

Symbiotic ants (Hymenoptera: Formicidae) associated with aphids (Hemiptera: Aphididae) in Golestan province, Iran

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Mutualistic interaction between aphids and ants is one of the classical examples of mutualism. The current study was carried out during 2013-2014 in Golestan province, North-eastern Iran, to investigate the myrmecophilous aphids and their relationships with ants. In this study, 11 ant species representing seven genera and two subfamilies associated with 12 aphid species belonging to two subfamilies were collected on different host plants. Among aphid species, *Aphis gossypii* Glover 1877 and *A. craccivora* Koch 1854 were observed frequently associated with ants, while among ant species, *Crematogaster subdentata* Mayr 1877 and *Plagiolepis taurica* Santschi 1920 had more frequent interactions with aphids. Moreover, except *Formica persica* Seifert & Schultz, 2009, all ant species were reported for the first time from Golestan province. More detailed studies are needed to investigate ant–aphid mutualistic relationships in Iran to understand their complicated relationships in nature.

Key words: Aphid, Ant, Mutualism, Golestan, Iran

INTRODUCTION

Mutualistic interaction between aphids and ants is one of the classical examples of mutualism (Buckley, 1987; Holldobler, 1990; Keller & Gordon, 2010). There are numerous studies which focus on ant–aphid interactions, many of which indicate that ants are beneficial to aphids (Stadler & Dixon, 1999; Flatt & Weisser, 2000). Aphids provide honeydew (which is rich in carbohydrates) to ants and in return, gain protection against natural enemies (e.g. Sudd, 1987; Dixon, 1998; Renault et al., 2005; Stadler & Dixon, 2008). Several lines of evidence show that ant attendance improves aphid reproductive performance and promotes developmental rates, and colony growth (Flatt & Weisser, 2000; Fischer et al., 2001; Stadler & Dixon, 2008; Mehrparvar et al., 2013).

Although aphids and ants are two important groups of insects but there are very few reports on the ant fauna associated with aphids in Iran (e.g. Shiran et al., 2013; Mortazavi et al., 2015). In spite of the fact that Iran is a large country which placed among three distinct realms i.e. the Palearctic, Afrotropical and the Oriental and has rich and diverse fauna and flora, but so far ant fauna has been poorly investigated. According to the recent studies on ant fauna of Iran (Ardeh, 1994; Paknia & Kami, 2007; Paknia et al., 2008; Firouzi et al., 2011; Hossein Nezhad et al., 2012; Shiran et al., 2013; Mortazavi et al., 2015; Hosseini et al., 2015), the number of ant species reported from Iran has reached over 219 species. Since the majority parts of Iran have not been explored, more new associations are expected to be discovered by further surveys in various parts of this country. The

aim of this study was to investigate the ant-aphid associations in Golestan province, North-East of Iran to contribute to the knowledge of myrmecophilous aphids and their mutualistic ant partners.

MATERIAL AND METHODS

This study was carried out from March 2013 to July 2014, weekly in Golestan province, Iran (Fig. 1). Aphids and their associated ants were collected on different host plants using hand or fine paintbrush, and preserved in 75% ethanol. Ant associations with aphids were approved in three ways by monitoring: a) ant antennation for stimulating aphids to secrete honeydew droplets, b) honeydew collection by ants and c) ants trail for honeydew collecting followed and measured from nest to aphids' colony for some colonies. After ants were transferred to the laboratory, samples were identified to the genus level using identification keys provided by Bolton and Ficken (1994) and Collingwood (1978). For confirmation, the samples were sent to Sandor Csoz (Hungarian Natural History Museum), Kadri Kiran (Trakya University, Turkey) and Mostafa Sharaf (King Saud University, Saudi Arabia). Microscopic slides of aphids were prepared from healthy samples using boiling with Canadabalsam method and then were identified to species level by the last author. Host plant species were identified by plant research Institute of Ferdowsi University of Mashhad.

Ant specimens are deposited in the insect collection of Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran. Aphid samples are deposited in Aphid Collection of Aphidology Research Group, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran.

