Iranian Journal of Animal Biosystematics (IJAB)
Vol.8, No.2, 133-153, 2012
ISSN: 1735-434X

A review of the tribe Meteorini (Cresson, 1887) (Hymenoptera: Braconidae, Euphorinae) in Northern Iran, with eight new records

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The tribe Meteorini (Cresson, 1887) (Braconidae: Euphorinae) of Northern Iran was studied. The specimens were collected using Malaise traps during 2010 and 2011. A total of 13 species were collected and identified, among them eight species viz., *Zele albiditarsus* Curtis, *Meteorus alborossicus* Lobodenko, *M. breviantennatus* Tobias, *M. cinctellus* (Spinola), *M. colon* (Haliday), *M. consimilis* (Nees), *M. ictericus* (Nees) and *M. vexator* (Haliday) were recorded for the first time from Iran, including new records, number of Meteorini species in Iran is now raised from 6 to 14. Detailed morphological characters for the recorded species and an identification key to the known Iranian species of Meteorini are provided.

Key words: Taxonomy, Braconidae, Euphorinae, Meteorini, , Iran

INTRODUCTION

The subfamily Euphorinae Foerster, is one of the largest groups of the family Braconidae (Hym., Ichneumonoidea) which occurs worldwide, comprising 54 genera (Chen and van Achterberg, 1997) and more than 1113 described species (Cikman and Beyarslan, 2009). The tribe Meteorini (Cresson, 1887) is an important group of parasitic wasps, which attack a wide range of important Lepidopterous pests. This tribe is represented by two genera *Meteorus* Haliday, 1835 and *Zele* Curtis, 1832 with 316 and 29 described species worldwide (Yu, 2012; Aguirre et al., 2011; Stigenberg and Ronquist, 2011; Shaw and Jones, 2009), of which 54 and 5 species being found in the Palaearctic region, respectively (Stigenberg and Ronquist, 2011).

The genus *Zele* has been considered as a sister group to *Meteorus* (van Achterberg, 1979). The genus *Meteorus* can be separated from *Zele* by at least two distinct characters: the marginal cell of hindwing which is subparallel or narrowed apically and metasomal tergites with a single row of setae.

The cosmopolitan genus *Meteorus* is the most diverse taxon in the subfamily Euphorinae (Shaw and Huddleston, 1991; Shaw, 1995). Biology of *Meteorus* species have been studied by Shaw and Huddleston (1991), Shaw (1995, 1997), Zitani et al. (1997) and Stigenberg and Ronquist (2011). The species of the genus *Meteorus* are solitary or gregarious koinobiont endoparasitoids of the larvae of Lepidoptera and Coleoptera (Maeto, 1990). However, most species are solitary parasitoids of small caterpillars, such as Geometridae, Noctuidae and Pyralidae, but several tropical *Meteorus* species are known to be gregarious parasitoids of larger caterpillars, including Sphingidae and Limacodidae (Muesebeck, 1958; Zitani, 2003; Shaw and Nishida, 2005). Very little information is available about biology of the genus *Zele*, but seems to be solitary parasitoids (Stigenberg and Ronquist, 2011).

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The taxonomy of the genus *Meteorus* has already studied in Japan (Maeto, 1990), China (Chen and Wu, 2000), India (Shamim, 2011), Northern America (Muesebeck, 1923), European part of Russia (Tobias, 1986), Russian Far East (Belokobylskij, 2000), Columbia (Aguirre et al., 2011), Australia and New Guinea (Huddleston, 1983) and Sweden (Stigenberg, 2008). The West Palaearctic species of the tribe Meteorini were revised and keyed by Stigenberg and Ronquist (2011), who recorded a total 59 species, seven of which were described as new species for this taxon.

The fauna of Iranian Euphorinae was poorly studied. The first recorded species of *Meteorus* from Iran were made by Aubert (1966). Few other researchers have sporadically recorded some species of *Meteorus* in Iran (Herard et al., 1979; Abbasipour, 2001; Nikdel et al., 2004), distinctly representing a very small part of this large group of braconids. Ghahari et al. (2009) reported *Zele chlorophthalmus* (Spinola) from northern Iran.

The purpose of this study as a part of our ongoing research on braconid fauna of Iran is to contribute to the knowledge of the tribe Meteorini in northern Iran and understanding faunal changes on two different slopes of the Alborz Mountains and through the biodiversity hotspots of Iran. An illustrated identification key to the Iranian species of the tribe Meteorini is also provided.

MATERIAL AND METHODS

The specimens of the present study were collected using Malaise traps during March to November 2010 and 2011 in northern (including Alborz, Guilan, Mazandaran, Qazvin and Tehran provinces). Malaise traps were placed in different habitats such as forest, rangelands and orchards. The specimens were extracted from the Malaise traps and sorted weekly. They were then treated with 70% ethanol and finally placed on a filter paper for drying. The dried specimens were then card-mounted and labeled. The different parts of body were dissected using small needles and mounted on glass slides using Hoyer's medium. Measurements of taxonomic characters carried out using a glass ocular graticule according to the method of Stigenberg and Ronquist (2011). The specimens were identified using the keys by Huddleston (1980) and Stigenberg and Ronquist (2011). Images for this study were taken with an Olympus™ AX70 microscope and Olympus™ SZX9 stereomicroscope equipped with a Sony CCD digital camera. Morphological terminology follows van Achterberg (1988). All specimens were deposited in the insect collection of the Department of Entomology, Tarbait Modares University, Tehran, Iran.

The abbreviations used in the identification key and diagnostic characters of species are as follows: OOL= distance between posterior ocellus and eye margin; OD= diameter of posterior ocelli (Fig. 2).

RESULTS

In total 13 species of the tribe Meteorini were collected and identified from the 32 studied area, including five previously reported species and eight newly recorded species viz., *Meteorus alborossicus* Lobodenko, 2000, *M. breviantennatus* Tobias, 1986, *M. cinctellus* (Spinola, 1808), *M. colon* (Haliday, 1835), *M. consimilis* (Nees, 1834), *M. ictericus* (Nees, 1811), *M. vexator* (Haliday, 1835) and *Z. albiditarsus* Curtis, 1832. The newly recorded species from Iran are marked with an asterisk (*) in the following list. Totally 91 specimens of Meteorini were collected using Malaise traps during 2010-2011. The most abundant species was *M. rubens* (37.36% of all collected specimens) followed by *M. pendulus* (23.08%) and *M. breviantennatus* (7.69%) (Table 1).

TABLE 1. Species number and abundance of the tribe Meteorini in northern Iran.

Parasitoid species	Previously recorded species	Collected species	New records	Number of specimens	Frequency (%)
Zele albiditarsus		*	*	2	2.20
Z. chlorophthalmus	*	*		4	4.40
Meteorus alborossicus		*	*	2	2.20
M. breviantennatus		*	*	7	7.69
M. cinctellus		*	*	3	3.30
M. colon		*	*	6	6.59
M. consimilis		*	*	2	2.20
M. ictericus		*	*	2	2.20
M. obsoletus	*			ND*	ND
M. pendulus	*	*		21	23.08
M. pulchricornis	*	*		2	2.20
M. rubens	*	*		34	37.36
M. versicolor	*	*		4	4.40
M. vexator		*	*	2	2.20
Total	6	13	8	91	100

*ND= no data are available. This species has previously reported from Iran and not collected in this research.

***Meteorus alborossicus* Lobodenko, 2000**

Material examined: Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º18'51.42'', E 52º07'48.00'', 702m a. s. l.), 16-viii-2011, 2♀♀; leg. S. Farahani.

Brief description: Body length 4.0 mm; antennae with 29 segments in female; OOL=2.5 OD (Fig. 3A); eyes protuberant; malar space shorter than basal width of mandibles; face as wide as height (Fig. 4A); length of forewing 4.0 mm; pterostigma slender (Fig. 5A); the first metasomal tergite with distinct dorsal pits, ovipositor long and slender, 3.0 x longer than first metasomal tergite (Fig. 6A).

