

Research Article

The genus *Inostemma* Haliday (Hym.: Platygasteridae) in Iran with some new records and biological findings

Maryam Asadi-Farfar¹, Hossein Lotfalizadeh^{2*} and Younes Karimpour¹

1. Department of Plant Protection, Faculty of Agriculture, Urmia University, Urmia, Iran.

2. Plant Protection Research Department, East-Azarbaijan Agricultural and Natural Resources Research & Education Center, AREEO, Tabriz, Iran.

Abstract: Three species of the genus *Inostemma* Haliday (Hymenoptera: Platygasteridae), i.e. *Inostemma discessus* Szelenyi, *I. koponeni* Buhl and *I. contariniae* Szelenyi are reported as new records for the Iranian fauna. *Inostemma discessus* was reared for the first time from Ephedra gall midge, *Ephedromyia debilopalpis* Marikovskij (Dip.: Cecidomyiidae) on *Ephedra* sp. (Plantae: Ephedraceae) in the northwest Iran. The Iranian species of the genus *Inostemma* were listed.

Keywords: Platygasterinae, Gall midges, Host record, Fauna, Iran

Introduction

Cecidomyiidae with over 6200 known species are the most abundant groups among gall-inducing arthropods throughout the world. Different types of arthropod communities are commonly found inside the gall, living as inquiline, predators or parasitoids (Maia, 2001; Gagné, 2004; Yukawa and Rohfritsch, 2005; Dorchin *et al.*, 2015). Hymenoptera comprises the diverse parasitoid communities of egg/larval stages of gall midges, chiefly the families Platygasteridae, Proctotrupidae and superfamily Chalcidoidea (Merritt and Keiper, 2009; Patra *et al.*, 2012; Lotfalizadeh and Mohammadi-Khoramabadi, 2015).

The hymenopteran family Platygasteridae is a large group of exclusively parasitoid wasps (Koponen *et al.*, 2016). Within this family, Platygasterinae is a subfamily of tiny wasps, probably koinobiont egg-larval or egg-pupal

parasitoids of gall midges (Dip.: Cecidomyiidae) with a worldwide distribution (Buhl, 2011, 2009).

Inostemma Haliday, 1833 is a large, worldwide genus including numerous, mostly undescribed bizarre peripheral species (Margaría *et al.*, 2018). It belongs 109 nominal species worldwide (Johnson, 2020) which are associated with gall midges of the family Cecidomyiidae (Diptera) (Masner and Huggert, 1989; Mori *et al.*, 2019). The main diagnosis of most cecidomyiid parasitoid of the genus is the horn on the first metasomal tergite of female, hiding the ovipositor. The females can be easily separated, but it is commonly impossible to determine the males at the species level (Masner and Huggert 1989; Buhl and Choi, 2006; Rajmohana, 2006).

Among the collected specimens from East-Azarbaijan province in the northwest Iran by different methods that were reported in Asadi-Farfar *et al.* (2020), we found three species of *Inostemma*. A taxonomic study on these species is the aim of the present research.

Handling Editor: Ali Asghar Talebi

*Corresponding author: hlotfalizadeh@gmail.com

Received: 26 February 2020, Accepted: 01 May 2020

Published online: 10 May 2020

Materials and Methods

Collections were made in the northwest Iran (Figs 1, 2), mainly mountainous area with different vegetation. Studied materials were collected by different methods such as rearing on hosts, sweep netting (SN) and Malaise trapping (MT). In order to rear, galls of *Ephedra* sp. (Ephedraceae) from Kurddasht, East-Azərbayjan province were kept in containers until the gall midges and/or parasitoids appeared. The gall midges were then identified by Dr. M. Skuhrová (Czech Zoological Society, Czech Republic) (Hadi *et al.*, 2018).

Some other specimens were collected via a Malaise trap from Khosroshah, East Azarbaijan province and by sweeping net from Farfar village, Marand, East Azarbaijan province (Fig. 1 A, B). Captured parasitoids and cecidomyiids were conserved in ethanol 75% for taxonomic study. They were

mounted on card points and then examined using an Olympus™ SZH stereomicroscope. Generic and species identification of specimens was done using reliable keys and descriptions provided by Masner and Huggert (1989), Kozlov (1978) and Buhl (2005).

