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A contribution to the knowledge of Charipinae (Hymenoptera: Cynipoidea: Figitidae) associated with aphids (Hemiptera: Aphididae) from Iran, including new records

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Abstract. The aphid-associated Charipinae (Hym., Figitidae) of Iran were investigated together with their primary-host parasitoid–aphid–plant trophic associations. Fifteen species in total were collected and identified during this study; of which *Alloxysta arcuata* (Kieffer, 1902), *A. brevis* (Thomson, 1862), *A. castanea* (Hartig, 1841), *A. macrophadna* (Hartig, 1841), *A. melanogaster* (Hartig, 1840), *A. pusilla* (Kieffer, 1902), *A. ruficollis* (Cameron, 1883), *A. tscheki* (Giraud, 1860) and *A. ullrichi* (Giraud, 1860) are recorded for the first time from Iran. Six previously recorded species were also found; being *Phaenoglyphis villosa* (Hartig, 1841), *A. citripes* (Thomson, 1862), *A. erythrothorax* (Hartig, 1840), *A. fuscicornis* (Hartig, 1841), *A. mullensis* (Cameron, 1883) and *A. victrix* (Westwood, 1833). A discussion about diagnostic characters is presented for all species included here. The present contribution together with recent research has revealed many new records, and indicates various faunistic complexes in this poorly investigated region.

Key words: Figitidae, Charipinae, aphid hyperparasitoids, *Alloxysta*, *Phaenoglyphis*, Iran.

Introduction

The Charipinae (Hymenoptera: Cynipoidea: Figitidae) are a group of very small wasps, which are widely distributed throughout the world (Andrews 1978). They are biologically characterized as hyperparasitoids of aphids (Hemiptera: Aphididae) through Aphidiinae (Hymenoptera: Ichneumonoidea: Braconidae) and Aphelinidae (Hymenoptera: Chalcidoidea: Aphelinidae), and hyperparasitoids of psyllids (Hemiptera: Psyllidae) through Encyrtidae (Hymenoptera: Chalcidoidea) (Carver 1992, Menke & Evenhuis 1991).

Generally, hyperparasitoids are considered to be detrimental for biological control efforts as they reduce the efficiency of primary parasitoids on their hosts in the following ways: (i) increasing primary parasitoid mortality, (ii) indirectly increasing the growth rate of the aphid population and (iii) increasing the propensity for primary parasitoids to disperse (van Veen et al. 2001). However, under certain circumstances they may play a positive role in maintaining the balance between population of primary parasitoid and its host aphid (Bennet 1981, Starý 1970). Members of the subfamily Charipinae are assumed to have an important negative effect on the biological control of aphids and psyllids pest species. They only attack aphids and psyllids when they have already been parasitized by primary parasitoid.

Eight genera are currently considered valid in the Charipinae (Carver 1993, Ronquist 1999, Paretas-Martínez & Pujade-Villar 2006, Paretas-Martínez et al. 2007b, Pujade-Villar & Paretas-Martínez 2006). The genera associated with aphids are *Alloxysta* Förster, 1869 (cosmopolitan), *Phaenoglyphis* Förster, 1869 (cosmopolitan), *Lytoxysta* Kieffer, 1909 (North America), and *Lobopterocharips* Paretas-Martínez & Pujade-Villar, 2007 (Nepal), while those parasitizing Psyllidae are

Dilyta Förster, 1869 (cosmopolitan), *Apocharips* Fergusson, 1986 (cosmopolitan, not cited from Australia), *Dilapothor* Paretas-Martínez & Pujade-Villar, 2006 and *Thoreauana* Girault, 1930 (Australia). Two genera, *Alloxysta* Förster with 111 valid species and *Phaenoglyphis* Förster with 31 valid species, are the most widespread taxa within the subfamily. These two genera are cosmopolitan but are best known from the Palaearctic and Nearctic regions. Very few studies have been done to expand the knowledge of this group in other regions (Carver 1993–Australia, Pujade-Villar et al. 2002–Neotropical region, Takada & Nakamura 2010–Eastern Palaearctic). In Iran, only five species of *Alloxysta* and one of *Phaenoglyphis* have previously been reported (Rakhshani et al. 2001, 2004, Lotfalizadeh 2002a,b, Lotfalizadeh & van Veen 2004, Pujade-Villar et al. 2007, Khayrandish-Koshkooei et al. 2013).

Material and methods

Collection of specimens was carried out in different provinces of Iran during 2002–2010. Samples of various host plants bearing aphid colonies were collected and transferred to the laboratory, where they were subsequently maintained until parasitoid emergence. The mummified aphids, each attached to a small leaf piece, were placed separately within mesh covered; semi-transparent plastic boxes at laboratory constant conditions where they were maintained for 1–2 months under a temperature of 22–26°C, relative humidity 60–70% and a 16L: 8D photoperiod. The emerging primary and secondary wasps were collected daily from the boxes using an aspirator and directly dropped into 96% ethyl alcohol for later examination. Specimens were studied using light microscopy and environmental scanning electron microscopy. One adult female of each species was selected for dissection. Microscopic slides were made from the forewings and the rest of body was gold coated in a BAL-TEC SCD 005 sputter coater and then visualized with a JEOL JSM 6390 scanning electron microscope to observe fine morphological details. Additionally, a field emission gun environmental scanning electron microscope (FEI Quanta 200 ESEM) was used for high-resolution imaging without gold-coating. Wings were photographed with a Zeiss™ Discovery V8 compound microscope equipped with an attached INFINITYX-21C digital camera that fed image data to a notebook or desktop computer. The software DeltaPix™ View-Pro AZ was then used to merge an image series (typically representing 20 focal planes) into a single in-focus image. The morphological terminology used in this paper follows Paretas-Martínez et al. (2007a). The terms for surface sculpture follow Harris (1979). The abbreviation F1–F12, represent the first and subsequent flagellomeres. The width of the forewing radial cell is measured from the margin of the wing to the beginning Rs vein. We have examined the type material of: *Alloxysta arcuata* (Kieffer), *Alloxysta brevis* (Thomson), *Alloxysta melanogaster* (Hartig) and *Alloxysta mullensis* (Cameron), difficult species that previous authors have often confused. All of the newly collected material has been deposited in the collection of J. Pujade-Villar (UB - Universitat de Barcelona, Barcelona, Spain) and in the collection of E. Rakhshani (University of Zabol, Iran).

Host associations: Under the "Material examined" section, host associations for each species are given in the following format: "primary parasitoid–aphid on plant". Note that the name of the primary parasitoid is given in underlined.

Results

Fifteen species of Charipinae aphid hyperparasitoids were identified together with their trophic associations from a total of 402 specimens collected. Nine species are newly recorded from Iran, indicated in the key by an asterisk (*). A total of 77 trophic associations involving 20 parasitoids, 28 aphid species and 38 host plant species were recorded from the studied regions.

Key to species

1. Lower part of mesopleuron with horizontal sulcus (Fig. 5a) ..... ***P. villosa*** (Hartig)
— Lower part of mesopleuron smooth, without horizontal sulcus (Fig. 5b) ..... **2** (***Alloxysta*** Förster)
2- Radial cell totally or partially open along costal margin **3**
— Radial cell closed **8**
3. Radial cell large and expanded (3.3 times longer than wide) (Fig. 3e). Body length more than 1.3 mm ..... ***A. macrophadna** (Hartig)
— Radial cell medium to small in size (less than 3.3 times longer than wide). Body length less than 1.3 mm **4**
4. Propodeal carinae absent (Fig. 2a) ..... ***A. ullrichi** (Giraud)
— Propodeal carinae clearly visible (Figs 2d–f) **5**
5. Propodeal carinae forming a plate with very slightly curved sides (Fig. 2d) **6**

— Propodeal carinae well defined in their upper half and forming a plate in their lower half, lateral sides curved (Figs 2e, 2f) **7**

6. Head reddish brown, mesosoma and metasoma brown. Female antennae with F1 longer than pedicel, F2–F4 subequal in length. Propodeal plate with several setae at top (Fig. 2d) ..... ***A. castanea*** (Hartig)

— Head, mesosoma and metasoma yellow. Female antennae with F1 subequal to pedicel, F1 longer than F2, F2 subequal to F3, F4 longer than F3. Propodeal plate sparsely setose at top (Fig. 2c) ..... ***A. melanogaster*** (Hartig)

7. Propodeal carinae well defined (Fig. 2e). Female antennae with F1 longer than pedicel (Fig. 6b). Radial cell 2.9 times as long as width (Fig. 4b). ..... ***A. erythrothorax*** (Hartig)

