

## **Ants (Hymenoptera: Formicidae) and their aphid partners (Homoptera: Aphididae) in Mashhad region, Razavi Khorasan Province, with new records of aphids and ant species for Fauna of Iran**

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### **Abstract**

A survey of ant-aphid associations was conducted by collecting and identifying samples of ants and aphids found together on aphid host plants in Mashhad region, Razavi Khorasan province of Iran. As a result, a total of 21 ant species representing 13 genera and 3 subfamilies and 26 aphid species belonging to 13 genera from 37 host plant species were collected and identified. Among the recorded ant species, the genus *Crematogaster* with four species had the highest species richness. The three most frequent aphid attendant ants were *Lepisiota nigra* (Dalla Torre, 1893), *Tapinoma erraticum* (Latreille, 1798) and *Crematogaster inermis* Mayr, 1862 associated with 11, 10 and 9 aphid species, respectively. Eleven ant species were recorded from the colonies of one aphid species. Among the recorded ants, the species *Crematogaster sordidula* (Nylander, 1849) is new to Iranian ant fauna. This record increases the recorded ant-fauna of Iran to over 171 species. Among the identified aphid species, *Aphis craccivora* Koch, 1856 had the highest ant attraction. Also, *Aphis salicariae* Koch, 1855; *Chaitophorus hillerislambersi* Pintera 1987; *Chaitophorus israeliticus* Eastop and Hille Ris Lambers, 1976; *Cinara maghrebica* Mimeur, 1934 and *Schizaphis nigerrima* (Hille Ris Lambers, 1931) are first records for aphid fauna of Iran. The aphids, their attendant ants, and host plants collected in this study are given. Findings of this preliminary study indicated that much more detailed study should be conducted to investigate aphid-ant mutualistic associations in Iran.

**Key words:** *Mutualistic insects, Myrmecophilous aphids, new record, Iran.*

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### **Introduction**

Family Formicidae with approximately 15,000 species worldwide is considered one of the most successful taxa after their arising in the Mid-Cretaceous about 120 million years ago (Ward, 2007). They thrive in most ecosystems, and may form 15-25% of the terrestrial animal biomass (Schultz, 2000). Their social organization and behaviors, ability to change different habitats and exploit the useful resources have made them successful and survive in diverse environments. Most species are omnivorous and combine predation with feeding on sugary fluids from plants, aphids and other hemipterans. Among the phloem-sucking insects, aphids with over 4,500 species world-

wide (Remaudie`re and Remaudie`re, 1997) have many species that are strongly host-specific (Dixon, 1987) and many are tended by ants. The relationship between aphids and ants is generally thought to be mutualistic, as both partners seem to benefit from their association. By attending aphid colonies, ants gain a rich source of carbohydrates from honeydew which is thought to result in higher colony growth rates (e.g. Cushman and Beattie, 1991). In turn, ants often act as guards and decrease the impact of predators and parasitoids on the fitness of their hosts (El-Ziady and Kennedy, 1956). Also, ant-tended aphids live longer, mature earlier, have higher rate of reproduction in comparison with

those not tended by ants (Flatt and Weisser, 2000). However, interactions between ants and aphids range from mutualistic to antagonistic (Stadler and Dixon, 2005, 2008; Billick *et al.*, 2007).

The mutualistic relationship between ants and aphids has been the subject of many studies on various aspects of this phenomenon. Unfortunately, this subject in Iran has been ignored so far, and more importantly, the fauna of Iran has not been adequately studied systematically.

Paknia *et al.* (2008) reviewed the literature and provided the first checklist of Iranian ant fauna. Since that, several faunistic studies have been performed in some parts of Iran (e.g. Mossadegh *et al.*, 2008; Ghahari *et al.*, 2009; Rafinejad *et al.*, 2009; Paknia *et al.*, 2010; Radchenko and Paknia, 2010; Firouzi *et al.*, 2011; Mohammadi *et al.*, 2012; Gholami *et al.*, 2012; Hossein Nezhad *et al.*, 2012; Shiran *et al.*, 2013). As a result, the number of ant species reported from Iran has reached over 218 species. As many parts of the country have not been explored, more new records is expected to be discovered by further works. Except a recent study by Shiran *et al.* (2013), there is no report on aphids and their mutualistic ants in Iran. To fulfill this gap and provide a base for further studies on interactions between aphids and ants, the present study was conducted in some parts of Razavi Khorasan province, NE Iran.

