The new association records on ants (Hymenoptera: Formicidae) and aphids (Hemiptera: Aphididae) in the Central Province of Çanakkale

Çanakkale il merkezinde yaprakbitleri (Hemiptera: Aphididae) ile karınca (Hymenoptera: Formicidae) türlerinin yeni ilişki kayıtları

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INTRODUCTION

Mutualism is generally described as an interaction between two species beneficial to each other (Begon et al. 1999, Boucher et al. 1982, Krohne 1998). The best known example of mutualism should be the interaction between ants and honeydew producing insects such as aphids, scales, mealy bugs and whiteflies belonging to the suborder Sternorrhyncha in the order Hemiptera (Styrsky and Eubanks 2007). In the ant-aphid associations,
both partners may obtain benefits from each other. Ants gain a vital source of nutrition and in turn provide protection for aphids against their natural enemies (Stadler and Dixon 2005, Völkl et al. 2007). Consequently, these interactions have usually adverse effects on species diversity and abundance of natural enemies of pests such as aphids, scales, mealy bugs and whiteflies.

Although aphid and ant fauna of Turkey were represented by about 554, and 363 taxa respectively (Görür et al. 2017, Karaman et al. 2017) studies on the interactions of both organisms are still very limited. There are only three studies on the mutualistic interactions between ants and aphids in different locations and habitats across Turkey. The first study, conducted by Özdemir et al. (2008) on wild plants in Ankara Province, identified 16 ant species associated with 19 aphid species. Besides, Akyıldırım et al. (2014) reported the interactions between 15 ant and 48 aphid species in Artvin, Rize and Trabzon Provinces. Finally, 13 ant species associated with 45 aphid species were identified in Samsun Province, located in the Black Sea Region of Turkey (Akyürek et al. 2016). These studies conducted in different geographical regions of Turkey are of great importance for a better understanding of the interaction between ants and aphids. Therefore, it is very important to conduct local studies to investigate the interaction of ants and aphids and to reveal the rich diversity in Turkey.

There are few studies investigating ant species in different areas in Çanakkale (Aktacı and Karaman 2012, Aras and Aktacı 1992, Aras and Aktacı 1994). These studies were conducted to determine the faunal and taxonomic characteristics of ants and report ant species from different areas in Çanakkale, but there is no record of the associations between aphids and ants. Determination of the partnership between ants and aphids on different host plants is highly significant for biological control studies using the natural enemies against these pests. The ants feeding on honeydew secreted from the anus of aphids has reduced the success rate of biological control agents such as predator coccinellids, syrphids, chrysopids and parasitoids in cultivated areas. Accordingly, the aim of the study is to determine the interactions between ants and aphids on different host plants in Central Province of Çanakkale, Turkey.

MATERIALS AND METHODS

Aphid and ant specimens which has been found on the same host plant were collected in the Central Province of Çanakkale, located in the Southern Marmara region of Turkey between 2014 and 2015. To determine the associations between aphid and ant species, the live aphid and ant specimens were aperiodically collected from herbaceous plants, shrubs and trees in cultivated, uncultivated and urban areas during spring and summer. Both aphid and ant species were separately put in an Eppendorf tube containing 70% alcohol by using a 00 number soft brush and then were brought to the laboratory for identification.

To identify aphid species, both apterous and alate aphids were sufficiently collected. The method by Hille Ris Lambers (1950) was followed for collection and preparation of aphids. The identification of aphids was conducted according to Blackman and Eastop (2006, 2017), Bodenheimer and Swirski (1957), Heie (1986) and Kök et al. (2016). Host plants of aphids were checked according to Holman (2009).

Collected ant species were identified by the second author using CNA (Collection of Nihat AKTAÇ), collection of Biology Department of Trakya University and identification keys for ants of Turkey and its neighbors.

Current taxonomic statutes of aphid species were checked according to Favret (2017) and ant species according to Bolton’s Catalogue (2017). All aphid and ant specimens identified in the study were collected by the first author in the Central Province of Çanakkale, Turkey. The aphid specimens were identified by the first and third authors. The voucher specimens of aphid and ant species are deposited in the Department of Plant Protection, Agricultural Faculty, Çanakkale Onsekiz Mart University and Trakya University, respectively.