RESULTS

In this study, a total of 11 ant species belonging to two subfamilies (Formicinae and Myrmicinae) were collected associated with 12 aphid species belonging to two subfamilies (Aphidinae and Lachninae), from 19 host plants.

Family Formicidae

Subfamily Formicinae

Formica clara Forel 1889

Material examined: Golestan province, Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis fabae* Scop on *vicia faba* L. (Fabaceae) (4♀), 03.IV.2013, leg. S. M.; Khatir abad, 55 m.a.s.l., associated with *Pterochlorus persicae* Kholodk on *Prunus domestica* L. (Rosaceae) (2♀), 08.VIII.2013 leg. S. M.

Distribution in world: Submeridional and meridional zones of Palaearctic, Northern parts of European range (Seifert, 1997; Seifert, 2007).

Distribution in Iran: Mazandaran (Gholami et al., 2012).

Remark: Body is medium-sized, whole body is dark brown. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province.

Formica persica Seifert & Schultz, 2009

Material examined: Golestan province, Ali abad, 119 m.a.s.l., associated with *Aphis ruborum* Börner on *Rubus fruticosus* L. (Rosaceae) (9♀), 15.XI.2013 leg. S. M.; Gorgan, 134 m.a.s.l., associated with *Aphis spiraeicola* Patch on *Citrus sinensis* L. (Rutaceae) (8♀), 26.VII.2014, leg. S. M.

Distribution in world: This species has hitherto only been known from the North Iranian region of the Alburz Mountains (Seifert & Schultz, 2009).

Distribution in Iran: Mazandaran (Seifert & Schultz 2009, Gholami et al., 2012), Golestan (<http://www.antweb.org/ir>).

