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Research Article

Two species of the genus *Elachertus* Spinola (Hym.: Eulophidae) new larval ectoparasitoids of *Tuta absoluta* (Meyreck) (Lep.: Gelechidae)

Fatemeh Yarahmadi[1*], Zohreh Salehi[1] and Hossein Lotfalizadeh[2]

1. Ramin Agriculture and Natural Resources University, Mollasani, Ahvaz, Iran.
2. East-Azarbaijan Research Center for Agriculture and Natural Resources, Tabriz, Iran.

Abstract: This is the first report of two ectoparasitoid wasps, *Elachertus inunctus* (Nees, 1834) in Iran and *Elachertus pulcher* (Erdös, 1961) (Hym.: Eulophidae) in the world, that parasitize larvae of the tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) (Lep.: Gelechiidae). The specimens were collected from tomato fields and greenhouses in Ahwaz, Khouzestan province (south west of Iran). Both species are new records for fauna of Iran. The knowledge about these parasitoids is still scanty. The potential of these parasitoids for biological control of *T. absoluta* in tomato fields and greenhouses should be investigated.

Keywords: tomato leaf miner, parasitoids, identification, biological control

Introduction

The Eulophidae is one of the largest families of Chalcidoidea. The chalcid parasitoid wasps attack insects from many orders and also mites. Many eulophid wasps parasitize several pests on different crops. They can regulate their host's populations in natural conditions (Yefremova and Myartseva, 2004). Eulophidae are composed of four subfamilies, Entedoninae (Förster, 1856), Euderinae (Lacordaire, 1866), Eulophinae (Westwood, 1829) and Tetrastichinae (F□rster, 1856) (Schauff *et al*., 1997). The family has a total of 297 genera and 4472 described species (Noyes, 2015). The members of the subfamily Euolophinae are generally ectoparasitoid of many holometabolous insects (Noyes, 2015). Many species of the family have proven to be highly successful biological control agents. Although eulophid wasps are generally parasitoids of holometabolous insects, the overall range of hosts and biologies in eulophid wasps is remarkably diverse (Gauthier *et al.*, 2000).

Species of the genus *Elachertus* Spinola, 1811 (Hym.: Eulophidae) are primary parasitoids of a variety of lepidopteran larvae. Some species are polyphagous that parasite hosts belonging to different insect families. The larvae of these wasps are often gregarious and their pupae can be observed on the surface of plant leaves or the body of their host. They seem to prefer host larvae that occupy sheltered situations such as leaf rolls, leaf mines or that bore inside twigs or growing tips. Several of these host species are economically important (Schauff, 1985).

The tomato leaf miner, *Tuta absoluta* Meyrick, is considered as a key pest of tomato both in the field and under protected conditions (Yankova, 2012) in Asia (Desneux *et al.*, 2011). Larvae preferentially feed on all above-ground parts of tomato, create mines on the leaves and penetrate into young stems and fruits. Both yield and fruit quality can be significantly reduced by the direct feeding of the pest and the secondary pathogens which may then enter through the

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* **Corresponding author**, e-mail: yarahmadi@ramin.ac.ir
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wounds made by the pest. Severely attacked tomato fruits lose their commercial value (Cristina *et al.*, 2008).

The following species belong to *Elachertus* genus was previously recorded from Iran: *E. gallicus* (Erdös, 1958) and *E. lateralis* (Spinola, 1808) (Yefremova *et al*., 2007; Talebi *et al*., 2011).

Materials and Methods

During bio-ecological studies on tomato leaf miner, *Tuta absoluta* (Meyrick) (Lep.: Gelechiidae), in tomato greenhouses and fields in Ahwaz (Khouzestan province, south west Iran), some larval parasitoid specimens were directly collected from tomato leaf mines by fine needle and reared at 25 ± 1 °C, RH 60% and photoperiod 16:8 L:D in incubator. The adult wasps emerged from last instar larvae.

The emerged parasitoids were carefully collected using an aspirator and placed into 75% ethanol for further examination. External morphology was illustrated using an Olympus™ SZH, equipped with a Canon™ A720 digital camera. The specimens were identified according to the reliable keys and descriptions (Askew and Boucek, 1968; Trjapitzin, 1978; Zhu and Huang, 2001; Yefremova and Myartseva, 2004; Lotfalizadeh, 2013).

The specimens were deposited in collection of the Department of Plant Protection, East-Azarbaijan Research Center for Agriculture and Natural Resources, Tabriz, Iran.

Results

In this research two *Elachertus* (Eulophidae) species were reared for the first time as larval ectoparasitoids of *Tuta absoluta*. These species are as follow:

***Elachertus inunctus* (Nees, 1834)** (Fig. 1 A-B)
Material examined: Iran, Khouzestan province, Ahwaz, greenhouse and fields of Veis region (N 3130 E 490), from *Tuta absoluta* (Meyrick) larvae on tomato, 17 March to 13 July 2015, 2♀♀ and 2♂♂.