The taxonomic status, host aphid species, host plants of aphids and locality coordinates, locality, collected altitude and collection dates of the determined ant and aphid species are given below.

RESULTS

Family Formicidae
Subfamily Dolichoderinae
Tapinoma erraticum (Latreille, 1798)
Material examined: Brachycaudus cardui (Linnaeus, 1758), Cirsium arvense (L.) Scop. (Asteraceae), 40°05’29.6” N 26°23’12.5” E, Çanakkale-Kepez, 19 m, 25.iv.2014; Aphis craccivora Koch, 1854, Robinia pseudoacacia L. (Fabaceae), 40°06’41.0” N 26°25’00.4” E, Çanakkale-Terzioglu Campus, 80 m, 06.vi.2015.
Aphids associated with T. erraticum in Turkey: Unknown aphid species (Özdemir et al. 2008).
Subfamily Formicinae
Camponotus aethiops Latreille, 1798

Material examined: Aphis umbrellae (Börner, 1950), [Malva sp. (Malvaceae)], 40°05′35.7″ N 26°23′25.3″ E, Çanakkale-Kepez, 19 m, 25.iv.2014; Aphis fabae Scopoli, 1763, [Vicia faba L. (Fabaceae)], 40°05′38.7″ N 26°23′25.6″ E, Çanakkale-Kepez, 21 m, 25.IV.2014; Hyalopterus pruni (Geoffroy, 1762), [Typha sp. (Typhaceae)], 40°06′32.0″ N 26°24′45.1″ E, Çanakkale-Terziöğlu Campus, 38 m, 23.V.2014.

Aphids associated with C. aethiops in Turkey: Aphis brotericola Mier Durante, 1978; A. fabae; A. salviae Walker, 1852; Brachycaudus cardui; B. helicrysi (Kaltenbach, 1843); Lachmus robustus (Linnaeus, 1758); Thelaxes suberi (Del Guercio, 1911) (Akyürek et al. 2016, Özdemir et al. 2008).

Camponotus samius Forel, 1889

Material examined: Cinara pini (Linnaeus, 1758), [Pinus sp. (Pinaceae)],[40°06′37.7″ N 26°24′37.1″ E, Çanakkale-Kepez, 36 m, 14.x.2014.]

Aphids associated with C. samius in Turkey: First record of C. samius with an aphid species in Turkey.

Camponotus sanctus Forel, 1904

Material examined: Myzus cerasi (Fabricius, 1775), [Prunus avium L. (Rosaceae)], 40°13′56.1″ N 26°32′25.4″ E, Çanakkale-Yapıldak Village, 8 m, 06.vi.2015.

Aphids associated with C. sanctus in Turkey: First record of C. sanctus with an aphid species in Turkey.

Formica cunicularia Latreille, 1798

Material examined: Aphis fabae, [Cirsium arvense, 40°05′23.2″ N 26°23′05.7″ E, Çanakkale-Kepez, 16 m, 30.v.2014; A. fabae, [Robinia pseudoacacia], 40°06′41.0″ N 26°25′00.4″ E, Çanakkale-Terziöğlu Campus, 80 m, 06.vi.2015.

Aphids associated with F. cunicularia in Turkey: Aphis brotericola; A. craccivora; A. nasturtii Kaltenbach, 1843; A. solanella Theobald, 1814; A. spiraecola Patch, 1914; Macrosiphum rosae (Linnaeus, 1758); Sipha maydis Passerini, 1860 (Akyürek et al. 2016, Özdemir et al. 2008).

Lasius alienus (Foerster, 1850)

Material examined: Aphis gossypii Glover, 1877, [Malva sp. (Malvaceae)], 40°06′38.9″ N 26°24′43.9″ E, Çanakkale-Terziöğlu Campus, 30 m, 23.x.2014; [Abelmoschus esculentus (L.) Moench (Malvaceae)],[40°13′56.1″ N 26°32′25.4″ E, Çanakkale-Yapıldak Village, 58 m, 06.vi.2015; A. punicae Passerini, 1863, [Punica granatum L. (Lythraceae)], 40°09′02.9″ N 26°24′29.6″ E, Çanakkale-City center, 9 m, 01.vi.2014; A. fabae, [Phaseolus vulgaris L. (Fabaceae)], 40°05′57.5″ N 26°22′03.4″ E, Çanakkale-Kepez, 6 m, 05.vi.2015; A. craccivora, [R. pseudoacacia], 40°06′41.0″ N 26°25′00.4″ E, Çanakkale-Terziöğlu Campus, 80 m, 06.vi.2015; Chaitophorus leucomas Koch, 1854, [Populus sp. (Salicaceae)], 40°08′24.1″ N 26°24′04.3″ E, Çanakkale-City center, 7 m, 10.vi.2015; Pterochloroides persicae (Cholodkovsky, 1899), [Prunus sp. (Rosaceae)], 40°09′02.2″ N 26°24′36.7″ E, Çanakkale-City center, 10 m, 17.vi.2015.