Keys to species of this genus for many European species are given by Szelenyi (1938), European USSR (Kozlov, 1978), Fennoscandia Denmark (Buhl, 1999) and India (Mukerjee, 1981). Identification results were consequently confirmed by Dr. Peter Neerup Buhl (Natural History Museum of Denmark, University of Copenhagen). Photos were taken using a BK Lab System by Visionary Digital and also Zerene Stacker 1.04 (Zerene Systems LLC, Richland, Washington, USA) for focus stacking and assemblage and illustrations in the plates were done in Adobe Photoshop CS4® software.



Figure 1 Habitats of collected specimens of *Inostema* species in the northwest of Iran, via a Malaise trap in Khosroshah (A) and a net in Marand (B).



Figure 2 Collection localities of *Inostemma* species in the northwest of Iran.

Voucher specimens are deposited in the insect collection of the Plant Protection Research Department, East-Azərbayjan Research & Education Center for Agriculture and Natural resources, Tabriz, Iran.

Used abbreviations: A1-n = antennal segments 1-n; T1-n = gastral tergites 1-n.

Results

Our platygastriid specimens belong to the genus *Inostemma* Haliday that are new records for the Iranian fauna as follows:

Genus *Inostemma* Haliday, 1833

Distribution: Worldwide (Vlug, 1995)

Valid subordinate taxa: 109 species (Johnson, 2020).

Biology: The members are parasitic in gall midges (Cecidomyiidae) (Masner and Huggert, 1989; Mori *et al.*, 2019).

Inostemma contariniae Szelenyi, 1938

Material examined: Iran, East Azarbaijan province, Marand, Farfar village (38°48'47"N, 45°68'47"E), Sweep netting, 1.V.2017; M. Asadi-Farfar leg., 1♀.

General distribution. West Palearctic: Hungary, Spanish mainland, Sweden, Germany, Fennoscandia and Denmark (Fabritius and Grellmann, 1971; Vlug, 1995; Buhl, 1999).

Main characteristics: Body Black; Legs black-brown; Head more than twice as wide as long, matt, densely wrinkled; vertex with a distinct notch; mesonotum matt, in the middle densely coriaceous; notauli distally quite indistinct; wing apparent, slightly more than twice as long as wide; abdomen hardly longer than head and mesonotum combined; T1 strongly transverse, longitudinally striated; cornutus of T1 reaches occiput, touching the head at the back, not protruding from the line of the rear ocellus, without spines at the apex, glabrous, fairly shining, longitudinally striated; T2 longer than wide, laterally striated at the base.

Inostemma discensus Szelenyi, 1939 (Fig. 3)

Material examined: Iran, East Azarbaijan province, Kurddasht (46°14'45"E, 38°52'11"N), ex *Ephedromyia debilopalpis* on *Ephedra* sp., 10-25.IV.2016, H. Lotfalizadeh leg., 15♀♀ 1♂♂. Iran, East Azarbaijan province, Khosroshah (46°02'55"E, 37°58'28"N), Malaise trap, 15.X.2012, H. Lotfalizadeh leg., 3♀; 2.VI.2016, M. Asadi-Farfar leg., 2♀.

Comment. This species was reared for the first time on *Ephedromyia debilopalpis* Marikovskij (Dip.: Cecidomyiidae) on *Ephedra* sp. (Ephedraceae). It was previously reported from Spain as a parasitoid of *Xerephedromyia*

ustjurtensis Fedotova, on *Ephedra distachya* L. (Buhl, 1998).

General distribution. Palearctic: Hungary, Czechoslovakia, USSR (Fabritius and Grellmann, 1971; Kozlov, 1978).

Main characteristics: Body black, antenna dark brown; legs black-brown; transverse head, 2 times wider than long, hardly wider than the thorax; eyes slightly hairy; antenna 10-segmented, A1 slightly longer than the 5 following segments combined; A2 twice as long as wide; mesonotum very shiny, finely sculptured, almost smooth in front of posterior margin, with some indistinct longitudinal wrinkles; notauli distinct, sharp, converging towards the hind and widened; first tergite transverse and smooth, longitudinally striated, without horn.

Inostemma kaponeni Buhl, 2005

Material examined: Iran, East-Azarbaijan province, Khosroshah (46°02'55"E, 37°58'28"N), Malaise trap, X.2007, 8-16.V.2008, IX. 2009, V.2009, 11.VII.2011, H. Lotfalizadeh leg., 7♀♀. Iran, East-Azarbaijan province, Marand, Farfar village (45°41'8" E, 38°29'0" N), sweeping net, V.2017, M. Asadi-Farfar leg., 3♀♀.