— Propodeal carinae not protruding (Fig. 2f). Antennae with F1 subequal to pedicel (Fig. 6a) in both sexes. Radial cell 2.1 times longer than wide (Fig. 4a) ..... ***A. citripes*** (Thomson)

8. Pronotal carinae absent (Fig. 1a) **9**

— Pronotal carinae present (Fig. 1b) **10**

9. Antennae shorter than body length; F1–F3 subequal and very short. Propodeal plate sub-quadrate (Fig. 2k) ..... ***A. brevis*** (Thomson)

— Antennae longer than body length; F1–F3 not subequal (Figs 6c). Propodeal plate elongate ..... ***A. mullensis*** (Cameron)

10. Propodeal carinae absent (Fig 2h) **11**

— Propodeal carinae present (Figs 2g, 2j, 2l) **12**

11. Head brown. Propodeum completely covered with dense setae (Fig. 2h). Radial cell 2.4 times longer than wide (Fig. 4d) ..... ***A. fuscicornis*** (Hartig)

— Head yellowish. Propodeum lack the setae at the longitudinal area where the carinae are present in Charipinae (Fig. 2i). Radial cell 3 times longer than wide (Fig. 4c) ..... ***A. victrix*** (Westwood)

12. Propodeal carinae well defined, at least on upper half, and forming a plate on lower half **13**

— Propodeal carinae fused, forming a complete central plate (Fig. 2l) **14**

13. Head brown. Propodeal carinae well defined on upper half, separated by few setae and forming a plate between their lower halves with curved sides (Fig. 2j). Radial cell 2.4 times longer than wide (Fig. 3h) ..... ***A. pusilla*** (Kieffer)

— Head yellowish. Propodeal carinae well defined, separated by a lot of setae in their upper and joining at their lower part (Fig. 2g). Radial cell 1.8 times longer than wide (Fig. 3g) ..... ***A. tscheki*** (Giraud)

14. Female antennae with F1 sub-equal to pedicel, F1 longer than F2, F2–F4 subequal in length (Fig. 6d). Male antennae with F1 longer than pedicel, F1 subequal to F2, F2 shorter than F3 and F3 shorter than F4 (Fig. 6e). Radial cell 2.1 times longer than wide (Fig. 3a) ..... ***A. arcuata*** (Kieffer)

— Female antennae with pedicel–F2 sub-equal in length, F3 longer than F2, F3 subequal to F4 (Fig. 6f). Male unknown. Radial cell 2.3 times longer than wide (Fig. 3f) ..... ***A. ruficollis*** (Cameron)

Alloxysta arcuata (Kieffer, 1902)

Distribution. Species known from Spain (Kieffer 1902), Netherlands (Evenhuis & Barbotin 1977) and Iran (this study). It was erroneously synonymized with *A. brevis* by Fergusson (1986).

Material examined: 27♂ & 112♀. "*Aphidius ervi* – *Sitobion avenae* on *Triticum aestivum*, Shiraz, coll.: E. Rakhshani, 27-IV-2005": 6♀; "on *Zea mays*, Gorgan, coll.: E. Rakhshani, 08-VI-2005": 5♂ & 4♀; "*Aphidius matricariae* – *Brachycaudus helichrysi* on *Zinia elegans*, Tehran, coll.: E. Rakhshani, 18-X-2005": 1♀; "*Capitophorus similis* on *Elaeagnus angustifolia*, Tabriz, 25-XI-2004": 1♂. "*Aphidius rhopalosiphi* – *Schizaphis graminum* on *Triticum aestivum*, Saveh-Ghasemabad, coll.: E. Rakhshani, 14-V-2005": 3♂ & 2♀. "*Aphidius rosae* – *Macrosiphum rosae* on *Rosa* sp., Kerman, coll.: A. Alipour, 01-V-2010": 3♀. "*Binodoxys acalephae* – *Aphis craccivora* on *Glycyrrhiza glabra*, Qazvin-Abiek, coll.: E. Rakhshani, 23-V-2003": 1♂. "*Diaeretiella rapae* – *Brevicoryne brassicae* on *Brassica oleracea*, Tehran, coll.: E. Rakhshani, 18-XI-2004": 1♀; "*Rhopalosiphum padi* on *Zea mays,* Tehran, coll.: E. Rakhshani, 15-XI-2004": 1♂ & 3♀. "*Ephedrus persicae* – *Aphis fabae*, Karadj-Aghasht, on *Solanum lycopersicum*, coll.: E. Rakhshani, 05-XI-2004": 1♂ & 17♀. "*Lysiphlebus fabarum* – *Aphis craccivora* on *Glycyrrhiza glabra*, Khash-Taftan, coll.: E. Rakhshani, 29-IV-2004": 1♀. "Isfahan, 31-X-2003": 3♀; "*Aphis gossypii* on *Solanum melongena*, Tehran, coll.: E. Rakhshani, 17-X-2004": 2♂ & 16♀; "*Aphis idaei* on *Rubus idaeus*, Kiashahr, coll.: E. Rakhshani, 10-V-2005": 12♀; "*Aphis*

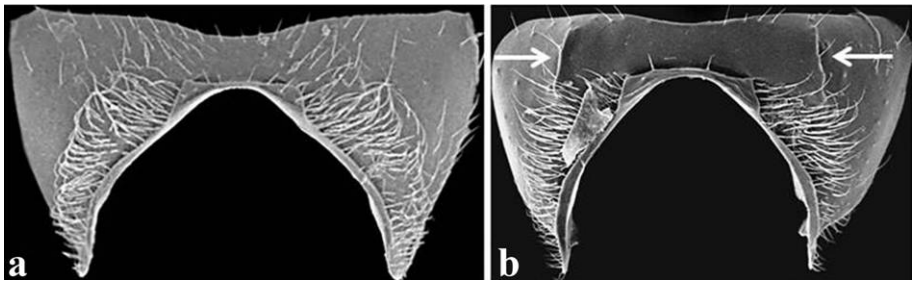

Figure 1. Types of pronotum of *Alloxysta* species:
a) *A. brevis*, without carinae; **b)** *A. arcuata* with carinae present (arrowed).