## **Materials and Methods**

During the growing season of the year 2013, a variety of cultivated and wild plants inside and around the agricultural ecosystems in Mashhad region, Razavi Khorasan province of Iran were visited and sampled for aphids and their attendant ants. Because host identity is important in identifying aphids, sampling was mostly done by visual inspection of plants, and the aphids and their attendant ants were removed using soft brush and forceps. Geoposition coordinates were recorded with a hand-held GPS unit. Collected materials were preserved in ethanol (75%) in small glass vials and transferred to the laboratory for processing and identification. Aphids were identified by Łukasz Depa. The resources applied for identification were the host-based keys by Blackman and

Eastop (1994, 2006) and also keys by Heie (1986) and Nieto Nafria *et al.* (2002, 2005).

Ants were identified by Nihat Aktac using mainly Agosti and Collingwood (1987); Collingwood and Agosti (1996); Czechowski *et al.* (2002); Dlussky (1967, 1969); Aktac and Radchenko (2002); Karaman and Aktac (2013); Seifert (1988, 1992) and materials compared with N.A. Collection.

Aphid names were updated with reference to Aphid Species File (Favret, 2009), ant names were checked with Bolton's Catalogue (2015), and host names were checked with the USDA Plants database (USDA, NRCS, 2009).

Voucher specimens of ants and aphids were deposited in Insect and Mite Collection of Plant Protection Department, Ferdowsi University of Mashhad, Iran. Also, some specimens of ants are held at the department of Zoology, Faculty of Science, Trakya University, Edirne, Turkey and of aphid specimens are deposited in the collection of the Department of Zoology, University of Silesia in Katowice, Poland.

## **Results and Discussion**

21 ant species were found to be attending 26 aphid species on 37 host plants. Among the determined ants and aphid species, the ant species *Crematogaster sordidula* and also, five aphids namely, *Aphis salicariae* Koch, 1855; *Chaitophorus hillerislambersi* Pintera, 1987; *Chaitophorus israeliticus* Eastop and Hille Ris Lambers, 1976; *Cinara maghrebica* Mimeur, 1934 and *Schizaphis nigerrima* (Hille Ris Lambers, 1931) are reported for the first time from Iran. Below is the list of ants attending aphid colonies on their various host plants found in the study area.

### **I. Subfamily Dolichoderinae**

#### ***Tapinoma erraticum* (Latreille, 1798)**

**Material examined:** Molkabad (36° 0'2.09"N, 59°35'35.59"E), 17♀♀ associated with *Aphis pomi* De Geer, 1773 on *Malus* sp. (Rosaceae), 15-4-2013; 6♀♀, 12-4-2013; 7♀♀ associated with *Aphis fabae* Scopoli, 1763 on *Elaeagnus angustifolia* L. (Elaeagnaceae), 12-4-2013; Mashhad-Toos (36°25'20.14"N, 59°28'57.74"E),