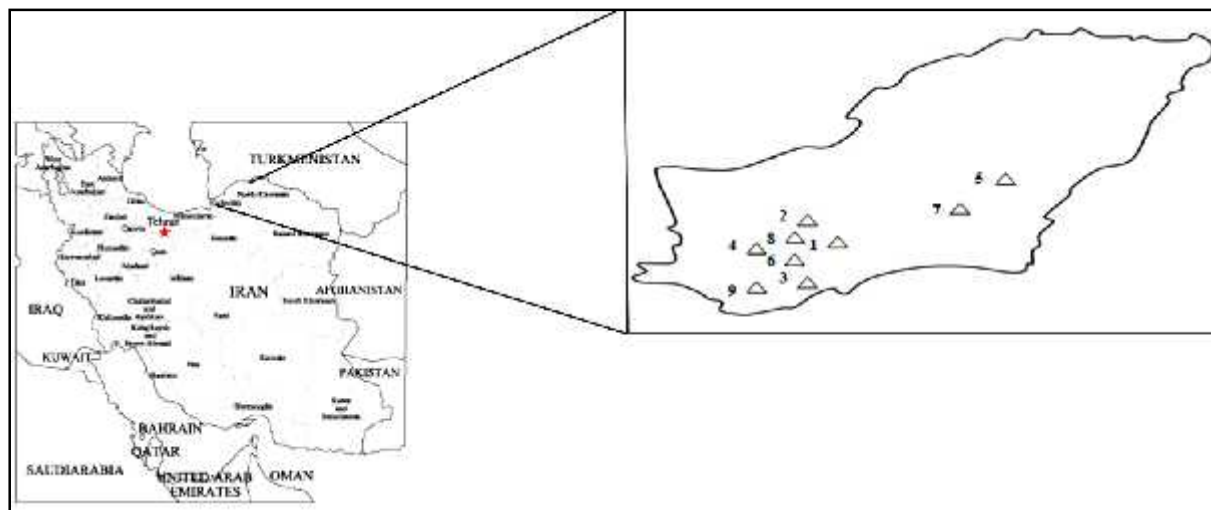


FIGURE 1. Distribution of sampling localities in Golestan province (The number correspond to map codes). 1) Gorgan ($36^{\circ}50'52.8534''$ N, $54^{\circ}25'56.8158''$ E); 2) Aqqala ($36^{\circ}51'42.5412''$ N, $54^{\circ}25'7.2756''$ E); 3) Khatir Abad ($36^{\circ}50'28.6512''$ N, $54^{\circ}21'43.4448''$ E); 4) Hashem Abad ($36^{\circ}53'16.7562''$ N, $54^{\circ}20'56.4786''$ E); 5) Daland ($37^{\circ}1'56.2326''$ N, $55^{\circ}3'5.2554''$ E); 6) Old road ($36^{\circ}50'25.1592''$ N, $54^{\circ}24'8.0526''$ E); 7) Ali Abad ($36^{\circ}54'21.9924''$ N, $54^{\circ}52'15.1386''$ E); 8) Amir Abad ($36^{\circ}52'31.2774''$ N, $54^{\circ}25'50.6382''$ E); 9) Shastkolah ($36^{\circ}49'43.1466''$ N, $54^{\circ}23'32.211''$ E)

Remark: Body is medium-sized, color of thorax and all body appendages brown, gaster always dark brown. This species was collected from an area with Mediterranean temperate climate.

***Lasius brunneus* (Latreille 1798)**

Material examined: Golestan province, Gorgan, 134 m.a.s.l, associated with *Rhopalosiphum nymphaeae* Linnaeus on *Prunus domestica* L. (Rosaceae) (8♀), 17.IV.2014, leg. S. M.; Gorgan, Hashem abad, -9 m.a.s.l, associated with *Aphis gossypii* Glover on *Gossypium hirsutum* L. (Malvaceae) (7♀), 12.VII.2014, leg. S. M.

Distribution in world: The northern border of its distributional range is Sweden and South to Anatolia (Seifert, 1992).

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

Remark: Body is medium-sized, color of head, mesosoma and gaster is brown, whole appendage light yellowish brown. This species was collected from an area with Mediterranean temperate climate. This is a new record for Golestan province.

***Lasius turcicus* Santchi 1921**

Material examined: Golestan province, Gorgan, 135 m.a.s.l, associated with *Aphis spiraecola* on *Citrus aurantium* L. (Rutaceae) (6♀), 17.IV.2013, leg. S. M.

Distribution in world: Known from France (4° E) eastwards to the Iran (49° E). The sites on the Greek islands Kos Rhodos are very near to Asia Minor (Seifert, 1992).

Distribution in Iran: Mashhad (Ghasemi et al., 2000), Tehran (Alipanah et al., 2000), Northern parts of Iran (Paknia et al., 2008), Mazandaran (Gholami et al., 2012), Mashhad (Mortazavi et al., 2015).

This species was also reported in association with *Acyrtosiphon gossypii* Mordvilko on *Lepidium draba* L. (Brassicaceae); *Chaitophorus billerislambersi* Pintera on *Populus alba* L. (Salicaceae); *Brachycaudus*