General distribution. Finland, Poland (Buhl, 2005).

Main characteristics: The vertex distinctly evenly convex; metapleuron completely covered with hairs; forewing 3.0 times as long as wide, with a brownish tint and dense microtrichia, marginal cilia 0.1 width of wing; hind wing 6.4 times as long as wide; marginal cilia 0.3 the widths of wing; metasoma 1.3 times as long as head and mesosoma combined, very slightly wider than mesosoma; T1 with two strong longitudinal keels, smooth between them, and hairy at their outer sides; T2 smooth but hairy in the anterior half of basal fovea. T3-T5 smooth, each with 2-3 superficially implanted hairs laterally; T6 smooth except for some small spots of rugosity, laterally with a few hairs.

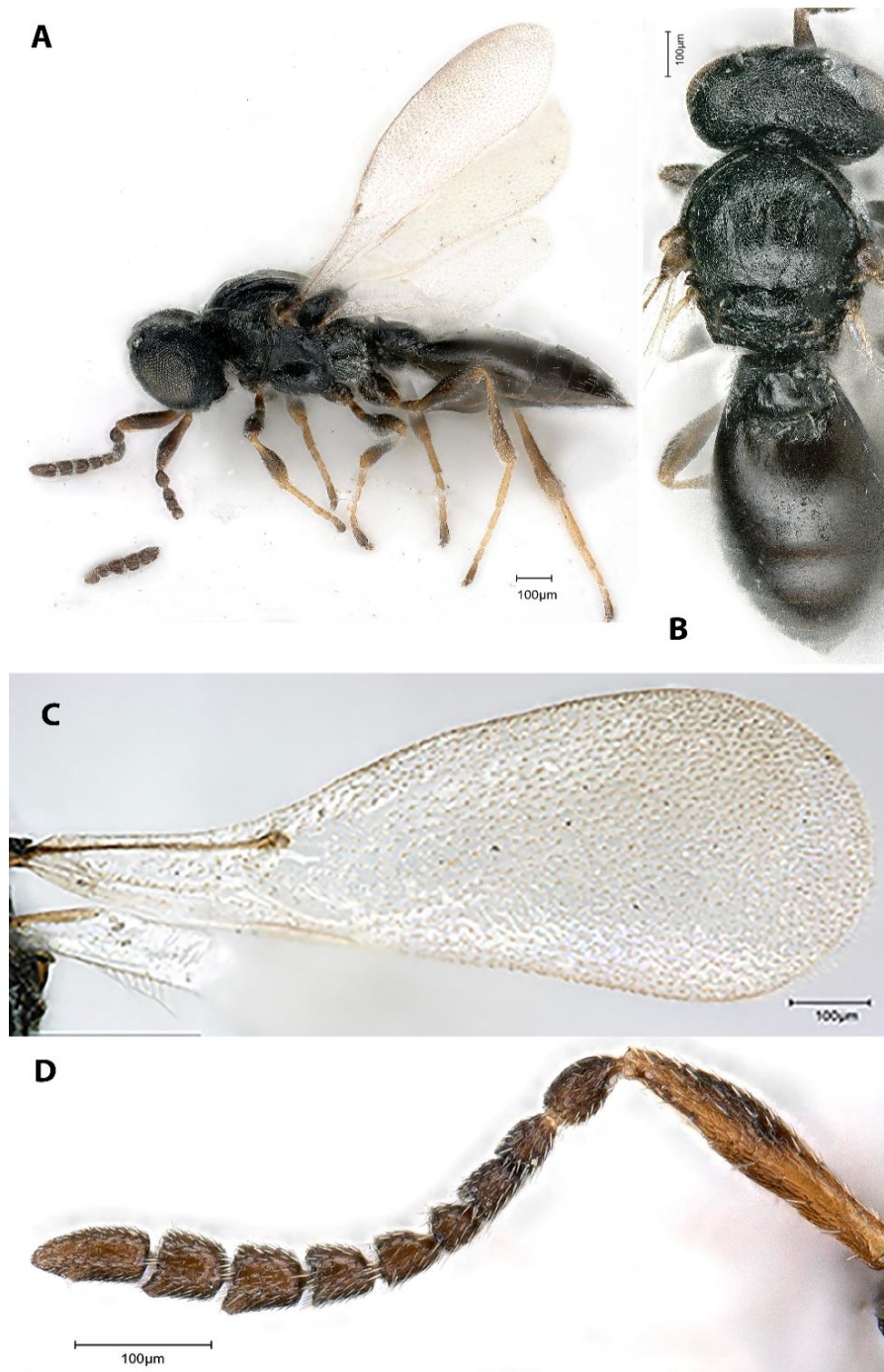


Figure 3 Female *Inostemma discessus* **A.** General habitus in lateral view; **B.** General habitus in dorsal view; **C.** Fore wing; **D.** Antennae.

Discussion

Inostemma is a specious worldwide genus (Johnson, 2020), while only three species

have been recorded from Iran (Table 1). Two species *I. reticulatum* Szelenyi and *I. hyperici* Debauche have been recorded from the coast of the Caspian Sea, while only *I.*

mediterraneum Kieffer was found in East Azarbaijan province.

Some species of the genus *Inostemma* have been reported as associated with pests (Margaría *et al.*, 2018). Biological association of *I. discessus* with cecidomyiid midges,

Ephedromyia debilopalpis Marikovskij on the *Ephedra* sp., is a new record. With three new records of this paper, the number of *Inostemma* known species from Iran raises to six. All biological associations of these species are provided in Table 1.

Table 1 *Inostemma* species recorded from Iran with geographical distribution in Iran and host associations in the world.