5♀♀ associated with *Aphis fabae* Scopoli, 1763 on *Elaeagnus angustifolia* L. (Elaeagnaceae), 25-4-2013; 11♀♀ associated with *Aphis craccivora* Koch, 1856 on *Alhaji pseudo-alhaji*, 25-4-2013; 5♀♀ associated with *Aphis craccivora* Koch, 1856 on *Kochia* sp. (Amaranthaceae), 25-4-2013; 7♀♀ associated with *Aphis craccivora* Koch, 1856 on *Robinia pseudoacacia* L. (Fabaceae), 25-4-2013; Mashhad-Toroq (36°13'6.29"N, 59°40'24.02"E), 5♀♀, associated with *Aphis craccivora* Koch, 1856 on *Robinia pseudoacacia* L. (Fabaceae), 16-5-2013; Molkabad (35°59'51.76"N, 59°35'23.06"E), 6♀♀ associated with *Brachycaudus amygdalinus* Schout., 1905 on *Prunus persica* (L.) Stokes (Rosaceae), 27-4-2013; Mashhad-Toos (36°25'20"N, 59°28'57"E), 9♀♀ associated with *Pterochloroides persicae* Cholodkovsky, 1899 on *Prunus persica* (L.) Stokes (Rosaceae), 23-6-2013; Aman abad (35°59'51.76"N, 59°35'23.06"E), 3♀♀ associated with *Aphis* sp. on *Lepidium draba* L. (= *Cardaria draba*) (Brassicaceae), 16-4-2013; Aman abad, 4♀♀ associated with *Aphis* sp. on *Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* Batsch) (Rosaceae), 16-4-2013; Mashhad-Grab (36°23'56.16"N, 59°39'11.31"E), 6♀♀ associated with *Aphis* sp. on *Carthamus lanatus* L. (Asteraceae), 23-5-2013; Molkabad (35°59'51.76"N, 59°35'23.06"E), 7♀♀ associated with *Aphis craccivora* Koch, 1856 on *Robinia pseudoacacia* L. (Fabaceae), 10-5-2013; Toroq (36°13'6.29"N, 59°40'24.02"E), 6♀♀ associated with *Eulachnus tuberculostemmatus* Theobald, 1915 and *Cinara maghrebica* Mimeur 1934 on *Pinus eldarica* Medw (Pinaceae), 16-5-2013; Mashhad-Ferdowsi University (36°18'19.03"N, 59°31'44.71"E), 12♀♀ associated with *Brachycaudus tragopogonis* Kaltenbach, 1843 on *Tragopogon* sp. (Asteraceae), 28-5-2013; Mashhad-Toos (36°25'20"N, 59°28'57"E), 7♀♀ associated with *Chaitophorus israeliticus* Hille Ris Lambers, 1960 on *Salix babylonica* L. (Salicaceae), 23-6-2013.

**Distribution in Iran:** Northern and southern parts of Iran (Paknia *et al.*, 2008).

## II. Subfamily Formicinae

### *Camponotus turkestanicus* Emery, 1887

**Material examined:** Mashhad-Shahid Shaabani Blv. (36°26'27.58"N, 59°30'13.29"E), 13♀♀ associated with *Aphis salicariae* Koch, 1855 on *Carduus pycnocephalus* L. (Asteraceae), 25-5-2013. The range of this aphid species and its host plants need further investigation.

**Distribution in Iran:** Northeast of Iran (Paknia *et al.*, 2008).

### *Cataglyphis aenescens* (Nylander, 1849)

**Material examined:** Mashhad-Toos (36°25'20.14"N, 59°28'57.74"E), 9♀♀ associated with *Pterochloroides persicae* Cholodkovsky, 1899 on *Prunus persica* (L.) Stokes (Rosaceae), 23-6-2013; Mashhad-Toos, 4♀♀ associated with *Macrosiphum euphorbiae* Thomas, 1878 on *Sonchus arvensis* L. (Asteraceae), 23-6-2013.

**Distribution in Iran:** Northern and northeast of Iran (Paknia *et al.*, 2008).

### *Cataglyphis nodus* (Brulle, 1833)

**Material examined:** Bozveshk (36° 4'23.37"N, 59°28'32.27"E), 3♀♀ associated with *Aphis gossypii* Glover, 1877 on *Prunus dulcis* (Mill.) D.A.Webb (= *Prunus amygdalus* Batsch) (Rosaceae), 16-5-2013; same locality, 3♀♀ associated with *Aphis gossypii* Glover, 1877 on *Prunus cerasus* L. (Rosaceae), 16-5-2013.

**Distribution in Iran:** Northern and southern parts of Iran (Paknia *et al.*, 2008; Shiran *et al.*, 2013).

### *Formica cunicularia* Latreille, 1798

**Material examined:** Mashhad-Ferdowsi University campus (36°18'26.73"N, 59°31'38.65"E), 5♀♀ associated with *Aphis acetosae* L., 1761 on *Rumex* sp., 6-4-2013; same locality, 5♀♀ associated with *Acyrtosiphon rubi* Narzikulov, 1957 on *Sonchus* sp. (Asteraceae), 6-4-2013; Mashhad-kohsangi (36°16'57.35"N, 59°33'46.54"E), 6♀♀ associated with *Acyrtosiphon pisum* Harris, 1776, *Brachycaudus tragopogonis* Kaltenbach, 1843 and *Cinara* sp. Curtis, 1835 on *Calendula officinalis* L. (Asteraceae), 19-5-2013; same locality, 9♀♀ associated with *Aphis craccivora* Koch, 1856 on *Ligustrum vulgare* L. (Oleaceae), 19-5-2013.