amygdalius Schout on *Prunus armeniaca* L. (Rosaceae); *Aphis craccivora* Koch on *Kochia* sp. L. (Amaranthaceae); *Aphis craccivora* Koch on *Hibiscus syriacus* L. (Malvaceae) (Mortazavi et al., 2015); *Icerya purchasi* Maskell on *Citrus aurantium* L. (Rutaceae) (Gholami et al., 2012); *Acyrtosiphom pisum* Harris on *Rhamnus* sp. L. (Rhamnaceae); *Anoecia corni* Fabricius on *Cornus sanguinea* L. (Cornaceae); *Aphis craccivora* Koach on *Rumex patientia* L. (Polygonaceae); *Aphis craccivora* Koach on *Sonchus arvensis* L. (Asteraceae); *Aphis craccivora* Koach on *Trifolium* sp. L. (Fabaceae); *Aphis fabae* Scopoli on *Valeriana* sp. L. (Valerianaceae); *Aphis farinosa* Gmelin on *Salix* sp. L. (Salicaceae); *Aphis gossypii* Glover on *Clerodendron* sp. L. (Lamiaceae); *Aphis sambuci* Linnaeus on *Sambucus ebulus* L. (Adoxaceae); *Aphis spiraeicola* Patch on *Erica* sp. L. (Ericaceae); *Aphis craccivora* Koach on *Malus* sp. L. (Rosaceae); *Bracycaudus cardui* Linnaeus on *Sinapis* sp. L. (Brassicaceae); *Chaetosiphon tetraarhodum* (Walker) on *Rosa* sp. L. (Rosaceae); *Chaitophorus salicti* Schrank on *Salix* sp. L. (Salicaceae); *Cinara pilicornis* Hartig on *Picea* sp. L. (Pinaceae); *Cinara pini* (Linnaeus) on *Pinus* sp. L. (Pinaceae); *Myzus cerasi* (Fabricius) on *Cerasus avium* (L.) (Rosaceae); *Myzus lythri* (Schrank) on *Lythrum salicaria* L. (Lythraceae); *Neobetulaphis pusilla* Basu on *Alnus glutinosa* (L.) (Betulaceae); *Phleomyzus passerine* on *Populus* sp. L. (Salicaceae); *Pterochloroides persicae* Cholodkovsky on *Persica vulgaris* (L.) (Rosaceae); *Toxoptera aurantii* Boyer on *Malus sylvestris* (L.) (Rosaceae); *Toxoptera aurantii* Boyer on *Citrus nobilis* L. (Rutaceae) (Akyildirim et al., 2014).

Remark: Body is medium-sized, color of head and gaster is yellowish brown, mesosoma and whole appendage is light yellowish brown. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province. Also this species was observed in association with *Icerya purchasi* Maskell on *Citrus aurantium* L. (Rutaceae) in Gorgan.

***Plagiolepis taurica* Santschi 1920**

Material examined: Golestan province, Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis fabae* Scopoli and *Aphis gossypii* Glover on *Chaenomeles japonica* L. (Rosaceae) (4♀), 03.IV.2013, leg. S. M.; Gorgan, Old road, 81 m.a.s.l., associated with *Aphis gossypii* Glover on *Gossypium hirsutum* L. (Malvaceae) (7♀), 23.VI.2013, leg. S. M.; Gorgan, Shastkolah forest, 87 m.a.s.l., associated with *Aphis nasturtii* Kaltenbach on *Amaranthus retroflexus* L. (Amaranthaceae) (5♀), 26.VII.2013, leg. S. M.; Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis* sp. on *Spinacia oleracea* L. (Amaranthaceae) (5♀), 15.IV.2014 leg. S. M.; Gorgan, Amir abad, 25 m.a.s.l., associated with *Aphis fabae* scopoli on *Vicia faba* L. (Fabaceae) (4♀), 18.IV.2014, leg. S. M.; Gorgan, Hashem abad, - 9 m.a.s.l, associated with *Aphis gossypii* Glover on *Gossypium hirsutum* L. (Malvaceae) (6♀), 12.VII.2014, leg. S. M.; Azadshahr, Daland, 55 m.a.s.l., associated with *Aphis craccivora* Koach on *Phaseolus vulgaris* L. (Fabaceae) (5♀), 26.VII.2014, leg. S. M.

Distribution in world: Central and Eastern Europe, Asia Minor (Moscaliuc, 2009).

Distribution in Iran: Northern parts of Iran (Paknia et al., 2008), Mazandaran (Gholami et al., 2012).

This species was also reported in association with *Toxoptera aurantii* Boyer on *Hypericum* sp. (Hypericaceae) (Akyildirim et al., 2014).

Remark: Body is medium-sized, whole body color is dark or brownish dark, body appendages are yellowish brown. This species was collected from a temperate humid climate with dense vegetation. This is a new record for Golestan province.

Subfamily Myrmicinae

***Cardiocondyla* sp.**

Material examined: Golestan province, Gorgan, Hashem abad, 9 m.a.s.l., associated with *Aphis gossypii* Glover on *Gossypium hirsutum* L. (Malvaceae) (6♀), 12.07.2014, leg. S. M.