<i>Inostemma</i> species	Distribution in Iran	Biological associations	References
<i>Inostemma contariniae</i> Szelenyi	East Azarbaijan (Present study)	<i>Contarinia medicaginis</i> Kieffer and <i>Jaapiela veronicae</i> Vallot on alfalfa	Fabritius and Grellmann (1971)
<i>Inostemma discessus</i> (Szelenyi)	East Azarbaijan (Present study)	<i>Xerephedromyia ustjurtensis</i> Fedotova, on <i>Ephedra distachya</i> L.	Buhl (1998)
<i>Inostemma hyperici</i> Debauch	Mazandaran (Sakenin <i>et al.</i> , 2008)	<i>Ephedromyia debilopalpis</i> Marikovskij on the <i>Ephedra</i> sp.	New host record
<i>Inostemma kopenhageni</i> Buhl	East Azarbaijan (Present study)	On the flowers of <i>Hypericum</i> sp.	Sakenin <i>et al.</i> (2008)
<i>Inostemma mediterraneum</i> Kieffer	East Azarbaijan (Samin <i>et al.</i> , 2010)	<i>Stefaniella atriplicis</i> Kieffer on <i>Atriplex halimus</i> L.	Fabritius and Grellmann (1971)
<i>Inostemma reticulatum</i> Szelenyi	Golestan (Sakenin <i>et al.</i> , 2008)	<i>Dasineura brassicae</i> (Winnertz) on <i>Brassica</i> sp.	Vlug (1995)
-	-	<i>Ozirhincus tanaceii</i> Kieffer on <i>Tanacetum vulgare</i> L.	Buhl (2009)

Acknowledgments

Special thanks to the University of Urmia for financial support of the first author to visit the Natural History Museum of Denmark, University of Copenhagen. We thank Dr. P. N. Buhl (University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen) for his valuable help with the identification of *Inostemma* species.

Disclosure statement

No potential conflict of interest was reported by the author.

References

Asadi-Farfar, M., Lotfalizadeh, H., Karimpour, Y., and Buhl, P. N. 2020. Discovery of the genera *Trichacis* Förster and *Piestopleura* Förster (Hymenoptera: Platygastroidea) in Iran with descriptions of three new species. *International Journal of Environmental Studies*, 78: 1-9.