Aphids associated with L. alienus in Turkey: Aphis fabae; A. galliscabri Schrank, 1801; A. gossypii; A. molluginis (Börner, 1950); A. nasturtii; A. pomi De Geer, 1773; A. pseudocaradii Theobald, 1915; A. solanella; A. urticata J. F. Gmelin, 1790; A. verbasci Schrank, 1801; Brachycaudus cardui; B. tragopogonis (Kaltenbach, 1843); Caperiophorus hippophaes (Walker, 1852); Chaitophorus kappuri Hille Ris Lambers, 1966; Dysaphis foeniculaceae (Theobald, 1923); Dysaphis pyri (Boyer de Fonscolombe, 1841); Myzus cerasi; Neobetulaphis pusilla Basu, 1964; Sipha maydis; Toxoptera aurantii Boyer de Fonscolombe, 1841 (Akyürek et al. 2014, Akyürek et al. 2016, Özdemir et al. 2008).

Plagiolepis pygmaea (Latreille, 1798)

Material examined: A. gossypii, [Malva sp.], Çanakkale-Terziöğlu Campus, 40°06′38.9″ N 26°24′43.9″ E, 30 m, 23.x.2014; Procipophilus fraxini (Fabricius, 1777), [Fraxinus excelsior L. (Oleaceae)], 40°06′41.6″ N 26°25′01.4″ E, Çanakkale-Terziöğlu Campus, 82 m, 13.v.2015; Chromaphis juglandicola (Kaltenbach, 1843) and Panaphis juglandis (Goeze, 1778), [Juglans regia L. (Juglandaceae)], 40°06′38.1″ N 26°24′23.6″ E, Çanakkale-Kepez, 14 m, 31.v.2015.

Aphids associated with P. pygmaea in Turkey: Aphis fabae; A. gerardiana Mordviko, 1929; A. gossypii; A. spiraecola; Brachycaudus cardui (Akyürek et al. 2016).

Plagiolepis taurica Santisci, 1920

Material examined: A. fabae and Brachycaudus helichrysi (Kaltenbach, 1843), [Cirsium arvense, 40°05′29.6″ N 26°23′12.5″ E, Çanakkale-Kepez, 17 m, 25.iv.2014; A. gossypii, [Abelmoschus esculentus],[40°13′56.1″ N 26°32′25.4″ E, Çanakkale-Yapıldak Village, 58 m, 06.vi.2015.

Aphids associated with P. taurica in Turkey: Staegeriella necopinata Börner, 1939 and one unknown species (Özdemir et al. 2008).
Subfamily Myrmicinae

Crematogaster ionia Forel, 1911

Material examined: Aphis nerii Boyer de Fonscolombe, 1841, [Nerium sp. (Apocynaceae)], 40°09’59.9” N 26°24’39.5” E, Çanakkale-City center, 50 m, 17.vi.2015.

Aphids associated with C. ionia in Turkey: First record of C. ionia with an aphid species in Turkey.

Crematogaster sordidula (Nylander, 1849)

Material examined: Cinara pini, [Pinus sp.], 40°06’37.7” N 26°24’37.1” E, Çanakkale-Kepez, 36 m, 14.v.2014; A. fabae, [Spartium junceum L. (Fabaceae)], 40°06’43.1” N 26°25’16.0” E, Çanakkale-Terziöglu Campus, 130 m, 23.v.2014.

Aphids associated with C. sordidula in Turkey: Unknown aphid species, Brachycaudus cardui (Özdemir et al. 2008).