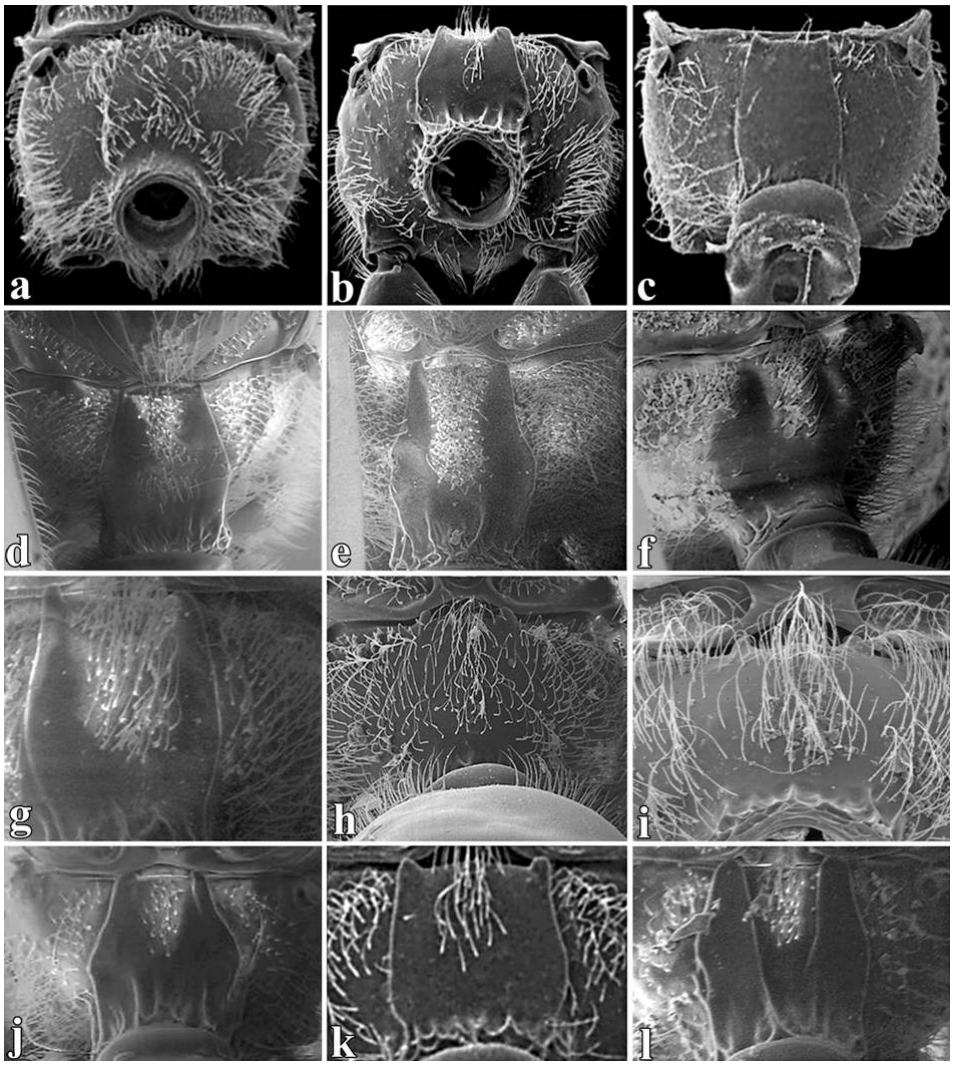

Figure 2. Propodea of *Alloxysta* species: **a)** *A. ullrichi*; **b)** *A. arcuata*; **c)** *A. melanogaster*; **d)** *A. castanea*; **e)** *A. erythrothorax*; **f)** *A. citripes*; **g)** *A. tscheki*; **h)** *A. fuscicornis*; **i)** *A. victrix*; **j)** *A. pusilla*; **k)** *A. brevis*; **l)** *A. ruficollis*.

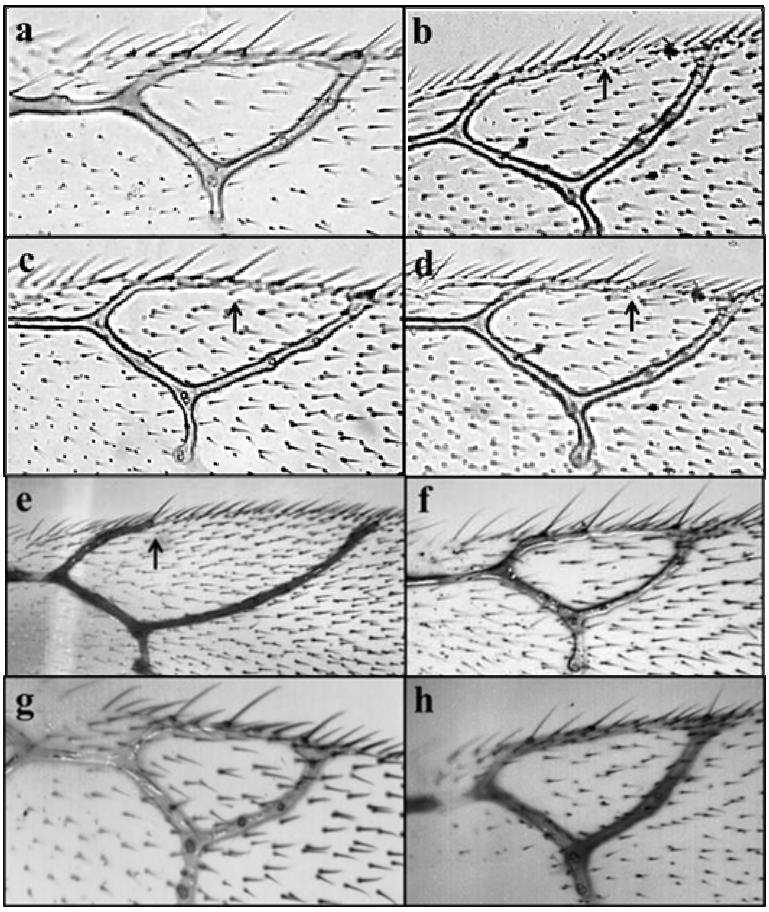

Figure 3. Radial cell of *Alloxysta* species newly recorded from Iran: **a)** *A. arcuata*; **b)** *A. melanogaster*; **c)** *A. ullrichi*; **d)** *A. castanea*; **e)** *A. macrophadna*; **f)** *A. ruficollis*; **g)** *A. tscheki*; **h)** *A. pusilla*. Opening shown by an arrow.

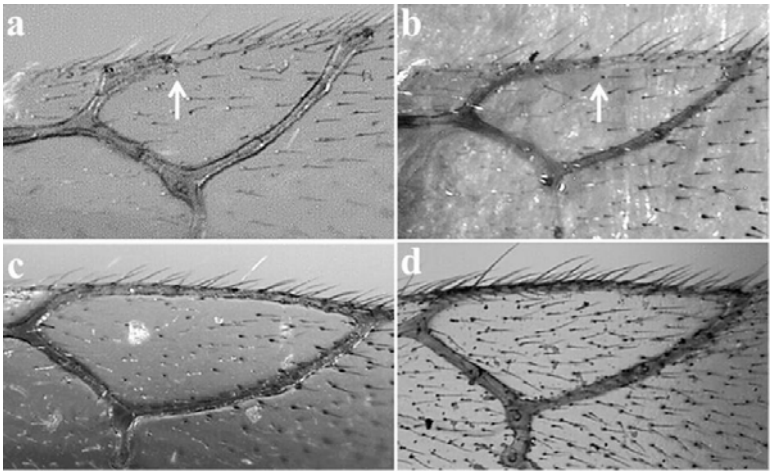

Figure 4. Radial cell of *Alloxysta* species previously recorded from Iran: **a)** *A. citripes*; **b)** *A. erythrothorax*; **c)** *A. victrix*; **d)** *A. fuscicornis*. Opening shown by an arrow.

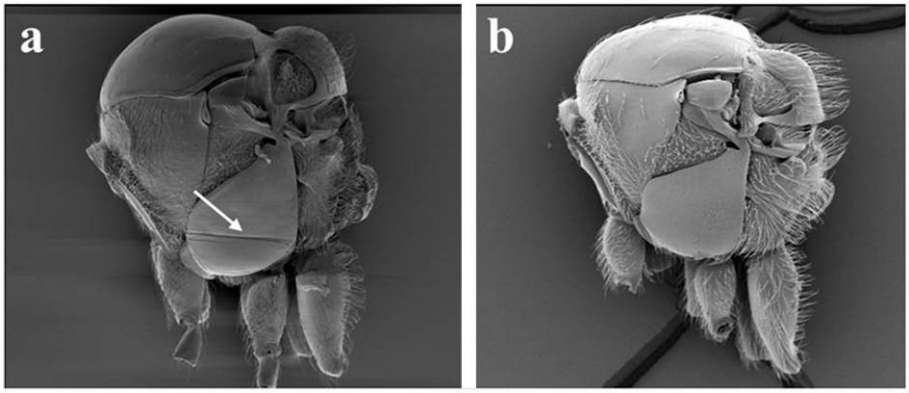

Figure 5. Mesopleura of Charipinae:
a) *Phaenoglyphis*, horizontal sulcus on mesopleuron arrowed; **b)** *Alloxysta*.

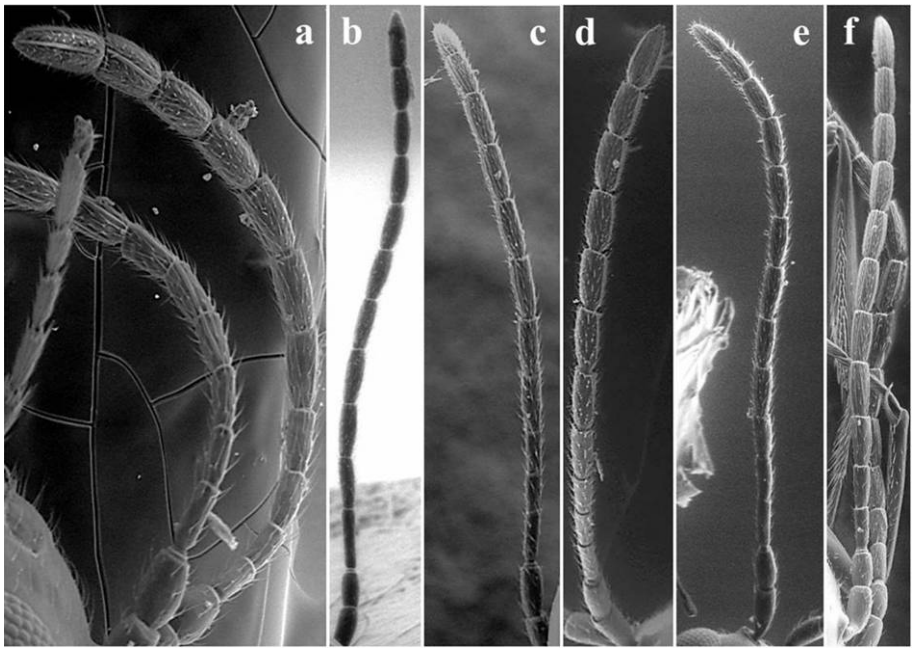

Figure 6. Antennae of some *Alloxysta* species: **a)** *A. citripes* (female); **b)** *A. erythrothorax* (female); **c)** *A. melanogaster* (female); **d)** *A. arcuata* (female); **e**) *A. arcuata* (male); **f)** *A. ruficollis* (female).