Comment: *Meteorus alborossicus* is an easily diagnosed species. It can be distinguished from congeneric species by forewing venation. Vein 1–SR+M of forewing is incomplete (Fig. 5A).

Distribution: Belarus (Lobodenko, 2000), Sweden, United Kingdom (Stigenberg and Ronquist, 2011), new record from Iran.

Biology: Unknown.

***Meteorus breviantennatus* Tobias, 1986**

Material examined: Guilan province, Roodsar, Rahim abad, Orkom (N 36º45'44.34'', E 50º18'11.88'', 1201m a. s. l.), 25-vii-2010, 1♀; 02-viii-2010, 1♀; 23-viii-2010, 1♀; 29-viii-2010, 1♀; 20-ix-2010, 1♀; Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º21'55.02'', E 52º06'10.74'', 692m a. s. l.), 08-vi-2011, 1♀; 28-vi-2011, 1♀; leg. A. Mohammadi.

Brief description: Body length 3.0 mm; antennae with 21–22 segments in female; OOL=3.0 OD (Fig. 3B); eyes small, slightly protuberant, inner margins convergent; malar space shorter than basal width of mandibles; face 1.2–1.3 x as broad as height (Fig. 4B); length of forewing 2.9–3.0 mm;

pterostigma broad (Fig. 5B); the first metasomal tergite with distinct dorsal pits; ovipositor 2.0–2.5 x longer than first metasomal tergite (Fig. 6B).

Comment: *Meteorus breviantennatus* is similar to *M. cis* (Bouché) but *M. breviantennatus* has clypeus almost as wide as face and protruding while the clypeus of *M. cis* is narrower than face and flat. Also, *M. breviantennatus* is a smaller species.

Distribution: Georgia, Russia (Yu et al., 2005); Austria, China, France, Germany, Ireland, Japan, Korea, Netherlands, Sweden, United Kingdom (Stigenberg and Ronquist, 2011), new record from Iran.

Biology: *Meteorus breviantennatus* has been recorded as a parasitoid of *Tomicus minor* (Hartig) (Coleoptera: Scolytidae) (Martikainen and Koponen, 2001). Tobias (1986) reported this species as a parasitoid of *Ips acuminatus* (Gyllenhal) (Coleoptera: Scolytidae).

***Meteorus cinctellus* (Spinola, 1808)**

Material examined: Mazandaran province, Noor, Chamestan, Gaznasara (N 36º16'58.08'' , E 52º10'55.62'', 2013m a. s. l.), 07-vi-2011, 1♀; Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º21'55.02'' , E 52º06'10.74'', 692m a. s. l.), 28-vi-2011, 1♀; Guilan province, Roodsar, Rahim Abad, Orkom (N 36º45'44.34'', E 50º18'11.88'', 1201m a. s. l.), 25-x-2010, 1♀; leg. A. Nadimi.

Brief description: Body length 4.0 mm; antennae with 27 segments in female; OOL=2.5 OD (Fig. 3C); eyes large, protuberant, inner margins convergent; malar space shorter than basal width of mandibles; face as high as broad (Fig. 4C); length of forewing 3.9–4.0 mm; vein m–cu of forewing postfurcal; pterostigma slender (Fig. 5C); the first metasomal tergite without dorsal pits; margins of first metasomal tergite joined mid-ventrally, ovipositor 2.0–2.2 x longer than first metasomal tergite (Fig. 6C).

Comment: *Meteorus cinctellus* is the most easily recognizable species because of a blunt tubercule in frons and subapical antennal segment (in female) subquadrate. *Meteorus cinctellus* is close to *M. colon* (Haliday) and *M. tenellus* Marshall. But this species differ from *M. colon* by long ovipositor (2.0–2.2 x first metasomal tergite) and differ from *M. tenellus* by vein m–cu of forewing that is distinctly postfurcal.

Distribution: Albania, Austria, Belgium, Bulgaria, China, Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Latvia, Madeira Islands, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Switzerland, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005), new record from Iran.

Biology: *Meteorus cinctellus* is recorded as a parasitoid on Leaf roller Moths (Lepidoptera: Tortricidae) (Yu et al., 2005).

***Meteorus colon* (Haliday, 1835)**

Material examined: Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º21'10.50'' , E 49º57'56.16'', 2m a. s. l.), 01-vi-2010, 1♀; 27-ix-2010, 1♀; 18-x-2010, 1♀; 25-x-2010, 1♀; 01-xi-2010, 1♀; Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º22'03.66'' , E 49º57'57.84'', -1m b. s. L.), 27-ix-2010, 1♀; leg. M. Khayrandish.

Brief description: Body length 4.0–4.5 mm; antennae with 30–32 segments in female; OOL=1.5–2.0 OD (Fig. 3D); inner margins of eyes slightly convergent; malar space slightly shorter than basal width of mandibles (Fig. 4D); length of forewing 3.8–4.0 mm; vein m–cu of forewing postfurcal; pterostigma slender (Fig. 5D); the first tergite without dorsal pits; margins of first metasomal tergite joined mid-ventrally, ovipositor 1.3–1.6 x longer than first metasomal tergite (Fig. 6D).

Comment: *Meteorus colon* mostly resembles *M. artocerus* Stigenberg and *M. tenellus* Marshall, but the vein m–cu of forewing is postfurcal in *M. colon* and prefurcal in two other species.

Distribution: Armenia, Azerbaijan, Belgium, Bulgaria, China, Croatia, Czech Republic, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Japan, Lithuania, Moldova, Netherlands, Norway, Poland, Russia, Slovakia, Sweden, Switzerland, Turkey, United Kingdom, former Yugoslavia (Yu et al., 2005), Denmark (Stigenberg and Ronquist, 2011), new record from Iran.
Biology: Host records of *M. colon* include Lepidoptera, with most records involving species of Noctuidae (Huddleston, 1980; Yu et al., 2005).

***Meteorus consimilis* (Nees, 1834)**
Material examined: Guilan province, Roodsar, Rahim abad, Ziaz (N 36º52'27.18'', E 50º13'24.78'', 490 m a. s. l.), 06-vii-2010, 1♂; Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º21'55.02'', E 52º06'10.74'', 692m a. s. l.), 26-vii-2011, 1♀; leg. S. Farahani.
Brief description: Body length 4.0 mm; antennae with 33 segments in female; OOL=1.5 OD (Fig. 3E); eyes small and inner margins not convergent; malar space longer than basal width of mandibles; face 2.2 x as broad as height (Fig. 4E); length of forewing 4.0 mm; vein m–cu of forewing antefurcal (Fig. 5E); first metasomal tergite with dorsal pits; margins of first metasomal tergite completely separate in ventral view**,** ovipositor as long as first metasomal tergite (Fig. 6E).
Male same as female except antennae 36 segmented and without pale band on flagellum. Also, male color is darker than female.
Comment: This species is similar to *M. abdominator* (Nees) but it can be easily recognized by at least four distinct characters: malar space almost twice as long as basal width of mandible. OOL more than 2.0 x OD, pale band on flagellum and occipital carina complete.
Distribution: Belgium, Croatia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Poland, Romania, Slovenia, Sweden, Switzerland, Turkey, Turkmenistan, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005) and new record from Iran.
Biology: *Meteorus consimilis* is a parasitoid recorded as parasitizing on the larval stages of *Scolytus multistriatus* (Marsham) (Coleoptera: Scolytidae) (Yu et al., 2005).