Distribution in world: This species is mostly distributed in the old world tropics and subtropics, but a few of which occurs in the temperate zone. Some species are also found widely spreaded in North America and the Pacific Islands, as a result of human introduction (Okita et al., 2013).

Distribution in Iran: Southern, Southwest and Northwest parts (Seifert, 2003; Ghahari & Collingwood, 2011; Mohammadi et al., 2012), Northern parts (Ghahari et al., 2009) of Iran.

Remarks: This species was collected from a temperate humid with dense vegetation.

***Creinatogaster subdentata* Mayr 1877**

Material examined: Iran: Golestan province, Aqqala, 70 m.a.s.l., associated with *Rhopalosiphum maidis* Fitch on *Zea mays* L. (7♀), 05.VII.2013, leg. S. M.; Aqqala, 05.VII.2013, 70 m.a.s.l., associated with *Aphis craccivora* Koch on *Amaranthus retroflexus* L. (Amaranthaceae) (10♀), leg. S. M.; Aqqala, 70 m.a.s.l., associated with *Aphis gossypii* Glover on *Solanum melongena* L. (Solanaceae) (8♀), 05.VII.2013, leg. S. M.; Ali abad, 204 m.a.s.l., associated with *Aphis ruborum* Börner on *Rubus fruticosus* L. (8♀), 05.VII.2013, leg. S. M.; Aqqala, 70 m.a.s.l., associated with *Aphis spiraeicola* Patch on *Eriobotrya japonica* L. (Rosaceae) (8♀), 15.XI.2013 leg. S. M.; Aqqala, 70 m.a.s.l., associated with *Melanaphis donacis* Passerini on *Phragmites australis* L. (Poaceae) (8♀), 15.XI.2013, leg. S.M.; Aqqala, 70 m.a.s.l., associated with *Aphis solanella* Theobald and *Aphis fabae* Scopoli on *Rumex acetosella* L. (Polygonaceae) (8♀), 15.XI.2013, leg. S. M.; Aqqala, 70 m.a.s.l., associated with *Aphis craccivora* Koch on *Phasaelous vulgaris* L. (Poaceae) (8♀), 15.XI.2013, leg. S. M.

Distribution in world: Central Asia, Afghanistan, Caucasus, China (Collingwood & Heatwole, 2000).

Distribution in Iran: Northern parts of Iran (Paknia et al., 2008), Mazandaran (Ghahari et al., 2009), Mashhad (Mortazavi et al., 2015).

This species was also reported in association with *Aphis craccivora* Koach on *Vitis* sp. L. (Vitaceae), *Aphis craccivora* Koach on *Carduus pycnocephalus* L. (Asteraceae), *Aphis craccivora* Koach on *Morus alba* L. (Moraceae), *Aphis craccivora* Koach on *Glycyrrhiza glabra* L. (Fabaceae); *Periphyllus bulgaricus* Tashev on *Acer* sp. L. (Aceraceae); *Tuberculatus maximus* Hille Ris Lambers on *Ulmus* sp. L. (Ulmaceae) (Mortazavi et al., 2015).

Remark: Body is medium-sized, head and prothorax are light reddish brown, gaster is dark reddish brown. This species was collected from an area with a semi-arid climate and sparse vegetation cover. This is a new record for Golestan province.

***Pheidole pallidula* (Nylander 1849)**

Material examined: Golestan province, Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis gossypii* Glover on *Lagenaria vulgaris* L. (Cucurbitaceae) (8♀), 08.VIII.2013, leg. S. M.; Khatir abad, 55 m.a.s.l., associated with *Aphis frangulae* Kaltenbach on *Citrullus colocynthis* L. (Cucurbitaceae) (8♀), 08.VIII.2013, leg. S. M.

Distribution in world: Albania, Bulgaria, former Yugoslavia, Greece, Turkey (Agosti & Collingwood, 1987), France, Spain and Portugal (Collingwood, 1978), Slovenia (Bracko, 2007).