Table 1. The list of aphid species and their ant partners in the Central Province of Çanakkale from 2014 to 2015

| Aphids (Hemiptera: Aphididae) | Ants (Hymenoptera: Formicidae) |
|-------------------------------|---------------------------------|
| Aphis craccivora              | Lasius alienus                  |
|                               | Tapinoma erraticum              |
|                               | Tetraromorium caespitum         |
| Aphis fabae                   | Camponotus aethiops             |
|                               | Crematogaster sordidula         |
|                               | Formica cunicularia             |
|                               | Lasius alienus                  |
|                               | Plagiolepis taurica             |
| Aphis gossypii                | Lasius alienus                  |
|                               | Plagiolepis pygmaea             |
|                               | Plagiolepis taurica             |
|                               | Tetraromorium caespitum         |
| Aphis nerii                   | Crematogaster ionia             |
| Aphis punicae                 | Lasius alienus                  |
| Aphis umbrellae               | Camponotus aethiops             |
| Brachycaudus cardui           | Tapinoma erraticum              |
| Brachycaudus helichrysi       | Plagiolepis taurica             |
| Chaitophorus leucomelas       | Lasius alienus                  |
| Chromaphis juglandicola       | Plagiolepis pygmaea             |
| Cinara pini                   | Camponotus sanctus              |
|                               | Crematogaster sordidula         |
| Hyalopterus pruni             | Camponotus aethiops             |
|                               | Pheidole cf. pallidula          |
| Myzus cerasi                  | Camponotus sanctus              |
| Panaphis juglandis            | Plagiolepis pygmaea             |
| Prociphilus fraxini           | Plagiolepis pygmaea             |
| Pterochloroides persicae      | Lasius alienus                  |
Brachycaudus cardui; Macrosiphoniella sanborni (Gillette, 1908); Myzus lathyri (Schrank, 1801) (Akyürek et al. 2014, Akyürek et al. 2016).

Also, the list of aphid species and their ant partners in the Central Province of Çanakkale were given Table 1.

DISCUSSION

This study was performed to determine aphid and their ant partners in the Central Province of Çanakkale, located in Southern Marmara region of Turkey. Thus, 12 ant species belonging to 8 genera in 3 subfamilies of Formicidae and 16 aphid species belonging to 10 genera in family of Aphididae were determined for the purpose of the study. Of these ant species, 7 species are member of Formicinae, 4 species of Myrmicinae and one species of Dolichoderinae subfamily. Lasius alienus, Plagioteles pygmaea, Camponotus aethiops and P. taurica were the most encountered ant species associated with aphid species, respectively. L. alienus associated with 6 aphid species, P. pygmaea with 4 aphid species, C. aethiops and P. taurica with 3 aphid species were sampled. The other determined ant species, Tapinoma erraticum, Formica cunicularia, Crematogaster sordidula, Tetramorium caespitum with 2 aphid species and C. sanctus, C. ionia, Pheidole cf. pallidula associated with only one aphid species were sampled. As for aphids, Aphis fabae, A. gossypii and A. craccivora were the most frequently visited by ant species compared to the other aphid species. A. fabae with 5 species, A. gossypii with 4 species and A. craccivora with 3 species were sampled from many different host plants. In the present study, A. nerii, A. punicae, A. umbrellæ, Chaitophorus leucomelas, Chromaphis juglandicola, Panaphis juglandis, Prociphilus fraxini and different ant species associated with them were determined for the first time in Turkey. Moreover, Camponotus samius, C. sanctus, Crematogaster ionia and Pheidole cf. pallidula were identified as new mutualistic partners of aphid species.