***Meteorus ictericus* (Nees, 1811)**
Material examined: Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º21'55.02'', E 52º06'10.74'', 692m a. s. l.), 16-viii-2011, 1♀, 1♂; leg. A. Mohammadi.
Brief description: Body length 4.0 mm; antennae 28-segmented in both females and males; OOL=1.5 OD (Fig. 3F); eyes large, protuberant, inner margins not convergent; malar space slightly shorter than basal width of mandibles; face 1.5 x as broad as height (Fig. 4F); length of forewing 3.8 mm; vein m–cu of forewing antefurcal; pterostigma broad (Fig. 5F); the first metasomal tergite with distinct dorsal pits; margins of first metasomal tergite completely separate in ventral view; ovipositor almost 2.5 x longer than first metasomal tergite (Fig. 6F).
Male similar to female except antennae slightly darker and longer.
Comment: *Meteorus ictericus* is resemble to *M. ruficeps* (Nees) but inner margin of compound eyes of *M. ictericus* not convergent and pterostigma is broad.
Distribution: Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, China, Croatia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Sweden, Switzerland, Turkey, USA, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005), Denmark (Stigenberg and Ronquist, 2011), new record from Iran.
Biology: *Meteorus ictericus* is recorded on different lepidopteran families, with most records involving species of Tortricidae (Huddleston, 1980; Yu et al., 2005).

***Meteorus pendulus* (Müller, 1776)**

Material examined: Mazandaran province, Noor, Joorband (N 36º26'17.28'' , E 52º07'13.62'', 272m a. s. l.), 26-ix-2011, 1♂; 10-x-2011, 1♀; 05-xi-2011, 1♀, 1♂; Mazandaran province, Noor, Joorband (N 36º26'15.54'' , E 52º07'13.50'', 275m a. s. l.), 26-ix-2011, 2♀♀, 1♂; 10-x-2011, 2♂; 05-xi-2011, 2♀♀, 2♂♂; Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º21'10.50'' , E 49º57'56.16'', 2m a. s. l.), 29-viii-2010, 1♀; 06-x-2010, 1♀; 08-xi-2010, 1♂; 15-xi-2010, 1♂; Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º22'03.66'' , E 49º57'57.84'', -1m b. s. l.), 19-x-2010, 1♀; 01-xi-2010, 1♂; 09-xi-2010, 1♂; Qazvin province, Zereshk Road (N 36º21'43.02'', E 50º03'53.22'', 1553m a. s. l.), 22-June-2011, 1♀; leg. A. Nadimi.

Brief description: Body length 4.6–5.0 mm; antennae with 30–34 segments in female; OOL=1.0–1.5 OD (Fig. 3G); eyes large, protuberant, inner margins slightly convergent; malar space equal basal width of mandibles; face a little broader than height (Fig. 4G); length of forewing 4.0–4.5 mm; vein m–cu of forewing postfurcal; pterostigma slender (Fig. 5G); the first metasomal tergite with dorsal pits; margins of first metasomal tergite completely separate in ventral view (Fig. 1B); ovipositor 1.6–2.0 x longer than first metasomal tergite (Fig. 7A).

Male similar to female except antennae with up to 37 segments and propodeum more depressed.

Comment: *Meteorus pendulus* confused with *M. ictericus*. However, *M. ictericus* can be recognized by whitish hairs on possession between eyes and clypeus. Ovipositor is also longer than in *M. ictericus*.

Distribution: Austria, Azerbaijan, Belgium, Bulgaria, China, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, Iran, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Madeira Islands, Moldova, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005).

Biology: It is a solitary endoparasitoid on lepidopteran families (including Geometridae, Lasiocampidae, Lycaenidae, Lymantridae, Noctuidae and Tortricidae) and emerges from the larval stage (Yu et al., 2005). We received some specimens from Oromiyeh province as a solitary endoparasitoid of *Spodoptera exigua* (Hubner) (Lepidoptera: Noctuidae) in July, 2008.

***Meteorus pulchricornis* (Wesmael, 1835)**

Material examined: Mazandaran province, Noor, Chamestan, Joorband (N 36º26'17.28'', E 52º07'13.62'', 272m a. s. l.), 05-xi-2011, 2♀♀; leg. M. Khayrandish.

Brief description: Body length 4.7 mm; antennae with 30 segments in female; OOL=1.5 OD (Fig. 3H); eyes large, protuberant, inner margins moderately convergent; malar space slightly shorter than basal width of mandible; face 1.5 x as broad as height (Fig. 4H); length of forewing 4.2 mm; vein m–cu of forewing antefurcal; pterostigma slender (Fig. 5H); the first of tergite without dorsal pits; margins of first metasomal tergite joined mid-ventrally; ovipositor 2.0 x longer than first metasomal tergite (Fig. 7B).

Comment: *Meteorus pulchricornis* is similar to *M. abscissus* Thomson, but dorsal pits are absent in *M. pulchricornis*. Also, margins of first metasomal tergite joined mid-ventrally.

Distribution: Armenia, Austria, Azerbaijan, Belgium, Bulgaria, China, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Greece, Hungary, India, Iran, Ireland, Israel, Italy, Japan, Korea, Lithuania, Macedonia, Moldova, Morocco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005).

Biology: It is a solitary endoparasitoid on lepidopteran families (including Arctiidae, Geometridae, Herminiidae, Hesperiidae, Lasiocampidae, Lycaenidae, Lymantridae, Lyonetiidae, Noctuidae, Nolidae, Nymphalidae, Papilionidae, Plutellidae and Psychidae) and emerges from larval stage (Yu et al., 2005).

***Meteorus rubens* (Nees, 1811)**

Material examined: Alborz province, Karaj (N 35º46'08.88'', E 50º56'55.20'', 1277m a. s. l.), 08-vi-2010, 1♂; 29-vi-2010, 1♀; Alborz province, Chalous Road, Shahrestanak (N 35º57'34.98'' , E 51º22'20.34'', 2305m a. s. l.), 14-vii-2010, 1♀; 28-vii-2010, 1♂; Alborz province, Chalous Road, Arangeh (N 35º55'07.20'', E 51º05'09.24'', 1891m a. s. l.), 14-vii-2010, 6♀♀; 20-vii-2010, 1♂; Tehran province, Peykan Shahr, Botanic Gardan (N 35º44'19'', E 51º10'42'', 1891m a. s. l.), 18-v-2010, 1♀; 08-vi-2010, 1♀; Mazandaran province, Noor, Chamestan, Gaznasara (N 36º16'56.82'', E 52º10'58.50'', 2032m a. s. l.), 28-vi-2011, 2♀♀; 13-vii-2011, 3♀♀; 16-viii-2011, 1♀; Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º16'56.82'', E 52º10'58.50'', 2032m a. s. l.), 28-vi-2011, 1♀; 16-viii-2011, 1♀; Mazandaran province, Noor, Chamestan, Joorband (N 36º26'15.54'', E 52º07'13.50'', 275m a. s. l.), 28-vi-2011, 1♀; Qazvin province, Loshan (N 36º40'14.58'', E 49º25'38.52'', 259m a. s. l.), 25-v-2011, 2♀♀, 1♂; 09-vi-2011, 5♀♀, 1♂; Qazvin province, Zereshk Road (N 36º25'23.88'', E 50º06'37.68'', 1926m a. s. l.), 04-ix-2011, 1♀; 11-x-2011, 1♀; Qazvin province, Koohin (N 36º22'14.22'', E 49º40'02.28'', 1514m a. s. l.), 10-v-2011, 1♀; leg. A. Mohammadi.

Brief description: Body length 3.9–4.6 mm; antennae with 24–26 segments in female; OOL=1.0–1.5 OD (Fig. 3I); inner margins of eyes not convergent; malar space slightly shorter than basal width of mandibles; face 2.0 x as broad as height (Fig. 4I); length of forewing 3.5–4.0 mm; vein m-cu of forewing antefurcal; pterostigma slender (Fig. 5I); the first metasomal tergite without or sometimes trace of dorsal pits; margins of first metasomal tergite joined mid-ventrally (Fig. 1A), ovipositor 1.7–2.0 x longer than first metasomal tergite (Fig. 7C).

Male similar to female except antennae 26–30 segmented and propodeum more depressed.

Comment: *Meteorus rubens* and *M. heliophilus* Fischer are resemble. But it is recognized by two important characters: Ocelli are large in *M. rubens* (OOL=1.0–1.5 OD) and antennae of female with 24–26 segments, while ocelli in *M. heliophilus* are small (OOL=3.0 OD) and antennae of female with 28–30 segments.