## Ants and their aphid partners in Mashhad region, with new records of ant and aphids

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

### *Lasius alienus* (Foerster, 1850)

**Material examined:** Mashhad-kohsangi (36°16'57.70"N, 59°33'49.79"E), 3♀♀ associated with *Periphyllus bulgaricus* Tashev, 1964 on *Acer* sp. (Aceraceae), 19-5-2013.

**Distribution in Iran:** North-west of Iran (Paknia *et al.*, 2008).

### *Lasius turcicus* Santschi, 1921

**Material examined:** Mashhad-Ferdowsi University campus (36°18'19.03"N, 59°31'44.71"E), 6♀♀ associated with *Acyrtosiphon gossypii* Mordvilko, 1914 on *Lepidium draba* L. (= *Cardaria draba*) (Brassicaceae), 6-4-2013; same locality, 8♀♀ associated with *Chaitophorus hillerislambersi* Pintera, 1987 on *Populus alba* L. (Salicaceae), 7-5-2013; Bozveshk (36°4'20.89"N, 59°26'35.38"E), 8♀♀ associated with *Brachycaudus amygdalinus* Schout., 1905 on *Prunus armeniaca* L. (Rosaceae), 16-5-2013; Mashhad-kohsangi (36°17'0.34"N, 59°33'43.85"E), 10♀♀ associated with *Aphis craccivora* Koch, 1856 on *Kochia* sp. L. (Amaranthaceae), 19-5-2013; Mashhad-Ferdowsi University campus (36°18'19.03"N, 59°31'44.71"E), 9♀♀ associated with *Aphis craccivora* Koch, 1856 on *Hibiscus syriacus* L. (Malvaceae), 2-7-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

### *Lepisiota dolabellae* (Forel, 1911)

**Material examined:** Mashhad-kohsangi (36°16'57.35"N, 59°33'46.54"E), 6♀♀ associated with *Acyrtosiphon pisum* Harris, 1776, *Brachycaudus tragopogonis* Kaltenbach, 1843 and *Cinara* sp. on *Calendula officinalis* L. (Asteraceae), 19-5-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008); Brazjan in South of Iran (Ghahari *et al.*, 2011).

### *Lepisiota frauenfeldi* (Mayr, 1855)

**Material examined:** Beheshte-reza (36°9'58.60"N, 59°42'11.21"E), 5♀♀ associated with

*Pterochloroides persicae* Cholodkovsky, 1899 on *Ulmus* sp. L. (Ulmaceae), 1-5-2013.

**Distribution in Iran:** Zanjan (<http://www.antweb.org/iran.jsp>).

### *Lepisiota nigra* (Dalla Torre, 1893)

**Material examined:** Molk abad (36°0'2.09"N, 59°35'35.59"E), 7♀♀ associated with *Aphis fabae* Scopoli, 1763 on *Elaeagnus angustif* L. (Elaeagnaceae), 15-4-2013; Arefi (36°7'22.20"N, 59°31'1.12"E), 7♀♀ associated with *Brachycaudus helichrysi* Kalt., 1843 and *Hyalopterus amygdali* Blanchard, 1840 on *Prunus dulcis* (Mill.) D.A. Webb (= *Prunus amygdalus* Batsch) (Rosaceae), 15-4-2013; Bozveshk (36°4'43.81"N, 59°25'50.65"E), 5♀♀ associated with *Aphis gossypii* Glover, 1877 on *Prunus dulcis* (Mill.) D.A. Webb (= *Prunus amygdalus* Batsch) (Rosaceae), 16-5-2013; Beheshte-reza (36°9'58.60"N, 59°42'11.21"E), 6♀♀ associated with *Brachycaudus tragopogonis* Kaltenbach, 1843 on *Tragopogon* sp. (Asteraceae), 17-4-2013; Mashhad-kohsangi (36°16'59.11"N, 59°33'48.46"E), 8♀♀ associated with *Chaitophorus israeliticus* Hille Ris Lambers, 1960 on *Salix babylonica* L. (Salicaceae), 19-5-2013; Beheshte-reza (36°9'58.60"N, 59°42'11.21"E), 4♀♀ associated with *Pterochloroides persicae* Cholodkovsky, 1899 on *Ulmus* sp. (Ulmaceae), 1-5-2013; Mashhad-Ferdowsi University campus (36°18'19.03"N, 59°31'44.71"E), 11♀♀ associated with *Aphis* sp. on *Tamarix* sp. (Tamaricaceae), 27-5-2013; same locality, 3♀♀ associated with *Macrosiphon rosae* L., 1758 on *Rosa* sp. (Rosaceae), 27-5-2013; Mashhad-Tollab (36°18'9.63"N, 59°39'24.59"E), 10♀♀ associated with *Periphyllus bulgaricus* Tashev, 1964 on *Acer* sp. (Aceraceae), 28-5-2013; Mashhad-Shahid Shafei (36°22'9.78"N, 59°33'12.43"E), 14♀♀ associated with *Schizaphis nigerrima* Hille Ris Lambers, 1931 on *Sorghum vulgare* Pers. (Poaceae), 23-6-2013.

