilae* Inouye, 1939***	*Pinus* sp.
***A. gossypii* Glover, 1877**	*Punica granatum* *Senecio* sp.	***Hyalopterus pruni* (Geoffroy, 1762)**	*Prunus domestica*
***A. hederae* Kaltenbach, 1843**	*Hedera helix*	***Liosomaphis berberidis* (Kaltenbach, 1843)**	*Berberis thunbergii 'Atropurpurea'*
***A. molluginis* (Börner, 1950)**	*Gallium aparine*	***Lipaphis erysimi* (Kaltenbach, 1843)**	*Brassica* sp.
***A. nasturtii* Kaltenbach, 1843**	*Rumex* sp.	***Macrosiphum euphorbiae* (Thomas, 1878)**	*Urtica* sp.
***A. nerii* Boyer de Fonscolombe, 1843**	*Nerium oleander*	***M. impatientis* Williams, 1911**	*Rosa canina*
***A. pomi* de Geer, 1773**	*Pyrus* sp.	***M. rosae* (Linnaeus, 1758)**	*Rosa* sp.
***A. ruborum* (Börner, 1932)**	*Rubus* sp.	***Myzus persicae* (Sulzer, 1776)**	*Malva* sp.
***A. spiraecola* Patch, 1914**	*Trifolium pratense* *Cotoneaster franchetti* *Chenopodium sp.* *Nerium oleander*	***Ovatomyzus chamaedrysi* (Passerini,1879)**	*Mentha* sp.
***A. umbrella* (Börner, 1950)**	*Malva neglecta*	***Panaphis juglandis* (Goeze, 1778)**	*Juglans regia*
***Aulocorthum solani* (Kaltenbach, 1843)**	*Ulmus* sp.	***Patchiella reaumuri* (Kaltenbach, 1843)**	*Tilia* sp.
***Brachycaudus cardui* (Linnaeus, 1758)**	*Carthamus* sp. *Carduus acanthoides*	***Rhopalosiphum padi* (Linnaeus,1758)**	*Hordeum murinum*
***B. helichrysi* (Kaltenbach, 1843)**	*Cynoglossum* sp.	***Schizaphis rotundiventris* (Signoret, 1860)**	*Palm* sp.
Brevicoryne brassicae	*Brassica* sp.	***Sitobion avenae***	*Cynodon*

(Linnaeus, 1758)		**(Fabricius, 1775)**	*dactylon*
***Chaitophorus populialbae* (Boyer de Fonscolombe, 1841)**	*Populus alba*	***S. fragariae* (Walker, 1848)**	*Hordeum* sp. *Poa* sp. *Bromus* sp.
***Cinara tujafilina* del Guercio, 1909**	*Platycladus orientalis*	***Uroleucon sonchi* (Linnaeus, 1767)**	*Chondrilla juncea*
***C. brauni* Börner , 1940**	*Pinus* sp.	***Wahlgreniella nervata* (Gilette, 1908)**	*Sonchus* sp.
***C. maghrebica* Mimeur, 1934**	*Pinus* sp.		

*These new records were listed in the checklist (Görür et al., 2012)

Aphid species and related host plants of Büyükada island are reported here for the first time. 43 species of aphids belonging to 23 genera from 46 different host plants only in Büyükada were recorded. *Eulachnus pumilae* Inouye, 1939 and *Acyrthosiphon kondoi* Shinji, 1938 were described as new additions to aphidofauna of Turkey. In Yalova, southern province of Büyükada, 21 aphid taxa placed in 13 genera were identified. *Aphis fabae* Scopoli 1763 and *A. gossypii* Glover, 1854 are the most common species, like our study (Kuloğlu & Özder, 2017). Among aphid population collected host plants *Malva neglecta, Nerium oleander* and *Pinus* spp. are the most sampled plant species. *Aphis craccivora, Aphis fabae* and *A. spiracola* are the most common and important pests for several plant species. This aphid species affects plants by direct or indirect damage. Therefore, the determining of t these species and their distribution areas are crucial for the control of aphids in Büyükada islands.

The determination of the aphid fauna and host plants of aphids from the study area are clearly indicated how it is important to conduct such detailed study to find out aphid-host plant relations in Turkey. Büyükada (İstanbul) has plant richness and different microclimatic areas and is isolated from the mainland. Number of the determined aphid species and collected host plants and new records are in accordance with the findings in neighboring areas and countries near to the study area (Kuloğlu & Özder, 2017; Kök & Kasap, 2019). Görür et al. (2020) pointed out that even listing about 570 aphid species on about 1100 plant species by analyzing 13.000 samples, findings do not adequately figure out real composition of Turkey aphid fauna. Turkey has its own particular features (floristic and faunistic richness) that directly impact aphid diversity and distributions. In the neighboring countries, number of aphid fauna (Greece, 335; Iran, 328; Georgia, 320) is close to Turkey aphid composition but host plant diversity in Turkey is more (Barjadze, Japoshvili, & Bakhtadze, 2010; Alikhani, Rezwani, Rakhshani & Madani, 2010; Margaritopoulos, Papapanagiotou, Voudouris, Kati & Blackman, 2013; Güner, Aslan, Ekim, Vural & Babaç, 2012).

4. Conclusion

Due to their reproduction style, invading new areas and resulting in considerable amount of decrease in agricultural production, aphids fascinate researchers. Despite these facts, there are still many places that their aphid fauna has not been observed yet in Turkey. This study is the first detailed scientific effort dealing with the aphid species and collected host plants of Büyükada island of İstanbul region. Furthermore, because of global climate change, tourism, agricultural activities, increasing international trades and transport over the last two decades, introduction of non-native species, including aphids has increased (Kollar & Barta, 2016). Büyükada is one of the most important tourism center of Istanbul. So non-native host plants and aphid species are easily introduced and distributed in all parts of the island (Kantarcı, 1984). Büyükada has impressive natural and exotic plant species so this introduction can be damage to them. Because Turkey has several natural areas such as Büyükada Island, the findings of the presented study strongly encourage researchers to carry out similar studies.

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These results are a part of Hayal AKYILDIRIM BEĞEN's Master Science Thesis and some part of this study published IVth Turkey Plant Protection Congress. This study is a original research article.

Author Contributions

Hayal AKYILDIRIM BEĞEN: Investigation, collected data, performed the analysis and wrote the paper.

Gazi GÖRÜR: Investigation, resource, review and wrote the paper.

Conflicts of Interest

The authors declare no conflict of interest.

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