nerii on *Nerium oleander*, Tehran, coll.: E. Rakhshani, 05-XI-2004": 6♂ & 1♀; "*Aphis urticata* on *Urtica dioica*, Rasht-Lashtenesha, coll.: E. Rakhshani, 11-V-2005": 1♀; "*Aphis craccivora* on *Robinia pseudoacacia*, Tehran, coll.: E. Rakhshani, 21-V-2002": 1♀. "*Praon exsoletum* – *Therioaphis trifolii* on *Medicago sativa*, Zahedan, coll.: E. Rakhshani, 23-IV-2003": 1♀. "*Praon volucre* – *Aphis fabae* on *Solanum dulcamara*, Karadj, coll.: E. Rakhshani, 06-XI-2004": 5♂ & 37♀; "*Uroleucon sonchi* on *Sonchus asper*, Tehran, coll.: E. Rakhshani, 15-XI-2004": 1♀. "Malaise trap on *Medicago sativa*, Sabzevar-Jovein, coll.: Kh. Fathabadi, 16-V-2011": 1♀. "Swept material on *Medicago sativa*, Hamadan, coll.: A.A. Talebi, 15-IV-2009": 2♂.

Diagnosis. Head yellowish brown in female, more yellowish in male; mesosoma and metasoma dark brown; scape, pedicel, F1 and F2 dark yellow, F3–F12 brown; legs yellow and veins yellowish brown. Female antennae 13-segmented; F1–F2

smooth and thinner than remaining segments; antennal club begins from F3 but is more evident from F4; F4–F11 with rhinaria; F1 subequal to pedicel, F1 longer than F2, F2–F4 subequal (Fig. 6d). Male antennae 14-segmented; F1 smoother and thinner than remaining segments, F2 slightly curved; F2–F12 with rhinaria and form the antennal club; F1 longer than pedicel and subequal to F2, F2 shorter than F3, F3 shorter than F4 (Fig. 6e). Pronotum densely pubescent bearing two prominent carinae clearly visible under pubescence (Fig. 1b). Propodeum densely pubescent, with a central plate formed by two carinae; propodeal plate bearing several setae on upper half and lateral sides slightly curved outward (Fig. 2b). Forewing longer than body; radial cell closed, 2.1 times longer than wide in both sexes (Fig. 3a).

Comments. This species is closely related to *A. pusilla* according to the shape of the radial cell but differs from *A. pusilla* based on the length ratio of F1 and pedicel: F1 is subequal in length to the pedicel in *A. arcuata* but is longer than the pedicel in *A. pusilla*.

Alloxysta brevis (Thomson, 1862)

Distribution. Palaearctic and Australian regions. First record from Iran.

Material examined: 7♂ & 8♀. "*Aphidius ervi* – *Sitobion avenae* on *Zea mays*, Gorgan, coll.: E. Rakhshani, 08-VI-2005": 1♂ & 1♀; "on *Triticum aestivum*, Shiraz, coll.: E. Rakhshani, 27-IV-2005": 1♂. "*Aphidius salicis* – *Cavariella* sp. on *Salix aquatica*, Tehran-Roodehen, coll.: E. Rakhshani, 27-VI-2002": 1♀. "*Ephedrus persicae* – *Aphis fabae*, Karadj-Aghasht, on *Solanum lycopersicum*, coll.: E. Rakhshani, 05-XI-2004": 1♀. "*Lysiphlebus fabarum* – *Aphis* (*Protaphis*) *terricola* on *Artemisia biennis*, Kerman, coll.: A. Alipour, 10-X-2008": 1♀; "*Aphis craccivora* on *Portulaca oleracea*, Tehran, coll.: E. Rakhshani, 06-VI-2002": 1♂. "on *Robinia pseudoacacia*, Tehran, coll.: E. Rakhshani, 21-V-2002": 1♀; "on *Vicia sativa*, Arak-Shanaq, coll.: M. Alikhani, 02-VI-2009": 1♀; "*Aphis punicae* on *Punica granatum*, Tehran, coll.: E. Rakhshani, 08-V-2004": 4♂ & 1♀. "*Praon volucre* – *Aphis fabae* on *Solanum dulcamara*, Karadj, coll.: E. Rakhshani, 06-XI-2004": 1♀.

Diagnosis. Head, mesosoma and metasoma brown (head slightly lighter); scape, pedicel, F1–F3 yellow, F4–F12 brown; legs yellowish testaceous, veins yellowish brown. Female antennae 13-segmented; F1–F3 smooth and thinner than remaining segments; F4–F11 with rhinaria and form the antennal club; F1 shorter than pedicel, F1–F3 sub-equal in width and length, F3 shorter than F4. Male antennae 14-segmented; as female, without any flagellomere curved. Pronotum covered by sparse setae, without carinae (Fig. 1a). Propodeum covered with abundant pubescence with a plate in the lower two-thirds formed by two carinae; propodeal plate with few setae, lateral sides slightly curved (Fig. 2k). Forewing longer than body; radial cell closed, 2.1 times longer than wide.

Comments. This species is closely related to *A. arcuata* according to shape of the radial cell, but differs in its pronotal sculpture and having a different F1/F2 length ratio. The pronotum of *A. brevis* lacks carinae (Fig. 1a), while a pair of clearly visible carinae are present on the pronotum of *A. arcuata* (Fig. 1b). In addition, the length ratio of F1 and F2 are subequal in *A. brevis,* but F1 is longer than F2 in *A. arcuata*. *Alloxysta brevis* is closely related to *A. mullensis* according to absence of pronotal carinae but differ in proportions of flagellomeres: *A. brevis* has F1–F3 subequal and short; while *A. mullensis* has F1 longer than F2, and F2 subequal to F3 in female, as in *A. arcuata* (Fig. 6e).

Alloxysta castanea (Hartig, 1841)

Distribution. Known from several European countries. First record from Iran.

Material examined: 2♀. "*Trioxys asiaticus* – *Acyrthosiphon gossypii* on *Sophora alopecuroides*, Kerman, coll.: A. Alipour, 25-X-2008": 1♀. "Without host data, Gilan-Ziaz, coll.: M. Kheryandish, 01-VIII-2010": 1♀.

Diagnosis. Head reddish brown; mesosoma brown and metasoma dark brown; scape, pedicel, F1 and F2 yellow, F3–F11 brown; legs yellow; veins yellowish brown. Female antennae 13-segmented; F1 and F2 smooth and thinner than other segments; F3–F11 with rhinaria and form antennal club; F1 longer than pedicel and F2, F2–F4 sub-equal in length. Pronotum densely pubescent bearing a pair of strong and elongated carinae. Propodeum densely covered with long setae, bearing a pair of carinae forming a central plate; propodeal plate sparsely setose on top, lateral sides slightly curved (Fig. 2d). Forewing longer than body; radial cell partially open, 2.4 times longer than wide (Fig. 3d).

Comments. This species is closely related to *A. ullrichi* according to the shape of the radial cell but differs in the presence of carinae on the propodeum; *A. castanea* has two carinae forming a plate on the propodeum (Fig. 2d) while *A. ullrichi* does not have carinae on the propodeum (Fig. 2a).

Alloxysta citripes (Thomson, 1862)

Distribution. Known from several European countries. Previously recorded from Iran by Rakhshani et al. (2001).

Material examined: 2♂ & 4♀. "*Trioxys pallidus* – *Chromaphis juglandicola* on *Juglans regia*, Bojnurd, coll.: S. Kazemzadeh, 26-V-2008": 2♂ & 4♀.