**Distribution in Iran:** Fars province (Mohammadi *et al.*, 2012).

### *Plagiolepis pallescens* Forel, 1889

**Material examined:** Mashhad-Kohsangi (36°16'57.35"N, 59°33'46.54"E), 3♀♀ associated with *Acyrtosiphon pisum* Harris, 1776,

*Brachycaudus tragopogonis* Kaltenbach, 1843 and *Cinara* sp. on *Calendula officinalis* L. (Asteraceae), 19-5-2013; Mashhad-Toos (36° 4'20.89"N, 59°26'35.38"E), 3♀♀ associated with *Callaphis juglandis* Goeze, 1778 on *Juglans* sp. (Juglandaceae), 23-6-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008); Dezful (Shiran *et al.*, 2013).

#### ***Plagiolepis pygmaea* (Latreille, 1798)**

**Material examined:** Mashhad-Tollab (36°18'10.13"N, 59°39'15.53"E), 5♀♀ associated with *Aphis craccivora* Koch, 1856 on *Fraxinus* sp. (Oleaceae), 1-5-2013; Bozveshk (36° 4'16.47"N, 59°27'13.21"E), 15♀♀ associated with *Aphis craccivora* Koch, 1856 on *Glycirizia glabra* L. (Fabaceae), 16-5-2013.

**Distribution in Iran:** Ahvaz (Ghahari *et al.*, 2009).

#### ***Proformica piloscapa* Dlussky, 1969**

**Material examined:** Bozveshk (36° 4'22.70"N, 59°28'24.67"E) (10♀♀), associated with *Brachycaudus amygdalinus* Schout., 1905 on *Pistacia terebinthus* L. (Anacardiaceae), 16-5-2013.

**Distribution in Iran:** Kaleibar (East Azarbaijan Province) (Ghahari *et al.*, 2011).

### **III. Subfamily Myrmicinae**

#### ***Aphaenogaster kurdica* Ruzsky, 1905**

**Material examined:** Beheshte-reza (36°10'1.24"N, 59°42'12.07"E), 8♀♀, associated with *Brachycaudus helichrysi* Kalt., 1843 on *Malcolmia africana* (L.) R. Br. (Brassicaceae), 24-4-2013.

**Distribution in Iran:** Northern part of Iran, Golestan province (Paknia *et al.*, 2008)

#### ***Crematogaster inermis* Mayr, 1862**

**Material examined:** Mashhad-Tollab (36°18'24.35"N, 59°39'1.79"E), 6♀♀ associated with *Acyrtosiphon gossypii* Mordvilko, 1914 on *Hibiscus syriacus* L. (Malvaceae), 1-5-2013; Mashhad-Tollab, 6♀♀ associated with *Aphis craccivora* Koch, 1856 on *Robinia*