Distribution in Iran: Tehran (Alipanah et al., 1995), Mashhad (Ghasemi et al., 2000), Northwest parts of Iran (Paknia et al., 2008), Mazandaran (Ghahari et al., 2009), Mazandaran (Gholami et al., 2012), Khorasan, Esfahan (Shiran et al., 2013).

This species was also reported in association with *Aphis davletshinae* Hille Ris Lambers on *Althaea rosae* L. (Malvaceae); *Aphis umbrella* Börner on *Malva parviflora* L. (Malvaceae); *Aphis gossypii* Glover on *Brassicae kabera* Wheeler; *Aphis gossypii* Glover on *Althaea rosae* L. (Malvaceae); *Myzus persicae* Sulzer on *Cydonia* sp.L. (Rosaceae); *Aphis gossypii* Glover on *Miralalis jalapa* (L.) (Shiran et al., 2013).

Remark: Body is medium-sized, head color is brown, mesosoma and whole body appendages are yellowish brown. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province.

***Pheidole teneriffana* Forel 1893**

Material examined: Golestan province, Gorgan, 135 m.a.s.l., associated with *Aphis gossypii* Glover on *Schefflera arboricola* L. (Araliaceae) (8♀), 17.IV.2013, leg. S. M.

Distribution in world: West Indian island, North Africa, southern Europe, The middle East and neighboring island (Wettere, 2011), Kuwait, Oman, Saudi Arabia, Yemen (Collingwood & Agosti, 1996).

Distribution in Iran: Tehran (Alipanah et al., 1995), Fars (Paknia, 2007), Northern and Southern parts of Iran (Paknia et al., 2008), Khozestan, Esfahan (Shiran et al., 2013).

This species was also reported in association with *Aphis umbrella* on *Malva parviflora* L. (Malvaceae); *Aphis craccivora* Koach on *Solanum melogena* L. (Solanaceae); *Aphis craccivora* Koach on *Hedra helix* L. (Araliaceae) (Shiran et al., 2013).

Remark: Body is medium-sized, color of body is reddish to darker brown, with significantly darker head and gaster. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province.

***Tetramorium caespitum* (Linnaeus 1758)**

Material examined: Golestan province, Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis gossypii* Glover on *Citrullus lanatus* L. (Cucurbitaceae) (8♀), 08.VIII.2013, leg. S. M.

Distribution in world: Bulgaria, Greece, Turkey, former Yugoslavia (Agosti & Collingwood, 1987), Slovenia (Bracko, 2007).

Distribution in Iran: Gilan (Crawley, 1920), Mazandaran (Paknia & Kami, 2007), Northern and Southern parts of Iran (Paknia et al., 2008), Mazandaran (Ghahari et al., 2009), Mazandaran (Gholami et al., 2012), Esfahan (Shiran et al., 2013), Neyshabur (Hosseini et al., 2015).

This species was also reported in association with *Aphis fabae* Scopoli on *Heracleum* sp. L. (Apiaceae); *Aphis farinose* Gmelin on *Salix* sp. L. (Salicaceae); *Aphis gossypii* Glover on *Salvia verticillata* L.; *Macrosiphoniella sanborni* Gillette on *Anthemis* sp. L. (Asteraceae) (Akyildirim et al., 2014); *Aphis fabae* Scopoli on *Tamarix* sp. L. (Tamaricaceae) (Shiran et al., 2013).

Remark: Body is medium to large sized, head, mesosoma and gaster dark brown, whole body appendages light brown. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province.

***Tetramorium chefketi* Forel, 1911**

Material examined: Golestan province, Gorgan, Khatir abad, 55 m.a.s.l., associated with *Aphis fabae* Scopoli on *Vicia faba* L. (Fabaceae) (3♀), 15.IV.2014, leg. S. M.; Gorgan, Hashem abad, -9 m.a.s.l., associated with *Aphis gossypii* Glover on *Gossypium hirsutum* L. (Malvaceae) (6♀), 12.VII.2014, leg. S. M.