Diagnosis. Head slightly yellowish brown; mesosoma and metasoma brown; antennae, legs and veins very light yellow. Female antennae 13-segmented; F1–F3 smooth and thinner than remaining flagellomeres, F4–F11 with rhinaria and form the antennal club; F1 subequal to pedicel, F1 a little longer than F2, F2 shorter than F3, F3 subequal to F4 (Fig. 6a). Male antennae 14-segmented; F1–F12 with rhinaria and form the antennal club; pedicel–F3 subequal, F3 a little shorter than F4, F4–F12 sub-equal. Pronotum covered by setae, two carinae clearly visible. Propodeum covered by dense setae, carinae present forming a weakly raised plate with curved lateral sides (Fig. 2f). Forewing longer than body; radial cell partially open, 2.1 times longer than wide (Fig. 4a).

Comments. This species is closely related to *A. erythrothorax*, *A. castanea* and *A. ullrichi* based on the shape of the radial cell, but differs in the shape of the propodeal carinae: *A. citripes* has a weakly raised propodeal plate (Fig. 2f), while *A. erythrothorax* and *A. castanea* have a well-defined and strongly raised plate (Figs 2d, 2e); *A. ullrichi* lacks carinae on the propodeum. Females of *A. citripes* differ from the females of *A. erythrothorax*, *A. castanea* and *A. ullrichi* in the ratio of pedicel to F1; in *A. citripes,* F1 is subequal in length to the pedicel, while in the other three species the F1 is longer than the pedicel. Males of *A. citripes* differ from the males of *A. ullrichi* in the antennal segment which marks the first to possess rhinaria and form the antennal club; in *A. citripes* rhinaria and the antennal club first begin on F1, but are not formed until F4 in *A. ullrichi*.

Alloxysta erythrothorax (Hartig, 1840)

Distribution. Known from several European countries. Previously recorded from Iran by Khayrandish-Koshkooei et al. (2013).

Material examined: 1♂ & 2♀. "*Praon volucre* – *Aphis fabae* on *Solanum lycopersicum*, Karadj-Aghasht, coll.: E. Rakhshani, 06-XI-2004": 1♂ & 2♀.

Diagnosis. Head yellowish red; mesosoma and metasoma dark brown; scape, pedicel, F1 and F2 yellow and F3–F12 brown; legs yellow and veins brown. Female antennae 13-segmented; F1 and F2 smooth, F1 thinner than remaining flagellomeres; F3–F11 with rhinaria and form the antennal club; F1 longer than pedicel, F1 longer than F2, F2–F4 subequal (Fig. 6b). Male antennae 14-segmented; without any flagellomeres curved, as in female. Pronotum covered by dense setae, a pair of carinae clearly visible. Propodeum also with abundant setae, two carinae well defined on upper two-thirds separated by setae; carinae form a plate on lower third, plate with lateral sides slightly curved (Fig. 2e). Forewing longer than body; radial cell partially open, 2.9 times longer than wide (Fig. 4b).

Comments. This species is closely related to *A. castanea* and *A. ullrichi* based on the shape of the radial cell, but differ in the shape of the propodeal carinae: *A. erythrothorax* has the two carinae well defined on the upper two-thirds of the propodeum (Fig. 2e), while *A. castanea* has the carinae well defined only on the upper third (Fig. 2d), and *A. ullrichi* does not have carinae on the propodeum at all (Fig. 2a). In addition, *A. erythrothorax* differs from these two species in the size of the radial cell (Fig. 4b), being longer than in *A. castanea* (Fig. 3d) and *A. ullrichi* (Fig. 3c).

Alloxysta fuscicornis (Hartig, 1841)

Distribution. Cosmopolitan. Previously recorded from Iran by Lotfalizadeh (2002b) and Lotfalizadeh & van Veen (2004).

Material examined: 3♂ & 2♀. "*Aphidius colemani* – *Aphis fabae* on *Francocuria* sp., Kerman, coll.: A. Alipour, 10-X-2008": 2♀. "*Lysiphlebus fabarum* – *Aphis fabae* on *Vicia sativa*, Gorgan, coll.: A. Sargazi, 22-XI-2009": 3♂.

Diagnosis. Head, mesosoma and metasoma brown; scape, pedicel, F1 and F2 yellow and F3–F12 yellowish brown; legs yellow; veins brown. Female antennae 13-segmented; F1–F3 smooth and thinner than remaining segments; F4–F12 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2 longer than F3, F3 shorter than F4. Male antennae 14-segmented; with the same proportions as female, but with F1 slightly curved and F2 and F3 clearly curved. Pronotum covered by setae, two carinae present and clearly visible. Propodeum also with abundant setae and without carinae (Fig. 2h). Forewing longer than body; radial cell closed, 2.4 times longer than wide (Fig. 4d).

Comments. This species is closely related to *A. victrix*, having a closed radial cell and lacking propodeal carinae, but differs from it in the size of the

radial cell and the pubescence on the propodeum: *A. fuscicornis* (Fig. 4d) has a shorter radial cell compared with *A. victrix* (Fig. 4c); and *A. fuscicornis* has the propodeum completely covered with dense setae (Fig. 2h), while in *A. victrix* the propodeum lacks setae at the longitudinal area where the carinae are usually present in Charipinae (Fig. 2i).

Alloxysta macrophadna (Hartig, 1841)

Distribution. Known from several European countries. First record from Iran.

Material examined: 1♂ & 1♀. "*Aphidius uzbekistanicus* – *Sitobion avenae* on *Triticum aestivum,* Karadj, coll.: E. Rakhshani, 11-XII-2004": 1♂ & 1♀.

Diagnosis. Head yellowish red; mesosoma and metasoma dark brown; scape, pedicel and F1–F3 yellow, the remaining segments yellowish brown; legs yellow testaceous; wing venation dark brown. Female antennae 13-segmented; F1–F3 smooth and thinner than remaining ones; F4–F11 with rhinaria and form the antennal club; F1 longer than pedicel, F1 longer than F2, F2 shorter than F3 and F3 shorter than F4. Male antennae 14-segmented; as female, but with F2 and F3 curved. Pronotum densely covered with short setae, with two long carinae under pubescence. Propodeum without carinae, densely covered with short setae. Forewing longer than body; radial cell partially open at the costal margin, 3.3 times longer than wide (Fig. 3e).

Comments. This species has a peculiar radial cell (Fig. 3e), unlike any other species from Iran.

Alloxysta melanogaster (Hartig, 1840)

Distribution. Known from some European countries (Austria, Finland, France, Germany, Romania and Scotland). First record from Iran.

Material examined: 7♂ & 1♀. "*Aphidius ervi* – *Sitobion avenae* on *Zea mays*, Gorgan, coll.: E. Rakhshani, 08-VI-2005": 6♂. "Swept matter on *Medicago sativa*, Sabzevar-Jovein, coll.: Kh. Fathabadi, 05-VI-2011": 1♂ & 1♀.

Diagnosis. Head yellow, mesosoma and metasoma very yellowish brown; antennae yellow with the last flagellomeres brown; legs and veins yellow. Female antennae 13-segmented; F1–F2 smooth and thinner than remaining ones; F3–F11 with rhinaria and form the antennal club; F1 subequal to pedicel, F1 longer than F2, F2 subequal to F3, F4 longer than F3 (Fig. 6c). Male antennae 14-segmented; F1 smooth and thinner than remaining ones; F2–F12 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2–F4 subequal in length. Pronotum densely covered with long setae, with a pair of carinae on the anterior margin. Propodeum densely setose; carinae present forming a plate with lateral sides slightly curved and few setae on surface (Fig. 2c). Forewing longer than body; radial cell partially open, 2.3 times longer than wide (Fig. 3b).

Comments. This species is closely related to *A. castanea* according to the shape of radial cell but differs in the proportion between flagellomeres: F2–F4 not subequal in *A. melanogaster* females, F2–F4 subequal in length in *A. castanea* female; beginning of rhinaria in male antennae: F2 in *A. melanogaster* but F3 in *A. castanea*.

Alloxysta mullensis (Cameron, 1883)

Distribution. Known from Russia (Bokina 1997) and Scotland (Ferrer-Suay et al. 2012). Previously recorded from Iran by Lotfalizadeh (2002a). This species was erroneously synonymized with *A. brevis* by Fergusson (1986).

Material examined: 2♂ & 4♀. "*Aphidius ervi* – *Sitobion avenae* on *Zea mays*, Gorgan, coll.: E. Rakhshani, 8-VI-2005": 1♂. "*Aphidius matricariae* – *Dysaphis pyri* on *Pyrus communis*, Karadj-Shahrestanak, coll.: E. Rakhshani, 20-VI-2003": 1♂ & 2♀. "*Lysiphlebus fabarum* – *Aphis gossypii* on *Buxus hyrcana*, Isfahan, coll.: E. Rakhshani, 10-IV-2004": 1♀. "Swept mater on *Medicago sativa*, Sabzevar-Jovein, coll.: Kh. Fathabadi, 4-VI-2011": 1♀.