*pseudoacacia* L. (Fabaceae), 1-5-2013; Mashhad-Tollab, 6♀♀ associated with *Aphis craccivora* Koch, 1856 on *Cydonia oblonga* Mill. (Rosaceae), 28-5-2013; Mashhad-Ferdowsi University campus (36°18'19.03"N, 59°31'44.71"E), 3♀♀ associated with *Aphis craccivora* Koch, 1856 on *Hibiscus syriacus* L. (Malvaceae), 2-7-2013; Bozveshk (36° 4'23.37"N, 59°28'32.27"E), 6♀♀ associated with *Callaphis juglandis* Goeze, 1778 on *Juglans* sp. L. (Juglandaceae), 16-5-2013; Bozveshk, 6♀♀, associated with *Aphis gossypii* Glover, 1877 on *Prunus cerasifera* Ehrh. (Rosaceae), 16-5-2013; Mashhad-kohsangi (36°16'59.11"N, 59°33'48.46"E), 3♀♀, associated with *Chaitophorus israeliticus* Hille Ris Lambers, 1960 on *Salix babylonica* L. (Salicaceae), 19-5-2013; Mashhad-kohsangi, 6♀♀, associated with *Acyrtosiphon pisum* Harris, 1776, *Brachycaudus tragopogonis* Kaltenbach, 1843 and *Cinara* sp. on *Calendula officinalis* L. (Asteraceae), 19-5-2013; Mashhad-Kalat road (36°34'31.22"N, 59°48'16.03"E), 2♀♀, associated with *Aphis pseudocardui* Theobald, 1915, on *Carthamus oxycantha* M. Bieb. (Asteraceae), 4-7-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

#### ***Crematogaster schmidtii* (Mayr, 1853)**

**Material examined:** Mashhad-kohsangi (36°16'59.11"N, 59°33'48.46"E), 3♀♀ associated with *Chaitophorus israeliticus* Hille Ris Lambers, 1960 on *Salix babylonica* L. (Salicaceae), 19-5-2013; Mashhad-Ferdowsi University campus (36°18'19.03"N, 59°31'44.71"E), 3♀♀, associated with *Aphis craccivora* Koch, 1856 on *Hibiscus syriacus* L. (Malvaceae), 2-7-2013; Mashhad-Kalat road (36°34'31.22"N, 59°48'16.03"E), 2♀♀ associated with *Aphis pseudocardui* Theobald, 1915 on *Carthamus oxycantha* M. Bieb. (Asteraceae), 4-7-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

#### ***Crematogaster sordidula* (Nylander, 1849)**

**Diagnostic characters:** Head smooth and shiny with long setae, distance between the setae less

## Ants and their aphid partners in Mashhad region, with new records of ant and aphids

than their length;  $CI \leq 95$ ; clypeus shiny, medially smooth; mandibles smooth and shiny with appressed pubescence, masticatory border with five teeth, first tooth biggest and sharply pointed than the rests; antennae with abundant, long sub erected setae; alitrunk shiny dorsally, sides irregular sculptured with more than 6 long setae; propodeal spines long, about two times longer than their width at the base, divergent in dorsal view; petiole with 4, postpetiole with more than 6 sub erect long setae; legs with scattered sub erect setae; dorsal surface of gaster with densely long setae, distance between their bases equal to their length.

**Material examined:** Mashhad-Mahammadabad (36°29'17.04"N, 59°27'40.50"E), 18♀♀ associated with *Brachycaudus cardui* Linnaeus, 1758 on *Cirsium arvense* (L.) Scopoli (Asteraceae), 27-5-2013.

**Distribution in Iran:** The first record from Iran.

### *Crematogaster subdentata* Mayr, 1877

**Material examined:** Mashhad-Shahid Abaspour (36°16'15.38"N, 59°39'28.49"E), 16♀♀ associated with *Aphis craccivora* Koch, 1856 on *Vitis* sp. L. (Vitaceae), 19-4-2013; Mashhad-Grab (36°23'56.16"N, 59°39'11.31"E), 14♀♀, associated with *Aphis craccivora* Koch, 1856 on *Carduus pycnocephalus* L. (Asteraceae), 23-5-2013; Mashhad-Tollab (36°18'11.83"N, 59°39'16.88"E), 12♀♀ associated with *Aphis craccivora* Koch, 1856, *Morus alba* L. (Moraceae), 1-5-2013; Bozveshk (36°4'16.47"N, 59°27'13.21"E), 5♀♀ associated with *Aphis craccivora* Koch, 1856 on *Glycirizia glabra* L. (Fabaceae), 16-5-2013; Mashhad-Kohsangi (36°16'57.70"N, 59°33'49.79"E), 7♀♀ associated with *Periphyllus bulgaricus* Tashev, 1964 on *Acer* sp. L. (Aceraceae), 19-5-2013; Mashhad-Tollab (36°18'11.83"N, 59°39'16.88"E), 9♀♀ associated with *Tuberculatus maximus* Hille Ris Lambers, 1974, *Ulmus* sp. L. (Ulmaceae), 2-6-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

### *Messor orientalis* (Emery, 1898)

**Material examined:** Mashhad-kohsangi (36°16'59.11"N, 59°33'48.46"E), 3♀♀ associated with *Chaitophorus israeliticus* Hille Ris Lambers, 1960 on *Salix babylonica* L. (Salicaceae), 19-5-2013.