Distribution in world: Southern Balkan peninsula, Southern part of Eastern Europe, Turkey, Caucasus, Middle Asia, Kazakhstan and Turkmenistan (Csosz et al., 2007).

Distribution in Iran: Tehran (Alipanah et al., 1995), Northern parts of Iran (Paknia et al., 2008), Mashhad (Mortazavi et al., 2015), Kashmar (Hosseini et al., 2015).

This species was also reported in association with *Aphis craccivora* Koch on *Fraxinus* sp. L. (Oleaceae) (Mortazavi et al., 2015); *Brachycaudus cardui* Linnaeus on *Echium vulgare* L. (Boraginaceae); *Cinara pilicornis* Hartig on *Picea* sp. L. (Pinaceae) (Akyildirim et al., 2014).

Remark: Body is medium to large sized, whole body and appendages dark brown to black. This species was collected from a temperate and humid climate with dense vegetation. This is a new record for Golestan province.

DISCUSSION

Among the ant species identified in this study, the most frequent observed mutualistic ant species were *Crematogaster subdentata* and *Plagiolepis taurica*, respectively. *Crematogaster subdentata* was in association with eight aphid species on nine host plants. This ant was only collected in association with *A. craccivora* from Iran (Mortazavi et al. 2015), whereas in current work the *C. subdentata* ants were reported in association with 7 other aphid species including *R. maidis*, *A. gossypii*, *A. ruborum*, *A. spiracola*, *M. donacis*, *A. solanella*, *A. fabae*. The genus *Crematogaster* is a worldwide distributed myrmecine ant, collected in disturbed environment near human settlements (Bolton et al., 2006). The *C. subdentata* ant nest generally in the soil but like most species of *Crematogaster* is very dependent on quality and quantity of homoptera honeydew on trees and shrubs (Collingwood & Heatwole, 2000). It seems that diversity of this ant species enhanced with increases in size and geographical spread of human population and the diversity of plant species. To our knowledge, the *P. taurica* ant was not reported in association with any aphid species from Iran (Shiran et al., 2013; Mortazavi et al., 2015), but interestingly this ant species was found in association with five aphid species in Golestan province. This ant nests under the stones in forest and open spaces, and has a preference for sweet liquids such as homoptera honeydew and extrafloral nectar (Moscaliuc, 2009). This species was collected in all localities of current study. This indicates that it is a widespread species adapted to various climates and environmental conditions of Golestan province.

Numerous different factors might influence the relationship between mutualistic ants and myrmecophilous aphids such as density of aphids and ants, host plant species and its characteristics, environmental conditions as well as geographical distribution (Stadler & Dixon, 2005). However, the relationship between ants and aphids is not always mutualistic; in some cases ants prey upon aphids (Sudd, 1987; Billick et al., 2007). For example, the sycamore aphid *Drepanosiphum platanoides* (Schrank) is frequently preyed by the wood ant, *Formica rufa* (L.) (Skinner, 1980).

Tending by ants of an aphid species may cause the extinction of other competitor aphid species (Addicott, 1978a). Ant attendance also could have an effect on extinction of tending aphid populations, for example, Addicott (1978b) showed that the populations of three species of aphids of the genus *Aphis* tended by ants had lower extinction rates than untended populations of the same species. In another study, Tilles & Wood (1982) revealed that colonies of *Cinara* spp. infesting white fir were more likely to go extinct if not attended by ants. In general, mutualistic ants–aphids interactions could have a crucial impact on the community dynamics of aphids and potentially might alter the ongoing community processes.

There are a very few studies on mutualistic ants associated with aphids in Iran but see (Shiran et al., 2013; Mortazavi et al., 2015), so it is needed to investigate interactions between aphids and ants throughout Iran. It is expected that these preliminary results stimulate further studies in this context and provide a base for studies on different interactions between aphids and their attendant ants which have been ignored so far in Iran.

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