Distribution: Algeria, Argentina, Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Canada, China, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Faeroe Islands, Finland, France, Germany, Greece, Greenland, Hungary, Iceland, Iran, Iraq, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Moldova, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Turkey, Turkmenistan, USA, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005).

Biology: *Meteorus rubens* is a solitary and gregarious endoparasitoid on lepidopteran families (including Coleophoridae, Gelechidae, Geometridae, Lasiocampidae, Lymantridae, Noctuidae, Nymphalidae, Pieridae, Pyralidae, Thaumetopoeidae, Tortricidae, Yponomeutidae) (Yu et al., 2005). We received some specimens from Qazvin province as a gregarious endoparasitoid of *Spodoptera exigua* (Hubner) (Lepidoptera: Noctuidae) in December 2009.

***Meteorus versicolor* (Wesmael, 1835)**

Material examined: Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º21'10.50'', E 49º57'56.16'', 2m a. s. l.), 04-x-2010, 1♀; 10-x-2010, 1♀; 18-x-2010, 1♀; Guilan province, Astaneh Ashrafieh, Eshmankomachal (N 37º22'03.66'' , E 49º57'57.84'', -1m b. s. l.), 18-x-2010, 1♀; leg. S. Farahani.

Brief description: Body length 4.5–4.7 mm; antennae with 29–30 segments in female; OOL=OD (Fig. 3J); eyes large, protuberant, inner margins not convergent; malar space shorter than basal width of mandibles; face 1.4 x as broad as height (Fig. 4J); length of forewing 4.0–4.2 mm; vein m–cu of forewing postfurcal; pterostigma slender (Fig. 5J); the first metasomal tergite without dorsal pits;

margins of first metasomal tergite joined mid-ventrally (Fig. 1C), ovipositor 1.5–2.0 x longer than first metasomal tergite (Fig. 7D).
Comment: *Meteorus versicolor* is close to *M. obsoletus* but can be separated by shape of the clypeus (convex in *M. versicolor*, flat in *M. obsoletus*) and convergence of inner margin eyes (not convergent in *M. versicolor*, convergence in *M. obsoletus*).
Distribution: Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Canada, China, Croatia, Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Madeira Islands, Moldova, Mongolia, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Tajikistan, Turkey, USA, Ukraine, United Kingdom, Uzbekistan, former Yugoslavia (Yu et al., 2005), new record from Iran.
Biology: *Meteorus versicolor* has been recorded as both solitary and gregarious endoparasitoid on lepidopteran families (including Arctiidae, Argyresthiidae, Geometridae, Lasiocampidae, Lycaenidae, Lymantriidae, Noctuidae, Nolidae, Notodontidae, Nymphalidae, Pieridae, Pyralidae, Thaumetopoeidae, Tortricidae) (Yu et al., 2005).

***Meteorus vexator* (Haliday, 1833)**
Material examined: Guilan province, Roodsar, Rahim Abad, Ziaz (N 36º52'27.18'', E 50º13'24.78'', 490m a. s. l.), 31-v-2010, 1♀; Guilan province, Roodsar, Rahim Abad, Ziaz (N 36º52'34.44'' , E 50º13'17.40'', 537m a. s. l.), 28-vi-2010, 1♀; leg. A. Nadimi.
Brief description: Body length 3.0–3.5 mm; antennae with 22–23 segments in female; OOL=3.0 OD (Fig. 3K); eyes large, protuberant, inner margins very convergent; malar space shorter than basal width of mandibles; face as broad as height (Fig. 4K); length of forewing 3.2 mm; vein m–cu of forewing antefurcal; pterostigma broad (Fig. 5K); the first metasomal tergite with dorsal pits; margins of first metasomal tergite completely separate in venteral view, ovipositor 2.5 x longer than first metasomal tergite (Fig. 7E).
Comment: *Meteorus vexator* is most similar to *M. affinis* Wesmael but *M. vexator* has smaller ocelli (OOL=3.0 OD in *M. vexator*, OOL=1.5–2.0 OD in *M. affinis*).
Distribution: Austria, Bulgaria, Croatia, Czech Republic, Finland, Germany, Hungary, Ireland, Latvia, Netherlands, Russia, Slovakia, Slovenia, Sweden, Switzerland, United Kingdom, former Yugoslavia (Yu et al., 2005), new record from Iran.
Biology: *Meteorus vexator* recorded by Morley (1912) and Stigenberg and Ronquist (2011) as a parasitoid of *Biphyllus lunatus* (F.) (Coleoptera: Biphyllidae) and *Dahlica lichinella* (L.) (Lepidoptera: Psychidae), respectively.

****Zele albiditarsus* Curtis, 1832**
Material examined: Alborz province, Chalous Road, Shahrestanak (N 35º57'34.98'', E 51º22'20.34'', 2305m a. s. l.), 01-vi-2010, 2♀♀; leg. M. Khayrandish.
Brief description: Body length 10.0 mm; antennae with 46 segments in female; OOL=OD (Fig. 8A); eyes large, protuberant; malar space shorter than (0.2 x) mandible base; face 1.4 x wider than height (Fig. 8B); vein cu–a of forewing postfurcal (Fig. 8C); vein r of hindwing absent (Fig. 8D), ovipositor short, about 1.5 x longer than first metasomal tergite (Fig. 9A).
Comment: Similar to *Z. deceptor* (Wesmael) but *Z. albiditarsus* has a shorter ovipositor.
Distribution: Canada, China, Croatia, Czech Republic, Denmark, Finland, France, Georgia, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Mexico, Moldova, Mongolia, Nepal, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, Turkey, USA, Ukraine, United Kingdom, former Yugoslavia (Yu et al., 2005), new record from Iran.

Biology: *Zele albiditarsus* is recorded as a solitary endoparasitoid on several Lepidoptera and Hymenoptera, being emerged from larval, prepupal and pupal stages of the hosts (Yu et al., 2005).

***Zele chlorophthalmus* (Spinola, 1808)**

Material examined: Mazandaran province, Noor, Chamestan, Tangehvaz (N 36º21'55.02'', E 52º06'10.74'', 692m a. s. l.), 27-vii-2011, 1♀; 16-viii-2011, 1♀; 10-x-2011, 1♀; Mazandaran province, Noor, Faculty of Natural Resources and Marine Sciences, (N 36º34'52.98'', E 52º02'45.78'', -14m b. s. l.), 05-xi-2011, 1♀; leg. A. Nadimi.

Brief description: Body length 6.0 mm; antennae with 37 segments in female; OOL=1.2 OD (Fig. 8E); eyes large, slightly protuberant; malar space shorter than (0.1 x) mandible base; face 1.3 x wider than height (Fig. 8F); vein cu–a of forewing antefurcal (Fig. 8G); vein r of hindwing present (Fig. 8H); ovipositor elongated, about 2.5 x longer than first metasomal tergite (Fig. 9B).

Comment: Similar to *Z. deceptor* and *Z. albiditarsus*, but vein cu–a of forewing is antefurcal in *Z. chlorophthalmus*.

Distribution: America, Austria, Azerbaijan, Belgium, Bulgaria, Cape Verde Islands, China, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Finland, France, Georgia, Germany, Hungary, India, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Macedonia, Madagascar, Moldova, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United kingdom, former Yugoslavia (Yu et al., 2005) and Iran (Ghahari et al., 2009).

Biology: *Zele chlorophthalmus* is a solitary endoparasitoid recorded as parasitiod of larval stages of several Lepidoptera families (Yu et al. 2005).