Diagnosis. Head brown, mesosoma and metasoma dark brown; scape, pedicel and F1–F3 dark yellow, F4–F11 yellowish brown; legs and veins yellow. Female antennae 13-segmented; F1–F3 smooth and thinner than remaining ones; F4–F11 with rhinaria and form the antennal club; pedicel subequal to F1, F1 longer than F2, F2 subequal to F3, F3 shorter than F4. Male antennae 14-segmented; F1 smooth and thinner than remaining segments; F2–F12 with rhinaria and form the antennal club; F2 slightly curved; F1 longer than pedicel, F1 sub-equal to F2, F2 shorter than F3 and F3 shorter than F4; proportions of flagellomeres similar to *A. arcuata* (Figs 6d, 6e). Pronotum covered by sparse setae, lacking carinae like *A. brevis* (Fig. 1a). Propodeum with abundant pubescence; two carinae present, forming a plate with lateral sides slightly curved. Forewing longer than body; radial cell closed, 2.2 times longer than wide.

Comments. This species is closely related to *A. arcuata* and *A. brevis* according to the shape of the

radial cell. *A. mullensis* differs from *A. arcuata* by the presence of the pronotal carinae: *A. mullensis* lacks pronotal carinae like *A. brevis* (Fig. 1a) while *A. arcuata* possesses pronotal carinae (Fig. 1b). *A. mullensis* differs from *A. brevis* in proportions of flagellomeres: *A. mullensis* has F1 longer than F2 and F2 subequal to F3 in female, like *A. arcuata* (Fig. 6e), but the female of *A. brevis* has F1–F3 subequal and short.

Alloxysta pusilla (Kieffer, 1902)

Distribution. Known from some European countries (England, France and Romania). First record from Iran.

Material examined: 1♀. "*Lysiphlebus fabarum* – *Aphis nasturtii* Kaltenbach on *Marrubium* sp., Kerman, coll.: A. Alipour, 20-XI-2008": 1♀.

Diagnosis. Head, mesosoma and metasoma dark brown; scape, pedicel and F1–F3 dark yellow, F4–F12 yellowish brown; legs dark yellow; veins yellowish brown. Female antennae 13-segmented; F1 and F2 smooth and thinner than remaining ones; F3–F11 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2 shorter than F3, F3 shorter than F4. Male antennae 14-segmented; filiform without an obvious club; F1–F12 with rhinaria; pedicel sub-equal in length to F1, F1–F3 sub-equals, F4 longer than F3. Pronotum with few setae and two clearly visible carinae. Propodeum densely pubescent; two carinae present, forming a plate on the lower half; upper half with carinae clearly defined and separated by setose area; propodeal plate on lower half with curved lateral sides (Fig. 2j). Forewing longer than body; radial cell closed, 2.1 times longer than wide in female and 2.4 times longer than wide in male (Fig. 3h).

Comments. This species is closely related to *A. arcuata* according to the shape of the radial cell, but differs *A. arcuata* in the ratio of F1 and the pedicel in the female antennae: F1 is longer than pedicel in *A. pusilla*, but is subequal in length to the pedicel in *A. arcuata* (Fig. 6d). These species also differ in the position where the club of the male antenna begins: it is F1 in *A. pusilla* and F2 in *A. arcuata* (Fig. 6e).

Alloxysta ruficollis (Cameron, 1883)

Distribution. Previously known only from Great Britain. First record from Iran.

Material examined: 1♂ & 2♀. "*Aphidius colemani* – *Aphis nerii* on *Nerium oleander*, Kerman, coll.: A. Alipour, 01-V-2010": 1♂ & 2♀.

Diagnosis. Head, mesosoma and metasoma yellowish brown; scape, pedicel and F1–F3 yellow, remaining antennal segments brown; legs light yellow; veins yellowish brown. Female antennae 13-segmented; F1 smooth; F2 with scarce rhinaria and F3 with dense rhinaria; F3–F11 form the antennal club; pedicel and F2 subequal in length, F3 longer than F2, F3 subequal to F4 (Fig. 6f). Pronotum bearing few setae and two strongly prominent carinae. Propodeum densely pubescent bearing a wide plate with lateral sides slightly curved outwardly, middle of upper half of plate setose (Fig. 2l). Forewing longer than body; radial cell closed, 2.3 times longer than wide (Fig. 3f).

Comments. No other species similar to *A. ruficollis* are currently known from Iran.

Alloxysta tscheki (Giraud, 1860)

Distribution. Known from several European countries. First record from Iran.

Material examined: 3♂ & 6♀. "*Aphidius ervi* – *Sitobion avenae* on *Zea mays*, Gorgan, coll.: E. Rakhshani, 08-VI-2005": 1♂; "on *Triticum aestivum,* Shiraz, coll.: E. Rakhshani, 27-IV-2005": 2♂ & 1♀. "*Aphidius uzbekistanicus* – *Sitobion avenae* on *Triticum aestivum,* Karadj, coll.: E. Rakhshani, 11-XII-2004": 5♀.

Diagnosis. Head yellow; mesosoma and metasoma dark brown; scape, pedicel and F1–F3 yellow, F4–F12 yellowish brown; legs and veins yellow. Female antennae 13-segmented; F1 and F2 smooth and thinner than remaining ones; F3–F11 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2 shorter than F3, F3 shorter than F4. Male antennae 14-segmented; F1–F2 smooth and thinner than remaining ones; F3–F12 with rhinaria and form the antennal club; pedicel–F4 subequal in length; F3 curved. Pronotum with two carinae; densely pubescent, especially along the anterior margin. Propodeum densely pubescent; two carinae present, carinae well defined and separated by a lot of setae in the upper half, carinae joining in the lower half, without forming a plate (Fig. 2g). Forewing longer than body; radial cell closed, 1.8 times longer than wide (Fig. 3g).

Comments. This species is closely related to *A. victrix* according to the yellowish colour of the head and the shape of the radial cell but differs in the size of the radial cell and in the presence of carinae on the propodeum: the radial cell of *A. tscheki* (Fig. 3g) is shorter than radial cell of *A. victrix* (Fig. 4c); *A. tscheki* has propodeal carinae (Fig.

2g) which *A. victrix* lacks (Fig. 2i).

Alloxysta ullrichi (Giraud, 1860)

Distribution. Known from some European countries (Austria, Bulgaria and Balkan Peninsula, England, Germany, Romania) and Israel. First record from Iran.

Material examined: 2♂ & 1♀. "*Aphidius funebris* – *Uroleucon sonchi* on *Sonchus* sp., Kerman, coll.: A. Alipour, 21-X-2008": 1♂ & 1♀. "*Praon volucre* – *Uroleucon cichori* on *Tragopogon pratensis*, Tehran, coll.: E. Rakhshani, 22-IV-2004": 1♂.

Diagnosis. Head, mesosoma and metasoma dark brown; scape, pedicel and F1–F3 testaceous, remaining segments brown; legs testaceous and veins yellowish brown. Female antennae 13-segmented; F1–F2 smooth and thinner than remaining segments; F3–F11 with rhinaria and form the antennal club; F1 longer than pedicel, F1 longer than F2, F2 subequal to F3 and F4 in length. Male antennae 14-segmented; F1–F3 smooth and thinner than remaining segments; F4–F12 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2 sub-equal to F3 and F3 shorter than F4. Two carinae present on the pronotum, under abundant pubescence. Propodeum also with plenty of pubescence and without carinae present (Fig. 2a). Forewing longer than body; radial cell partially open, 2.5 times longer than wide (Fig. 3c).

Comments. This species is closely related to *A. castanea* according to the shape of the radial cell, but differs in the presence of carinae on the propodeum: *A. castanea* has two carinae forming a plate with almost straight sides at propodeum (Fig. 2d), while *A. ullrichi* lacks carinae (Fig. 2a).

Alloxysta victrix (Westwood, 1833)

Distribution. Probably cosmopolitan. Previously recorded from Iran by Khayrandish-Koshkooei et al. (2013).