- Buhl, P. N. 1998. Platygasteridae (Hymenoptera) species of a *Juniperus thurifera* L. forest of Los Monegros region (Zaragoza, Spain). *Revista Aragonesa de Entomología*, 8: 11-42.
- Buhl, P. N. 1999. A synopsis of the Platygasteridae of Fennoscandia and Denmark (Hymenoptera, Platygastroidea). *Entomofauna*, 20(3): 17-52.
- Buhl, P. N. 2005. New or little known Palearctic species of Platygasterinae (Hymenoptera: Platygasteridae). II. *Entomologica Fennica*, 16: 74-82.
- Buhl, P. N. 2009. Six new species of Platygasterinae from the British Isles (Hymenoptera, Platygasteridae). *Journal of Natural History*, 43(11-12): 687-699.
- Buhl, P. N. and Choi, J. Y. 2006. Taxonomic review of the family Platygasteridae (Hymenoptera: Platygastroidea) from the Korean Peninsula. *Journal of Asia-Pacific Entomology*, 9(2): 121-137.
- Buhl, P. N. and Jałoszyński, P. 2016. Two new European species of Platygasterinae and discovery of the male of *Synopeas burgeri*

- Buhl, 2012 (Hymenoptera: Platygasteridae). *Annales Zoologici*, 66(3): 411-416.
- Dorchin, N., Astrin, J. J., Bodner, L. and Harris, K. M. 2015. Morphological and molecular revision of the genus *Ozirhincus* (Diptera: Cecidomyiidae) long-snouted seed-feeding gall midges on Asteraceae. *PLoS One*, 10(8): 1-29.
- Fabritius, K. and Grellmann, D. 1971. Contributii la studiul inostemminelor din România (Hymenoptera, Platygasteridae, Inostamminae). *Lucrari Stiintifice-Zoologie*, Constanta, 5-14.
- Floate, K. D., Fernandes, G. W. and Nilsson, J. A. 1996. Distinguishing intrapopulational categories of plants by their insect faunas: Galls on rabbit bush. *Oecologia*, 105: 221-229.
- Gagné, R. J. 2004. A catalog of the Cecidomyiidae (Diptera) of the world. *Memoirs of the Entomological Society of Washington*, 25: 1-408.
- Ghahari, H. and Buhl, P. N. 2011. Check-list of Iranian Platygasteridae (Hymenoptera, Platygastroidea). *Entomofauna*, 32(8): 329-336.
- Hadi, O., Lotfalizadeh, H., Kazemi, M. H. and Skuhra, M. 2018. Presence of ephedra gall midge, *Ephedromyia debilopalpis* Marikovskij (Diptera: Cecidomyiidae) in Iran. *Journal of Insect Biodiversity and Systematics*, 4(2): 135-139.
- Johnson, N. F. 2020. Hymenoptera on-line. Available from: <https://hol.osu.edu/index.html?id=7832>, accessed on 01/01/2020.
- Koponen, M., Buhl, P. N. and Vikberg, V. 2016. Check list of Platygasteridae of Finland (Hymenoptera, Platygastroidea). *Sahlbergia*, 22(2): 32-47.
- Kozlov, M. A. 1978. Identification of the insects of the European part of the USSR. Vol. 3. Hymenoptera, superfamily Proctotrupeoidea. Second part: Platygasteridae. *Opredeliteli Faune SSSR*, 120: 538-664.
- Margaría, C. B., Buhl, P. N., Aquino, D. A. and Ricci, E. M. 2018. Parasitoid wasp *Inostemma striaticornu* Buhl (Hymenoptera: Platygasteridae) in crops of bell pepper in Argentina. *Acta Zoológica Lilloana*, 62(1): 42-46.
- Masner, L. 1964. A comparison of some Nearctic and Palearctic genera of Proctotrupeoidea (Hymenoptera) with revisional notes. *Časopis Československé společnosti entomologické*, 61(2): 123-155.
- Masner, L., and Huggert, L. 1989. World review and keys to genera of the subfamily Inostemmatinae with reassignment of the taxa to the Platygasterinae and Sceliotrachelinae (Hymenoptera: Platygasteridae). *The Memoirs of the Entomological Society of Canada*, 121(147): 3-216.
- Maia, V. C. 2001. The gall midges (Diptera, Cecidomyiidae) from three restingas of Rio de Janeiro State, Brazil. *Revista Brasileira de Zoologia*, 18(2): 583-629.
- Merritt, R. W., Courtney, G. W. and Keiper, J. B. 2009. Diptera: (Flies, Mosquitoes, Midges, Gnats). In: Vincent, H. R. and Ring, T. C. (Eds.), *Encyclopedia of Insects (Second Edition)* Academic Press, San Diego. pp. 284-297.
- Mori, B. A., Andreassen, L., Heal, J. D., Dupuis, J. R., Soroka, J. J. and Sinclair, B. J. 2019. A new species of *Contarinia Rondani* (Diptera: Cecidomyiidae) that induces flower galls on canola (Brassicaceae) in the Canadian prairies. *The Canadian Entomologist*, 151(2):131-148.
- Mukerjee, M. K. 1981. On a collection of Scelionidae and Platygasteridae (Hymenoptera: Proctotrupeoidea) from India. *Records of Zoological Survey of India, Miscellaneous Publication, Occasional Papers*, 2: 78.
- Lotfalizadeh, H. and Mohammadi-Khoramabadi, A. 2015. Two torymid species (Hym.: Chalcidoidea, Torymidae) developing on *Artemisia* gall midges (Dip.: Cecidomyiidae). *Journal of Plant Protection Research*, 55(4): 344-346.
- Patra, B., Bera, S., Molchanoff, S., Wang, Y., Yang, J. and Li, C. 2012. Morpho-anatomy of *Xerephedromiya ustjurtensis* (Diptera: Cecidomyiidae) induced galls and intersexual variation of gall density in *Ephedra distachya* L. (Ephedraceae) from