Key to Iranian species Meteorini (based on females)

1- Marginal cell of hindwing widened apically (Figs. 8D, H); metasomal tergites completely setose (**genus *Zele***) …..…… ……..……2

- Marginal cell of hindwing subparallel or narrowed apically; metasomal tergites with single row setae (**genus *Meteorus***) …..…… ……...……...…3

2- Vein cu–a of forewing postfurcal (Fig. 8C); ovipositor about 1.5 x longer than first metasomal tergite, large size (about 10 mm) ……...……...…***Z. albiditarsus***

-Vein cu–a of forewing antefurcal (Fig. 8G); ovipositor about 2.5 x longer than first metasomal tergite, medium size (about 6 mm)….....……***Z. chlorophthalmus***

3- Dorsal pits on first tergite absent or weakly developed ……...……...……**4**

- Dorsal pits on first tergite well developed ……..……...…….....**9**

4- OOL almost equal OD (Fig. 3J); base of ventral first metasomal tergite closed (Fig. 1C)….....**5**

- OOL 1.5–2.5 x OD (Figs. 3C, D, H, I); base of ventral first metasomal tergite open (Fig. 1A) ...…….....**6**

5- Eyes strongly protuberant; face 1.4 x broader than height (Fig. 4J); base of first metasomal tergite whitish or yellowish (Fig. 1C); ovipositor thick and 1.5–2.0 x longer than first metasomal tergite ……...…...…….…… ***M. versicolor***

- Eyes not protuberant; face height and width nearly equal; base of first metasomal tergite blackish or brownish; ovipositor slender and 2.0–2.5 x longer than first metasomal tergite ……..…….. ***M. obsoletus***

6- Marginal cell of forewing short (1R1 as long as pterostigma) (Fig. 5I); mandible long; claws simple (without distinct lobe) and bent ...…….……...…. ***M. rubens***

- Marginal cell of forewing long (1R1 length longer than pterostigma) (Figs. 5C, D, H); mandible and claws with distinct lobe and normal ……...……...……**7**

7- Wings infuscated; inner margins of eyes convergent (Fig. 4C); OOL about 2.5 x OD (Fig. 3C); ovipositor 2.0–3.0 x longer than first metasomal tergite; hind femur dark brown or blackish apically ……..……...……...…***M. cinctellus***

- Wings not infuscated; inner margins of eyes not convergent (Figs. 4D, H); OOL 1.5–2.0 x OD (Figs. 3D, H); ovipositor 1.0–2.0 x longer than first metasomal tergite; hind femur yellowish brown apically ……...……...……. **8**

8- Frons with a blunt tubercle in front of the fore ocellus; propodeum with a strong median transverse carinae; vein m–cu of forewing postfurcal .....……..***M. colon***

- Frons not tubercle in front of the fore ocellus; propodeum without distinct carinae; vein m–cu of forewing antefurcal (Fig. 5H) ....…….. ***M. pulchricornis***

9- OOL 1.0–1.5 x OD; inner margins of compound eyes slightly or not convergent (Figs. 4E, F, G)..……...……..……..**10**

- OOL 2.0–3.5 x OD; inner margins of compound eyes very convergent (Figs. 4A, B, K) ……..**12**

10- Malar space long, almost twice basal of mandibles (Fig. 4E); second submarginal cell narrowed anteriorly (Fig. 5E) ……..……...…...…….. ***M. consimilis***

- Malar space short; second submarginal cell normal anteriorly ……...……..... **11**

11- The area between inner side of eyes and clypeus covered with white hairs (Fig. 4F) ……..……...…..... ***M. ictericus***

- The area between inner side of eyes and clypeus without white hairs ……...…… ***M. pendulus***

12- Length of OOL 3.0–3.5 x OD (Fig. 3B); ovipositor length 2.0 x first metasomal tergite……..……...……***M. breviantennatus***

- Length of OOL 2.0–3.0 x OD (Figs. 3A, K); ovipositor length 2.5-3.0 x first metasomal tergite ...**13**

13- Forewing 1-SR+M completely sclerotized (Fig. 5K); tarsal claws without a basal lobe; hind coxa generally at least rugose ventrolateraly……..……..***M. vexator***

- Forewing 1-SR+M not complete sclerotized (Fig. 5A); tarsal claws widening at the base; hind coxa rugose ..... ***M. alborossicus***

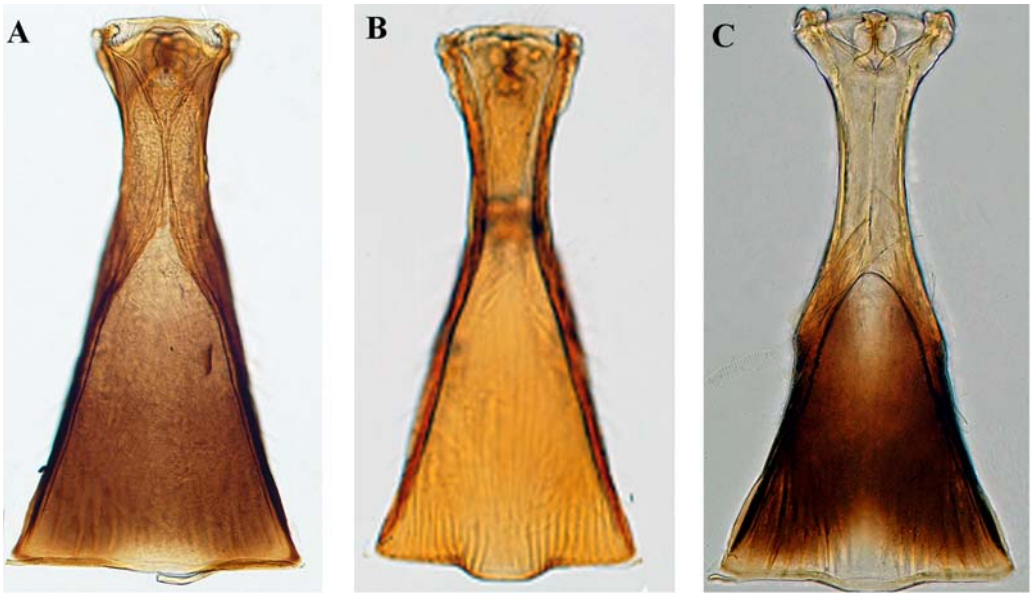

FIGURE 1. First metasomal tergite in ventral view (A) *Meteorus rubens*, (B) *Meteorus pendulus*, (C) *Meteorus versicolor*.

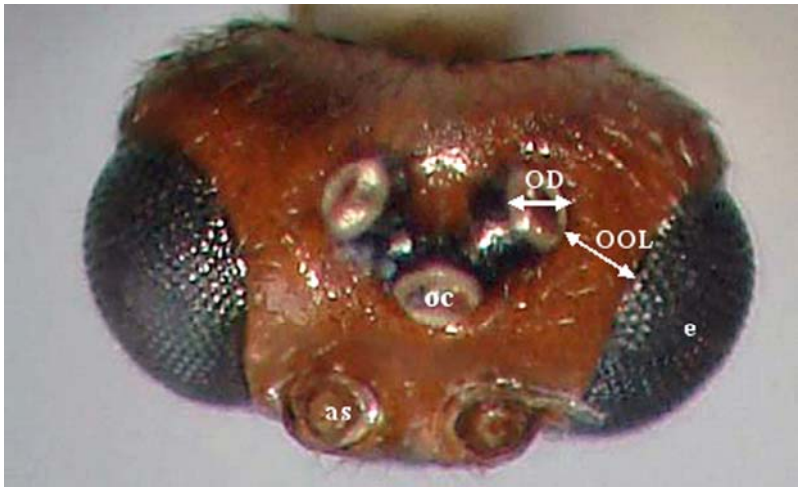

FIGURE 2. Morphological characters of *Meteorus rubens*; as= antennal socket, e= compound eye, oc= ocellus, OD= diameter of posterior ocellus, OOL= distance between posterior ocellus and eyes.