**Distribution in Iran:** Zanjan (Hosseini-Nezhad *et al.*, 2012).

### *Monomorium nitidiventre* Emery, 1893

**Material examined:** Beheshte-reza (36°10'0.89"N, 59°42'12.82"E), 3♀♀ associated with *Aphis craccivora* Koch, 1856 on *Chenopodium album* L. (Chenopodiaceae), 24-4-2013.

**Distribution in Iran:** Southern parts of Iran (Paknia *et al.*, 2008).

### *Tetramorium chefteki* Forel, 1911

**Material examined:** Mashhad-Tollab (36°18'10.13"N, 59°39'15.53"E), 3♀♀ associated with *Aphis craccivora* Koch, 1856 on *Fraxinus* sp. (Oleaceae), 1-5-2013.

**Distribution in Iran:** Northern parts of Iran (Paknia *et al.*, 2008).

From a biogeographical point of view, it is expected that the Iranian fauna would be much more diverse than those of its neighbors largely due to its geographic positioning between three distinct biogeographic realms, the Palaearctic, Afrotropical and the Oriental. However, still the number of insects especially ants recorded from Iran is much less than those of its neighbors (Shiran *et al.*, 2013). Most probably due to the fact that the Iranian fauna has been poorly investigated and many areas have been sampled only sporadically. This preliminary research on aphid-ant association and their host plants in NE Iran have added five new records of aphid species and one new record of ant species to Iranian fauna. Previously about 480 aphid species were known from Iran (Alikhani *et al.*, 2010). By the present study, the Iranian aphid fauna has at least 485 species. The occurrence of the new records of some aphids in Iran show a range extension and provides an important baseline for studying changes in the distribution of these important species which might be a result of climatic change.

Aphid species reported here exhibited a range of ant tending. Three species of ants, namely *Lepisiota nigra*, *Tapinoma erraticum* and *Crematogaster inermis* were found tending more than 9 species of aphids. It seems that these three ant species most possibly have an important role in dispersion of aphids from one plant to other ones in the region. Among the determined ant-aphid associations, *Aphis craccivora* had the greatest variety of ant tending it. We have no a clear answer to give why *A. craccivora* has the highest ant attraction as the studies of the various researchers indicated how highly dynamic the mutualistic relations between aphid and ant species. Several different factors might influence this relation such as density of ants as well as aphids, host plants species and its features, climatic conditions and seasonal differences (Depa and Wojciechowski, 2009). Of the four ant species found at colonies of *Chaitophorous israeliticus* two of them, *Messor orientalis* and *Crematogaster schmidtii*, were exclusive to it, not found tending any other aphids.

The interaction between ants and hemipterans has been the subject of many studies on various aspects of this phenomenon (Stadler and Dixon 2005, 2008). Unfortunately, this topic in Iran has been limited to a few studies. In the only study of the mutualistic association between ants and aphids on different host plants in Iran, Shiran *et al.* (2013) reported 20 different species of ants associated with 33 aphid species. Dezhakam and Soleyman-Nejadian (2002) stated that the symbiotic ant *Crematogaster antaris* Forel, interfere with the performance of two encyrtid parasitoids *Anagyrus agransis* (Saraswat) and *A.dactylopii* (Howard) on *N. viridis*. Also, Mossadegh *et al.* (2008) reported that the ants in the colony of *Nipaecoccus viridis* (Newstead) in Dezful citrus orchards have a negative influence on biological control of this pest, by preventing feeding and subsequently reproduction of the released Crypt beetles, *Cryptolaemus montrouzieri* Mulsant.

The present study surveyed the ant-aphid association on aerial parts of the host plants. So, the underground living aphid-ant interactions remain unexplored. Depa and Wojciechowski (2009) investigated root aphid-

ant interaction and discussed morphological, behavioral and ecological interactions. This interesting subject needs further studies and discussion in the frame of mutualistic relations. It is expected that these preliminary results stimulate further studies in this context and provide a base for further studies on different interactions between aphids and their attendant ants which has been ignored so far in Iran.

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## Ants and their aphid partners in Mashhad region, with new records of ant and aphids

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