Material examined: 6♂ & 15♀. "*Aphidius absinthii* – *Macrosiphoniella abrotani* on *Artemisia annua*, Rasht-Lashtenesha, coll.: E. Rakhshani, 11-V-2005": 1♀; *Macrosiphoniella* sp. on *Artemisia annua*, Tutkabon, coll.: E. Rakhshani, 02-X-2004": 1♀. "*Aphidius salicis* – *Cavariella* sp. on *Salix aquatica*, Shiraz, coll.: E. Rakhshani, 27-VI-2002": 1♂. "*Lysiphlebus fabarum* – *Aphis craccivora* on *Vicia sativa*, Arak-Shanaq, coll.: M. Alikhani, 02-VI-2009": 2♀; "*Aphis fabae* - *Vicia sativa*, Gorgan, coll.: A. Sargazi, 22-XI-2009": 1♀; "*Aphis urticata* on *Urtica dioicea*, Rasht-Lashtenesha, coll.: E. Rakhshani, 25-V-2005": 5♂ & 10♀.

Diagnosis. Head dark yellow, mesosoma and metasoma dark brown; scape, pedicel, F1 and F2 yellow and F3–F12 yellowish brown; legs yellow; veins brown. Female antennae 13-segmented; F1 and F2 smooth and thinner than remaining flagellomeres; F3–F12 with rhinaria and form the antennal club; F1 longer than pedicel and F2, F2–F4 subequal. Male antennae 14-segmented, similar to female but with F1 slightly curved and F2 and F3 clearly curved. Pronotum covered by sparse setae, with a pair of carinae clearly visible. Propodeum with abundant pubescence, without carinae and lacking setae in the longitudinal area where carinae are usually present in Charipinae (Fig. 2i). Forewing longer than body; radial cell closed, 3.0 times longer than width (Fig. 4c).

Comments. This species is closely related to *A. tscheki* according to the yellowish colour of the head and the shape of the radial cell. It is also closely related to *A. fuscicornis* according to shape of radial cell and by not having carinae on the propodeum. *Alloxysta victrix* differs from *A. tscheki* in the size of radial cell and at the sculpture of the propodeum: the radial cell of *A. victrix* (Fig. 4c) is longer than the radial cell of *A. tscheki* (Fig. 3g), and *A. victrix* lacks propodeal carinae (Fig. 2i) which *A. tscheki* possesses (Fig. 2g). *Alloxysta victrix* differs from *A. fuscicornis* in the size of radial cell and the pubescence on the propodeum: the radial cell of *A. victrix* (Fig. 4c) is longer than the radial cell of *A. fuscicornis* (Fig. 4d) and *A. victrix* lacks setae in the area where carinae are usually present in other Charipinae (Fig. 2i), while the propodeum of *A. fuscicornis* is completely covered with setae (Fig. 2h).

Phaenoglyphis villosa (Hartig, 1841)

Distribution. Cosmopolitan. Previously recorded from Iran by Pujade-Villar et al. (2007).

Material examined: 78♂ & 101♀. "*Adialytus salicaphis* – *Chaitophorus pakistanicus* on *Salix alba*, Arak, coll.: M. Alikhani, 18-VI-2009": 2♀. "*Aphidius colemani* – *Aphis fabae* on *Rumex* sp., Kerman, coll.: A. Alipour, 25-X-2008": 1♀; "*Schizaphis graminum* on *Triticum aestivum*, Isfahan, coll.: E. Rakhshani, 10-IV-2004": 1♀. "*Aphidius ervi* – *Sitobion avenae* on *Triticum aestivum*, Shiraz, coll.: E. Rakhshani, 27-IV-2005": 8♂ & 3♀. "*Aphidius matricariae* – *Capitophorus similis* on *Elaeagnus angustifolia*, Tabriz, 25-XI-2004": 1♂; "*Myzus persicae* on *Prunus persica*, Shahriar, E. Rakhshani, 16-V-2002": 9♂ & 4♀. "*Binodoxys angelicae* – *Aphis fabae* on *Solanum nigrum*,

Shiraz, coll.: E. Rakhshani, 17-X-2003": 1♀. "*Diaeretiella rapae* – *Brevicoryne brassicae* on *Brassica juncea*, Isfahan, coll.: E. Rakhshani, 10-IV-2004": 1♀; "on *Brassica oleracea*, Tehran, coll.: E. Rakhshani, 18-XI-2004": 4♀; "*Rhopalosiphum padi* on *Zea mays*, Tehran, coll.: E. Rakhshani, 15-XI-2004": 1♀. "*Ephedrus niger* – *Uroleucon* sp. on *Lactuca* sp., Kerman, coll.: S. Ganjalikhani, 30-IX-2009": 1♂. "*Ephedrus persicae* – *Aphis fabae* on *Solanum lycopersicum*, Karadj-Aghasht, coll.: E. Rakhshani, 06-XI-2004": 6♂. "*Lysiphlebus fabarum* – *Aphis craccivora* on *Robinia pseudoacacia*, Tehran, coll.: E. Rakhshani, 21-V-2002": 4♂ & 1♀. "on *Vicia sativa*, Arak-Shanaq, coll.: M. Alikhani, 02-VI-2009": 1♀; "on *Portulaca oleracea*, Tehran, coll.: E. Rakhshani, 06-VI-2002": 1♂; "*Aphis fabae* on *Capsella bursa-pastoris*, Arak, coll.: M. Alikhani, 07-V-2009": 2♀; "*Aphis nerii* on *Nerium oleander*, Tehran, coll.: E. Rakhshani, 05-XI-2004": 3♂. "*Praon volucre* – *Aphis fabae* on *Cirsium arvense*, Shahriar, coll.: E. Rakhshani, 27-VI-2003": 1♂; "on *Solanum dulcamara*, Karadj, coll.: E. Rakhshani, 06-XI-2004": 4♂ & 26♀; "on *Solanum nigrum*, Kermanshah-Sahneh, coll.: E. Rakhshani, 06-X-2004": 1♀; "on *Solanum lycopersicum*, Karadj-Aghasht, coll.: E. Rakhshani, 05-XI-2004": 1♂ & 1♀; "*Uroleucon cichori* on *Sonchus oleraceus*, Karadj, coll.: E. Rakhshani, 28-X-2004": 3♂ & 2♀; "on *Tragopogon pratensis*, Tehran, coll.: E. Rakhshani, 22-IV-2004": 1♀; "*Uroleucon sonchi* on *Sonchus asper*, Tehran, coll.: E. Rakhshani, 15-XI-2004": 18♂ & 17♀; "17-X-2004": 15♂ & 19♀; "*Trioxys pallidus* – *Chromaphis juglandicola* on *Juglans regia*, Bojnurd, coll.: S. Kazemzadeh, 26-V-2008": 3♀. "Swept on *Triticum aestivum*, Sabzevar-Jovein, coll.: Kh. Fathabadi, 17-IV-2011": 1♀. "Without host data, Tehran, coll.: E. Rakhshani, 23-X-2004": 2♂ & 5♀; "Shahriar, coll.: A. A. Talebi, 14-IV-2009": 1♂ & 1♀; "Isfahan, coll.: E. Rakhshani, 31-X-2003": 2♀.

Diagnosis. Head, mesosoma and metasoma dark brown to blackish-brown; scape, pedicel, F1–F2 and sometimes F3 yellow to light brown, subsequent flagellomeres dark reddish-brown; legs yellow; veins yellowish to brownish. Female antennae 13-segmented; F1 and F2 smooth and thinner than remaining ones; F3–F11 with rhinaria and form the antennal club; F1 as long as pedicel or slightly longer, F1 subequal to F2, F2 shorter than F3, F3 shorter than F4. Male antennae 14-segmented; F1 and F2 smooth and thinner than remaining flagellomeres; F3–F12 with rhinaria and form the antennal club; F1 slightly curved and longer than pedicel, F1 subequal to F2, F2 shorter than F3. Pronotum covered by sparse setae with pronotal carinae present. Lower part of mesopleuron with horizontal sulcus (Fig. 5a). Mesoscutum without notauli, scutellum with two deep oval foveae more or less separated by a carina or completely fused. Propodeum with dense long setae; two carinae well defined, straight and parallel. Forewing longer than body; radial cell partially open along costal margin, 2.1–2.7 times longer than wide.

Comments. Only one species of this genus is present in Iran. This species is easily differentiated from other *Phaenoglyphis* species by being the only species with the radial cell partially open along the costal margin.