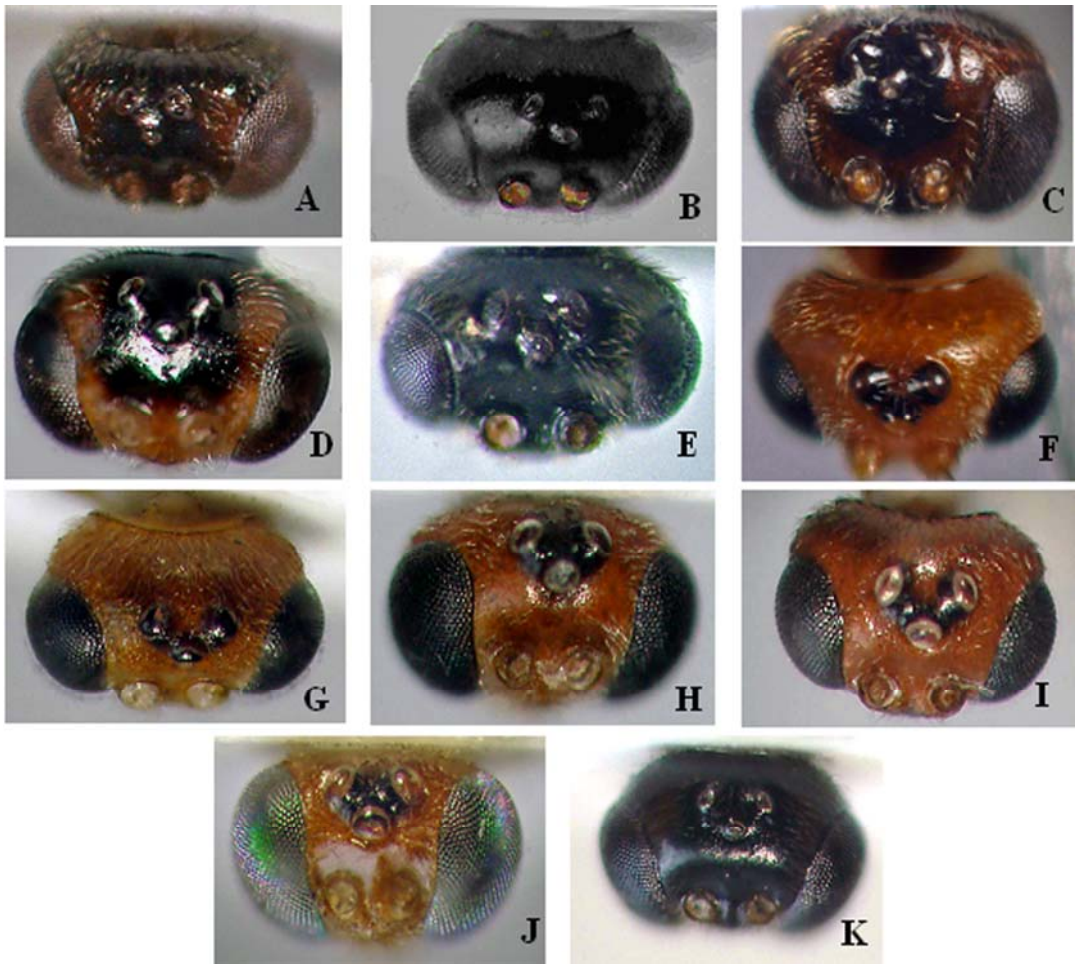

FIGURE 3. Dorsal view of head in *Meteorus* species: (A) *M. alborossicus*, (B) *M. breviantennatus*, (C) *M. cinctellus*, (D) *M. colon*, (E) *M. consimilis*, (F) *M. ictericus*, (G) *M. pendulus,* (H) *M. pulchricornis,* (I) *M. rubens*, (J) *M. versicolor*, (K) *M. vexator.*

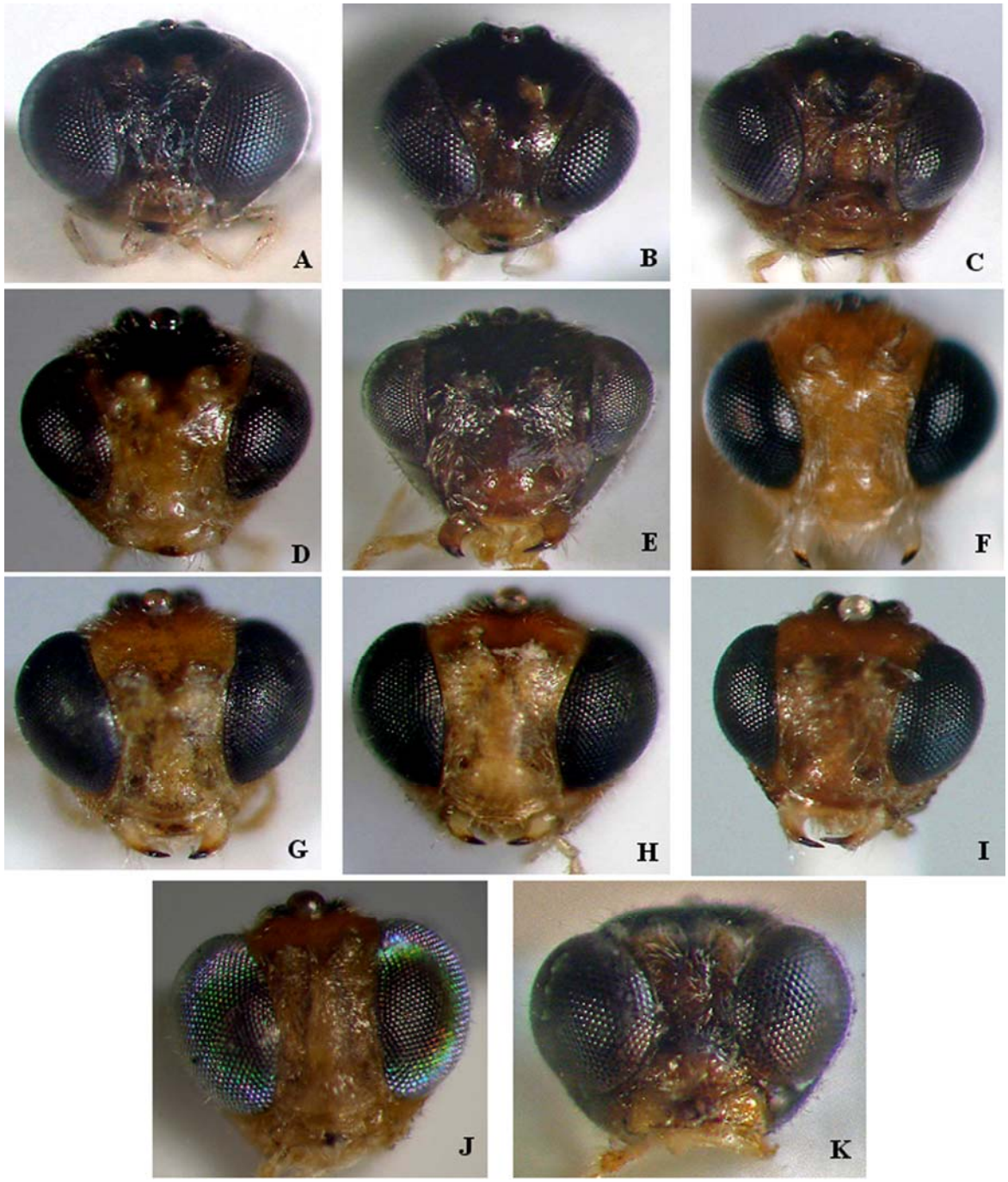

FIGURE 4. Frontal view of head in *Meteorus* species: (A) *M. alborossicus*, (B) *M. breviantennatus*, (C) *M. cinctellus*, (D) *M. colon*, (E) *M. consimilis*, (F) *M. ictericus*, (G) *M. pendulus,* (H) *M. pulchricornis,* (I) *M. rubens*, (J) *M. versicolor*, (K) *M. vexator*.