Diagnosis of female. First funicular segment 3 times longer than wide, the rest about 2.5 times longer than wide; scutellum smooth and shining, mid lobe of mesoscutum with only 3 pairs of strong setae; metasoma of female 2.0 times as long as wide, legs completely yellow; head and thorax dark-coloured, scape brownish.

Geographical distribution. It is widely distributed in Europe (Austria, Czech Republic, Germany, Hungary, Italy, Lithuania, Moldova, Norway, Poland, Slovakia, Sweden, Switzerland, United Kingdom and former Yugoslavia) and in Asia (Japan, South Korea and Turkmenistan) (Noyes, 2015); new record for Iran.

Hosts. We reared *E. inunctus* for the first time from larval stage of tomato leaf miner, *T. absoluta* (Meyrick) (Lep.: Gelechiidae) in Iran. This species has been reported from different lepidopterous pests of the families Elachistidae, Epermeniidae, Gracillariidae, Lyonetiidae, Momphidae, Nepticulidae, Oecophoridae and Tortricidae (Noyes, 2015). The parasitoid wasps have been previously reported on *T. absoluta* (Desneux *et al*., 2010; Marja *et al*., 2011).

***Elachertus pulcher* (Erdös, 1961)** (Fig. 1 C-E)
Material examined: Iran, Khouzestan province, Ahwaz, greenhouse and fields of Veis region (N 3130 E 490), from *Tuta absoluta* larvae on tomato, 17 March to 13 July 2015, 5♀♀.

Diagnosis of female. First funicular segment 1.6 times longer than pedicel and about 3 times longer than wide, the rest more than 2.5 times longer than wide; mid lobe of mesoscutum with additional setae scattered on disc in addition to some pairs of strong setae. Body mainly yellow, head and thorax with small dark spots, antennae dark brown, legs yellow.

Geographical distribution. It has been reported from Europe (Austria, Croatia, Czech Republic, France, Germany, Hungary, Moldova, Russia, Slovakia and Spain) and Asia (Azerbaijan, Taiwan, Turkey, Turkmenistan and Yemen) (Noyes, 2015); new record for Iran.