So far, 90 aphid and 31 ant species associated with each other were determined from Ankara, Artvin, Rize, Trabzon and Samsun Provinces of Turkey. With the results of our study, the number of aphids related to ant species has increased to 97 aphid and 35 ant species. There are very few studies conducted to investigate ant species in all the districts of Turkey. The first investigation related to aphid-ant associations in Turkey was conducted by Özdemir et al. (2008). They reported 16 ant species associated with 19 aphid species on wild plants in Ankara Province. In their study, C. aethiops, C. piceus, C. sordidula, Formica glauca Ruzsky, and Lasius paralienus Seifert were the most encountered ant species associated with different aphid species in Ankara. Likewise, C. aethiops was one of the most common ant species associated with aphids in this study. Moreover, aphid species belonging to Aphis genus were the most visited species by ant species in both studies. In addition, they emphasized the importance of aphid-ant associations for biological control studies. In the second study, Akyürek et al. (2014) determined 15 ant species associated with 48 aphid species in Artvin, Rize and Trabzon Provinces of Turkey. They reported that F. cinereofusca Karwaiew, 1929, L. tucicus Santschi, 1921, L. emarginatus (Olivier, 1792) were the most encountered ant species associated with aphids and A. fabae, A. gossypii, A. spiraecola, Brachycaudus cardui, Cinara pilicornis (Hartig, 1841), Toxoptera aurantii were the most visited species by ant species in these provinces. In their and the present study, A. fabae and A. gossypii were the most visited aphid species by ants. Besides, these aphid species were visited by L. alienus in both studies carried out in different localities of Turkey. The third study related to aphid-ant interactions in Turkey was conducted by Akyürek et al. (2016) in Samsun Province. As a result of this study, they reported 13 ant species associated with 45 different aphid species. L. alienus, L. brunneus (Latreille, 1798), L. tucicus Santschi, 1921, F. cunicularia and F. rufibarbis Fabricius, 1793 were presented as the most tending ant species. In addition, the most visited aphid species by ants in this study were A. fabae and B. cardui.

The number of interrelated aphid and ant of Iran located in the same biogeographical region as in Turkey are represented by about 80 and 55 species, respectively (Latibari et al. 2017, Mirzamohamadi et al. 2015, Mortazavi et al. 2015, Mossadegh et al. 2016, Shiran et al. 2013). The aphid and ant fauna of Turkey are represented by about 554 and 363 species, respectively (Görür et al. 2017, Karaman et al. 2017). Considering the aphid and ant fauna of Turkey, the number of aphid-ant associations is very limited because of the fact that very few related recent studies were conducted in Turkey. Consequently, the results of the present and other recent studies indicated that associations between aphid and ant species are not known well and should be further investigated locally.

ÖZET

Yapıkkıtlar ve karınçalar doğada mutualistik ya da zorunlu mutualistik bir ilişkiye sahiptir. Birçok karınca türü yumuşak vücutlu ve zayıf bir savunmaya sahip yaprakkıtlarını doğal düşmanlarına karşı korumaktadır. Çanakkale il merkezinde 2014 ve 2015 yılları arasında yapıkkıtlar ve karınçalar arasındaki ilişkileri belirlemek için yürütülen bu çalışmanın sonucunda Formicidae familyasının Dolichoderinae, Formicinae ve Myrmicinae altfamilyaları içerisinde bulunan 8 cinse ait, 12 karınca
türünün 16 farklı yaprakbiti ile ilişkisi tespit edilmiştir. Farklı yaprakbitleri ile ilişkili en fazla karşılaşılan karınca türleri Lasius alienus (Foerster, 1850), Plagiolepis pygmaea (Latreille, 1798), Camponotus aethiops Latreille, 1798 ve Plagiolepis taurica Santsci, 1920'dir. Farklı karınca türleri ile ilişkili en fazla karşılaşılan yaprakbitleri ise Aphis fabae Scopoli, 1763, Aphis gossypii Glover, 1877 ve Aphis craccivora Koch, 1854'dir. Ayrıca Camponotus samius Forel, 1889, Camponotus sanctus Forel, 1904, Crematogaster ionia Forel, 1911 ve Pheidole cf. pallidula (Nylander, 1849) karınca türlerinin yaprakbitleri ile ilişkili olduğu Türkiye'de ilk kez bu çalışma ile belirlenmiştir. Bunlara ilave olarak belirlenen yaprakbitlerden Aphis nerii Boyer de Fonscolombe, 1841, Aphis punicae Passerini, 1863, Aphis umbrella (Börner, 1950), Chaitophorus leucomelas Koch, 1854, Chromaphis juglandicola (Kaltenbach, 1843), Panaphis juglandis (Goeze, 1778), Prociphilus fraxini (Fabricius, 1777)'nin ise karıncalar ile işbirliği içinde olduğu Türkiye'de ilk kez tespit edilmiştir. Sonuç olarak son çalışmalar yaprakbitleri ve karıncalar arasındaki ilişkilerin bölgesel olarak daha detaylı araştırılması gerektiğini göstermektedir.

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