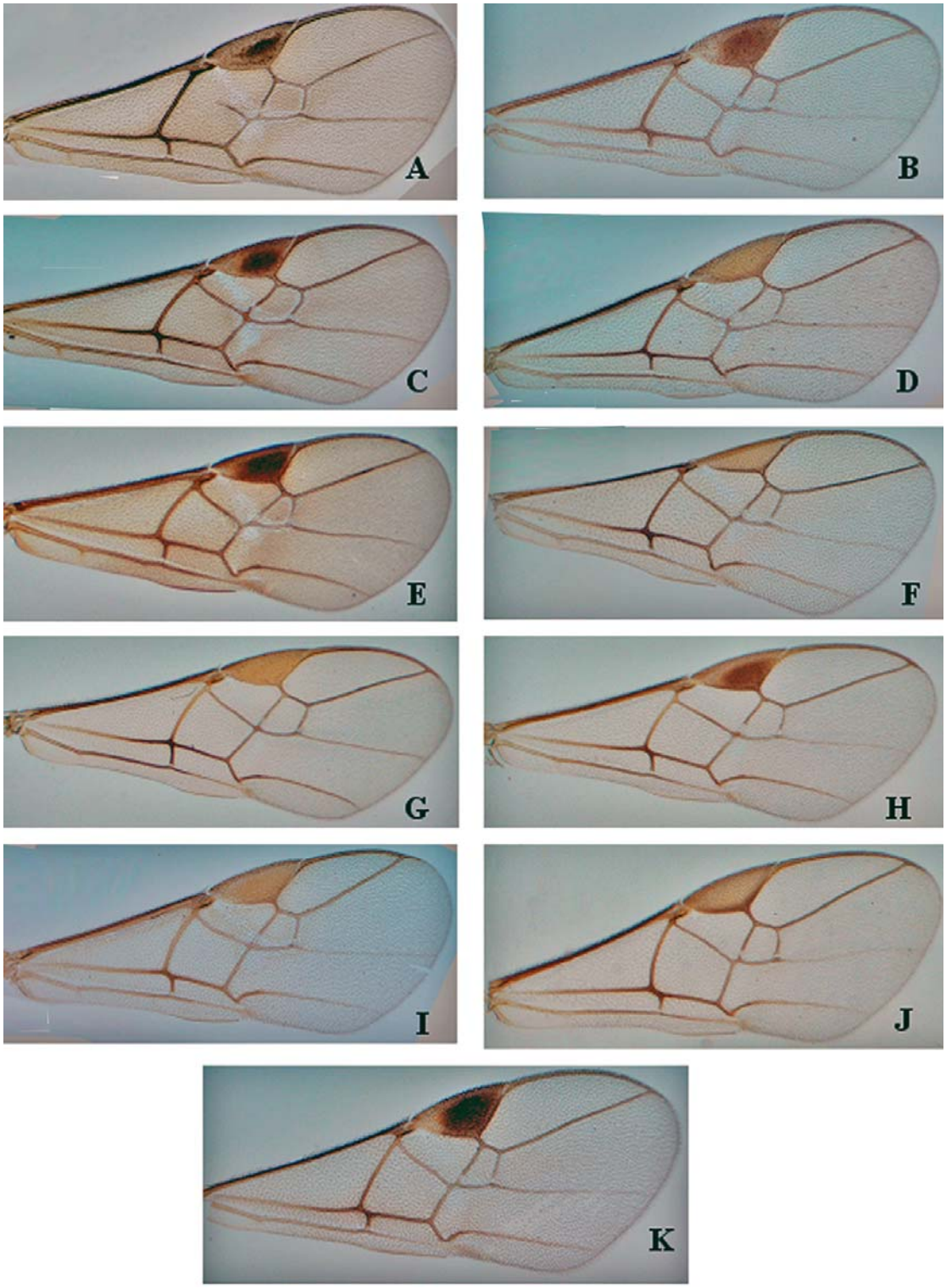

FIGURE 5. Forewings of *Meteorus* species: (A) *M. alborossicus*, (B) *M. breviantennatus*, (C) *M. cinctellus*, (D) *M. colon*, (E) *M. consimilis*, (F) *M. ictericus*, (G) *M. pendulus,* (H) *M. pulchricornis,* (I) *M. rubens*, (J) *M. versicolor*, (K) *M. vexator*.

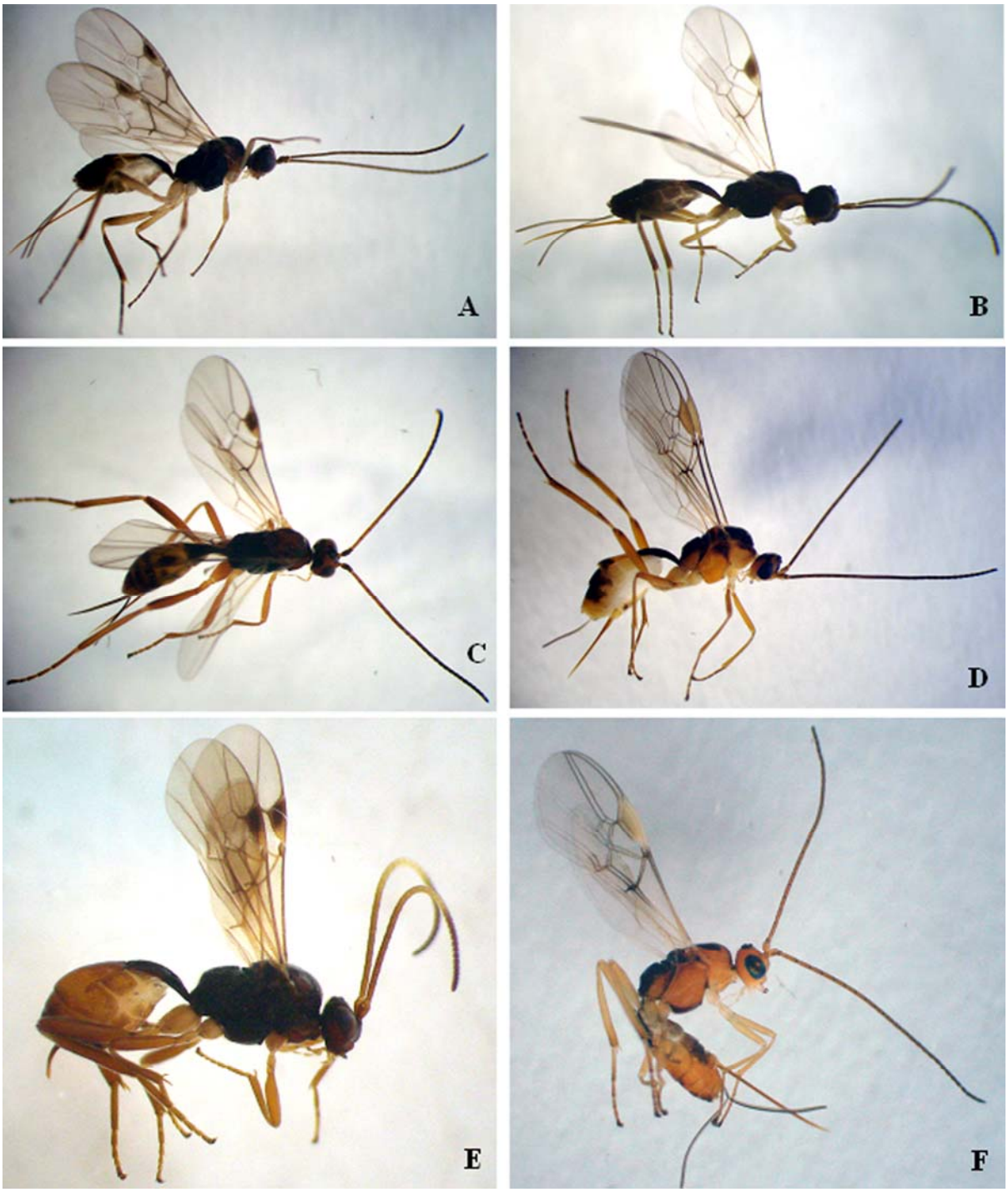

FIGURE 6. Lateral habitus of female in *Meteorus* species: (A) *M. alborossicus*, (B) *M. breviantennatus*, (C) *M. cinctellus*, (D) *M. colon*, (E) *M. consimilis*, (F) *M. ictericus*.

FIGURE 7. Lateral habitus of female in *Meteorus* species: (A) *M. pendulus,* (B) *M. pulchricornis,* (C) *M. rubens*, (D) *M. versicolor*, (E) *M. vexator*.