Discussion and conclusions

Two genera of Charipinae are associated with aphids in Iran: *Alloxysta* and *Phaenoglyphis* (Table 1). The second genus is paraphyletic (Paretas-Martínez et al. 2007a) but can be distinguished by having a transverse sulcus on the mesopleuron. The genus *Alloxysta* is a monophyletic lineage (Paretas-Martínez et al. 2007a) made up of very similar and homogeneous species. However, the following characters are valuable for separating species: (i) the aspect ratio of flagellomeres 1–4; (ii) the presence or absence of pronotal carinae (Fig. 1); (iii) the presence or absence of propodeal carinae and the shape of the propodeal plate (Fig. 2-3); (iv) the size and shape of the radial cell (Fig. 4). Great morphological variability (Andrews 1978) arising partly from the morphology of the host aphid (Carver 1992, Ronquist 1999), together with small size leading to the reduction of diagnostic characters, are the main reasons which make the taxonomy and identification of Charipinae difficult. This has led to controversy about the status of several species (Fergusson 1986, Menke & Evenhuis 1991, van Veen et al. 2003, Pujade-Villar et al., 2007, Quinlan & Evenhuis 1980).

Within *Alloxysta* there are two very similar and cosmopolitan species: *Alloxysta victrix* (Westwood) and *Alloxysta fuscicornis* (Hartig). These species share many diagnostic characters. Fergusson (1986) synonymized *A. fuscicornis* with *A. victrix* without any explanation. Evenhuis (in Menke & Evenhuis 1991) found that they are quite distinct when reared from the mummies of *Macrosiphum rosae* and related species, as well as *Brevicoryne brassicae* (Menke & Evenhuis 1991). These

species differ in the size of the radial cell, the length of the flagellomeres and the colour of the head. For these reasons, these authors resurrected *A. fuscicornis* from synonymy with *A. victrix*, but mentioned that the status of these two species needs further careful study. More recently, van Veen et al. (2003) sequenced a variable nuclear gene region (ITS2) for several *Alloxysta* species. The authors showed that each species possesses a unique allele with no intraspecific variation, concluding that *A. victrix* and *A. fuscicornis* should be considered as different species.

Table 1. Number of species of *Alloxysta* Förster and *Phaenoglyphis* Förster in each of Wallace's biogeographic regions.

	Alloxysta Förster	*Phaenoglyphis* Förster
Nearctic	22	10
Palaearctic	82	21
Neotropical	4	1
Afrotropical	3	1
Oriental	1	1
Australia	6	1

Another taxonomical problem is the "*brevis* complex". *Alloxysta brevis* (Thomson) has always been characterized by its small size and its small closed radial cell, but there are more features that need to be considered for its identification, including: the presence or absence of pronotal carinae, the shape of the propodeal carinae and the length ratio of the flagellomeres. Fergusson (1986) synonymized three species, *Alloxysta arcuata* (Kieffer), *Charips* (*Charips*) *castaneiceps* (Kieffer) and *Alloxysta mullensis* (Cameron), with *A. brevis*. This species was previously recorded from Iran as *A. mullensis* by Lotfalizadeh (2002a). The *brevis*-complex is being studied at the University of Barcelona (Spain) on the basis of morphology. Their results indicate that the synonymies made by Fergusson (1986) were incorrect and that these names represent valid species. For this reason, only *A. mullensis* has been previously recorded from Iran, while *A. arcuata* and *A. brevis* are considered to be recorded for the first time here.

Finally, *Alloxysta erythrothorax* (Hartig) has recently been recorded from Iran under the name *Alloxysta fulviceps* (Curtis) (Khayrandish-Koshkooei et al. 2013). The status of *Alloxysta fulviceps* (Curtis) as a synonym of *Alloxysta victrix* (Westwood) has recently been clarified (Pujade-Villar et al. 2011), with the result that previously published records for *A. fulviceps* have to be changed to the name *Alloxysta erythrothorax* (Hartig), the next name of this complex of species.

Nine *Alloxysta* species are newly recorded from Iran including *A. arcuata*, *A. brevis*, *A. castanea*, *A. macrophadna*, *A. melanogaster*, *A. pusilla*, *A. ruficollis*, *A. tscheki* and *A. ullrichi*. All these species have only been previously recorded from the northern Palaearctic region, especially Europe. The present contribution confirmed the presence of these species in the central Asian area.

Generally, the 'alloxystines' are assumed to be obligatory aphid hyperparasitoids (Carver 1992), mostly with a general preference for aphidiine aphid parasitoids (Andrews 1978). Most of the tritrophic associations presented here are cited for the first time, not only for the new records, but also for the other six species previously recorded from Iran. Some patterns of species-specific association like *Alloxysta citripes* – *Trioxys pallidus* are evident. However, these host association data are too sporadic to make intelligent hypotheses about the host specificity of other species. Furthermore, the influence of host aphid and host plant increases the complexity of the trophic associations. Some species, like *Phaenoglyphis villosa* with an aggressive host range pattern, was reared from three aphidiinae parasitoids at same time, all associated with single aphid species. The wide host range of *P. villosa*, has been limited by the absence of further preferred hosts in the study area. This phenomenon, arising from the effect of host and habitat preference on the host range, has been confirmed by previous authors (Andrews 1978, Müller et al. 1999). These host association data for fifteen species significantly increases our knowledge regarding the biology of subfamily Charipinae. The primary parasitoids, host aphids and host plants are listed in Appendix 1.

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+ 1 page Appendix

Appendix 1. List of the organisms: primary parasitoids, host aphids and host plants, which were in association with Charipinae hyperparasitoids.

Primary parasitoid (Hym., Braconidae, Aphidiinae)	Host aphid (Hemi., Aphididae)	Host plants (Various families)
Adialytus salicaphis (Fitch)	*Acyrthosiphon gossypii* Mordvilko	*Artemisia annua* L.
Aphidius absinthii Marshall	*Aphis* (*Protaphis*) *terricola* Rondani	*Artemisia biennis* Willd.
Aphidius colemani Viereck	*Aphis craccivora* Koch	*Brassica juncea* (L.)
Aphidius ervi Haliday	*Aphis fabae* Scopoli	*Brassica oleracea* L.
Aphidius funebris Mackauer	*Aphis gossypii* Glover	*Buxus hyrcana* Pojark
Aphidius matricariae Haliday	*Aphis idaei* van der Goot	*Capsella bursa-pastoris* Mœnch
Aphidius rhopalosiphi De Stefani-Perez	*Aphis nasturtii* Kaltenbach	*Cirsium arvense* (L.)
Aphidius rosae Haliday	*Aphis nerii* Boyer de Fonscolombe	*Elaeagnus angustifolia* L.
Aphidius salicis Haliday	*Aphis punicae* Passerini	*Francocuria* sp.
Aphidius uzbekistanicus Luzhetzki	*Aphis urticata* Fabricius	*Glycyrrhiza glabra* L.
Binodoxys acalephae (Marshall)	*Brachycaudus helichrysi* (Kaltenbach)	*Juglans regia* L.
Binodoxys angelicae (Haliday)	*Brevicoryne brassicae* (L.)	*Lactuca* sp.
Diaeretiella rapae (M'Intosh)	*Capitophorus similis* van der Goot	*Marrubium* sp.
Ephedrus niger Gautier, Bonnamour & Gaumont	*Cavariella* sp.	*Medicago sativa* L.
Ephedrus persicae Froggatt	*Chaitophorus pakistanicus* Hille Ris Lambers	*Nerium oleander* L.
Lysiphlebus fabarum (Marshall)	*Chromaphis juglandicola* (Kaltenbach)	*Portulaca oleracea* L.
Praon exsoletum (Nees)	*Dysaphis pyri* (Boyer de Fonscolombe)	*Prunus persica* (L.)
Praon volucre (Haliday)	*Macrosiphoniella abrotani* (Walker)	*Punica granatum* L.
Trioxys asiaticus Telenga	*Macrosiphoniella* sp.	*Pyrus communis* L.
Trioxys pallidus (Haliday)	*Macrosiphum rosae* (L.)	*Robinia pseudoacacia* L.
	Myzus persicae (Sulzer)	*Rosa* sp.
	Rhopalosiphum padi (L.)	*Rubus idaeus* L.
	Schizaphis graminum (Rondani)	*Rumex* sp.
	Sitobion avenae (Fabricius)	*Salix alba* L.
	Therioaphis trifolii (Monell)	*Salix aquatica* L.
	Uroleucon cichori (Koch)	*Solanum dulcamara* L.
	Uroleucon sonchi (L.)	*Solanum lycopersicum* L.
	Uroleucon sp.	*Solanum melongena* L.
		Solanum nigrum L.
		Sonchus asper (L.)
		Sonchus oleraceus L.
		Sonchus sp.
		Sophora alopecuroides L.
		Tragopogon pratensis L.
		Triticum aestivum L.
		Urtica dioica L.
		Vicia sativa L.
		Zinia elegans Jacq.