- Ukraine. *Acta Botanica Hungarica*, 54(3-4): 377-389.
- Rajmohana, K. 2006. Studies on Proctotrupeoidea and Platygastroidea (Hymenoptera: Insecta) of Kerala. *Memoirs of Zoological Survey of India*, 21(1): 1-153.
- Samin, N., Kocak, E., Shojai, M. and Havaskary, M. 2010. An annotated list of the Platygastroidea (Hymenoptera) from the Arasbaran biosphere reserve and vicinity, northwestern Iran. *Far Eastern Entomologist*, 210: 1-8.
- Szelényi, G. V. 1938. Über paläarktische Scelioniden (Hym.: Proct.). *Annales Musei Historico Naturalis Hungarici*, 31: 108-128.
- Szelényi, G. V. 1939. Neue Palaeartic Scelioniden (Hym.: Proct.). *Annales Musei Historico Naturalis Hungarici*, 32: 121-127.
- Vlug, H. J. 1995. Catalogue of the Platygasteridae (Platygastroidea) of the World (Insecta: Hymenoptera). In: van Achterberg, C. (Ed.), *Hymenopterorum Catalogus, (nova editio). Pars 19*. SPB Academic Publishing, Amsterdam, pp. 1-168.
- Yukawa, J. and Rohfritsch, O. 2005. Biology and ecology of gall-inducing Cecidomyiidae (Diptera). In: Raman, A., Schaefer, C. W., Withers, T. M. (Eds.), *Biology, Ecology, and Evolution of Gall-inducing Arthropods*. Science Publishers Inc., Enfield, pp. 273-304.

جنس *Inostemma* Haliday (Hym.: Platygasteridae) در ایران به همراه چند گزارش و یافته بیولوژیکی جدید

مریم اسدی فارفار^۱، حسین لطفعلی زاده^{۲*} و یونس کریم پور^۱

۱- گروه گیاه پزشکی، دانشکده کشاورزی، دانشگاه ارومیه، ایران.

۲- بخش تحقیقات گیاه پزشکی، مرکز تحقیقات و آموزش کشاورزی و منابع طبیعی استان آذربایجان شرقی، تبریز، ایران.

پست الکترونیکی نویسنده مسئول مکاتبه: hlotfalizadeh@gmail.com

دریافت: ۷ اسفند ۱۳۹۸؛ پذیرش: ۱۲ اردیبهشت ۱۳۹۹

چکیده: سه گونه زنبور از جنس *Inostemma* Haliday (Hymenoptera: Platygasteridae) به نام‌های *I. contariniae* Szelenyi و *I. koponeni* Buhl *Inostemma discensus* Szelenyi برای اولین بار از ایران گزارش می‌شوند. گونه *I. discensus* برای نخستین بار از روی پشه گالزای افسردا، *Ephedromyia debilopalpis* Marikovski (Cecidomyiidae) پرورش یافته روی گال‌های گیاه *Ephedra* sp. (Ephedraceae) واقع در شمال غرب کشور گزارش می‌شود. همه گونه‌های شناخته شده این جنس در ایران فهرست گردید.

واژگان کلیدی: Platygasterinae، پشه‌های گال‌زا، گزارش میزبانی، فون، ایران