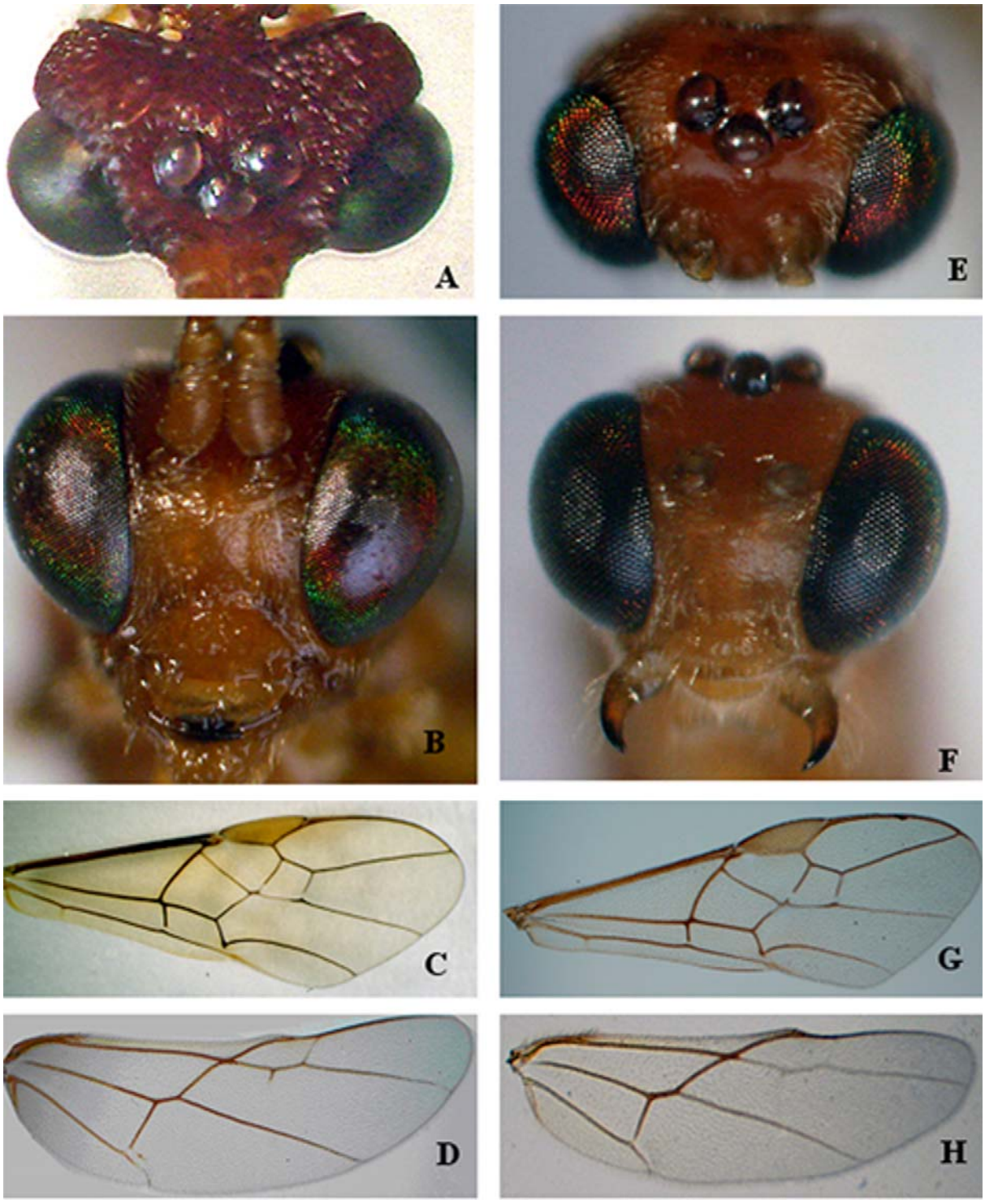

FIGURE 8. *Zele albiditarsus* (A – D): (A) dorsal view of head, (B) frontal view of head, (C) forewing, (D) hindwing; *Zele chlorophthalmus* (E – H): (E) dorsal view of head, (F) frontal view of head, (G) forewing, (H) hindwing.

FIGURE 9. Lateral habitus of female of *Zele* species: (A) *Zele albiditarsus*, (B) *Zele chlorophthalmus*.

DISCUSSION

According to our research and previous literatures 14 species of Meteorini are known in Iran. *Meteorus obsoletus* not found in our studied area. *Meteorus obsoletus* and *M. versicolor* reported on brown-tail moth, *Euproctis chrysorrhoea* Linnaeus, 1758 (Lepidoptera: Lymantriidae), by Nikdel et al. (2004) from Arasbaran forest. *Meteorus pendulus* reported as endoparasitoid wasp on rice armyworm, *Mythimna unipuncta* (Hawarth, 1809) (Lepidoptera: Noctuidae), from Mazandaran province by

Abbasipour (2001). Herard et al. (1979) recorded *M. pulchricornis* on *Lymantria dispar* (Linnaeus, 1758) from Iran. The number of species recorded in Iran is much lower than the Western Palaearctic (59 species), that indicating the necessity of further investigations in Iran to increase our understanding about the tribe Meteorini. Yilmaz et al. (2010) listed 19 species of the Meteorini (18 *Meteorus* and one *Zele*) from Turkey. The genus *Meteorus* has also a wide distribution in the world (Shaw and Jones, 2009; Stigenberg and Ronquist, 2011).

There are two major biodiversity hotspots in Northern Iran, Irano-Anatolian and Caucasus. The Irano-Anatolian biodiversity hotspot extending across portions of Armenia, Azerbaijan, Georgia, Iraq, Iran, Turkey and Turkmenistan. The Irano-Anatolian hotspot includes highlands of the central and eastern Anatolian Plateau as well as the Zagros, Alborz, and Kopet Dag mountain ranges. Alborz and Qazvin provinces is situated in the Irano-Anatolian hotspot. The Caucasus is a geopolitical region at the border of Europe and Asia, and situated between the Black and the Caspian seas which contain the Caucasus and Albros Mountains. Guilan and Mazandaran provinces are located in the Caucasus hotspot. Our study showed that three species distributed in the Irano-Anatolian hotspot (*M. pendulus*, *M. rubens* and *Z. albiditarsus*) and 12 species in the Caucasus hotspot (*M. alborossicus, M. breviantennatus*, *M. cinctellus*, *M. colon*, *M. consimilis*, *M. ictericus, M. pendulus, M. pulchricornis*, *M. rubens*, *M. versicolor*, *M. vexator* and *Z. chloroohthalmus*) and only two species (e.i. *M. pendulus* and *M. rubens*) have been collected from the both hotspots.

Potential of *M. pulchricornis* as a primary regulator of painted apple moth, *Orgyia anartoides* (Walker) (Lepidoptera: Lymantridae) populations successfully tested in New Zealand. This parasitoid prefers to parasitize second and third instar larvae of hosts (Chhagan et al., 2008). *Meteorus rubens* is a major biological control agent of *Agrotis ipsilon* (Hufnagel) (Lepidoptera: Noctuidae) and the rate of parasitism can be increase by using kairomones. The results of the current study may also contribute to the knowledge of biodiversity and geographical distribution of braconid parasitic wasps. Previous studies have been shown that the species of the genus *Meteorus* attack important lepidopterian pests (Stigenberg and Ronquist, 2011; Yu et al., 2005) and further investigations are required to determine the potential of these parasitic wasps against lepidopterous pests in Iran. Most probably, some other species of Meteorini are distributed in Iran, which needs further studies.

ACKNOWLEDGMENTS

We would like to thank the Department of Entomology, Tarbiat Modares University for providing financial support for this research. We are especially grateful to C. van Achterberg (Department of Zoological, Leiden Natural History Museum, the Netherlands) and Julia Stigenberg (Department of Zoology, Stockholm University, Sweden) for identifying some species. Our cordial thanks are expressed to Mr. A. Nadimi, Mr M. Kheyrandish and Mr A. Mohammadi for helping us in collecting and separating some of the specimens.

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