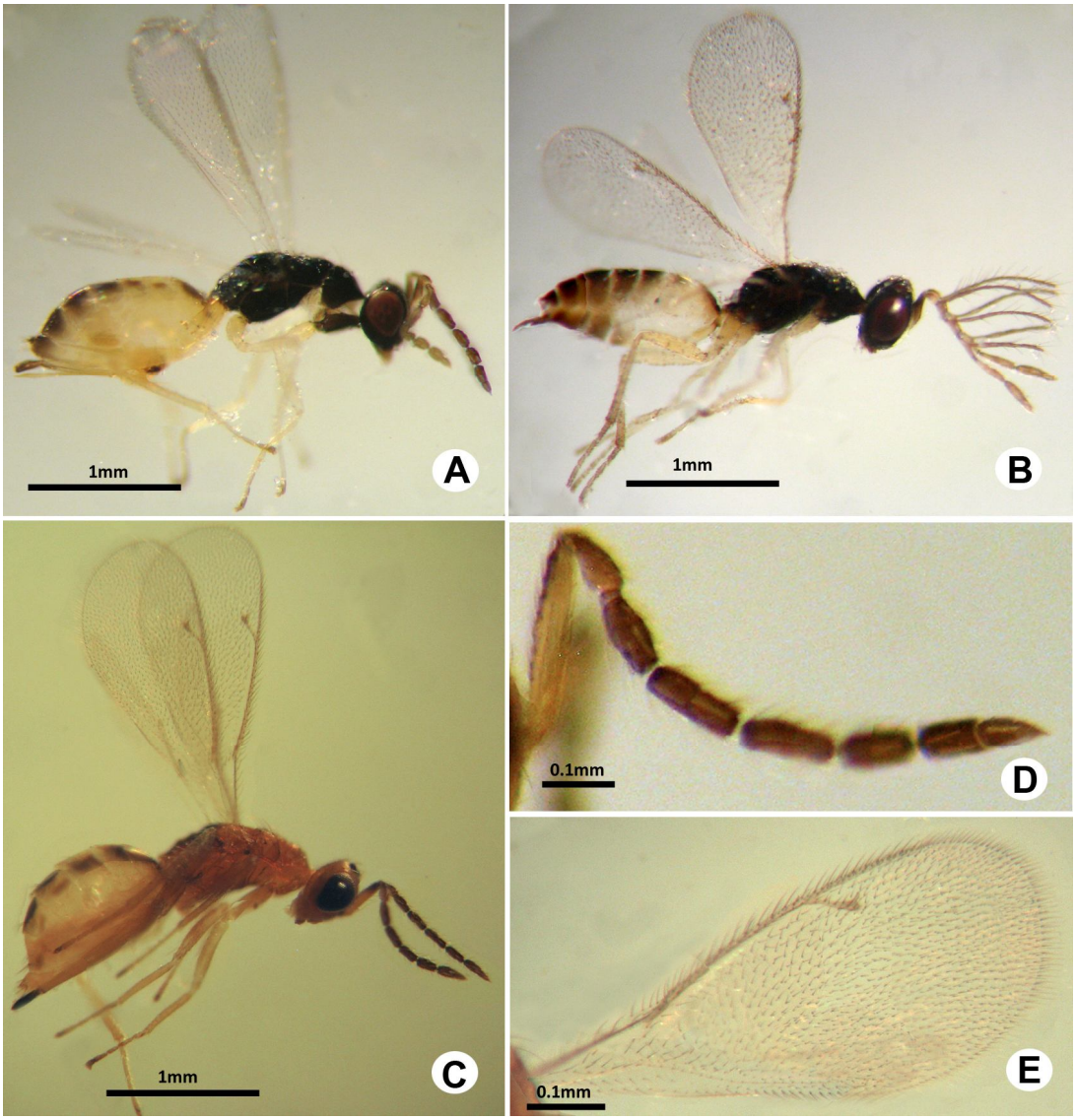

Figure 1 Two *Elachertus* species parasitizing *Tuta absoluta* in the south of Iran: A, B- *Elachertus inunctus* (A- female in lateral view, B- male in lateral view); C-E- *Elachertus pulcher* (C- female in lateral view, D- female antenna, E- fore wing).

Hosts. The parasitoid wasp was collected on *T. absoluta* for the first time. There is no biological information about this species on *T. absoluta* larvae.

Discussion

Elachertus is a large and widespread genus of the Eulophinae, with over 111 species worldwide (Noyes, 1998). The genus includes more than 65 Palaearctic species (Yefremova, 1998). This species belongs to the *charondas* species group (Zhu and Huang, 2001). This is the first record of *E. inunctus* in Iran and *E. pulcher* on *Tuta absoluta* in the world. However, two unknown species of this genus have been reported by Zappala *et al.* (2012a) from Italy. These two unknown species cause 8.6% parasitism in larval population of *T. absoluta* (Zappala *et al*., 2012b).

Only two species of the genus *Elachertus* have been previously reported from Iran and we add two new records (Table 1) and this report extends

geographical distribution of *E. inunctus* and *E. pulcher*. Five species belong to genus *Elachertus* (including *E. charondas* Walker, *E. fenestratus* Nee, *E. isadas* Walker, *E. lateralis* Spinola and *E. pulcher*) were reported from Yemen (Yefremova, 2007) and five species including *E. charondas* Walker, *E. fenestratus* Nees, *E. inunctus*, *E. kopetdagensis* Yefremova & Myartseva and *E. pulcher* were reported from Turkmenistan.

Phyllocnistidae (*Phyllocnistis blancardella* F., *Ph. coryli* Nic.), Tortricidae, Leucopteridae, Oecophoridae, Elachistidae were previously mentioned as hosts of *E. inunctus* (Trjapitzin, 1978). Also, *E. pulcher* were collected from more than 70 arthropod species, 20% predators and 80 % parasitoids, were recorded attacking various life stages of *T. absoluta* so far. Some parasitoid wasps belonging to Eulophidae and Braconidae have promising potential to be considered as effective tools in integrated pest management program of the pest in the newly invaded areas. Some identified and unidentified eulophid species belonging to genera *Baryscapus*, *Cirrospilus*, *Chrysocharis Closterocerus*, *Diglyphus*, *Closterocerus*, *Elasmus*, *Hemiptarsenus*, *Necremnus*, *Necremnus*, *Neochrysochari* and *Elachertus* were reported as larval parasitoids of *T. absoluta* in the Palaearctic countries (Zappala *et al*., 2013). Of the genus *Elachertus, E. inunctus* (during spring) and two unidentified species (during summer and autumn) were collected from the pest larvae in Italy (Zappala *et al*., 2012a).

Table 1 Recorded species of the genus *Elachertus* from Iran.

Elachertus species	Host	Distribution	References
E. fenestratus Nees, 1834	*Cephus pygmaeus* L. (Hym.: Cephidae)	Widely distributed in Iran	Talebi *et al.* (2011)
E. gallicus Erdös, 1958	*Pyllocnistis citrella* Stainton (Lep.: Gracillariidae)	Fars province, Jahrom	Yefremova *et al.* (2007)
E. inunctus Nees, 1834	*Tuta absoluta* (Lep.: Gelechiidae)	Khouzestan province	this study
E. pulcher (Erdös, 1961)	*Tuta absoluta* (Lep.: Gelechiidae)	Khouzestan province	this study

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دو گونه از جنس *Elachertus* Spinola (Hym.: Eulophidae) به‌عنوان پارازیتوئید خارجی *Tuta absoluta* (Meyreck) (Lep.: Gelechiidae)

فاطمه یاراحمدی[1*]، زهره صالحی[1] و حسین لطفعلی‌زاده[2]

۱- گروه گیاه‌پزشکی، دانشکده کشاورزی، دانشگاه کشاورزی و منابع طبیعی رامین خوزستان، ملاثانی، اهواز، ایران.
۲- مرکز تحقیقات کشاورزی و منابع طبیعی آذربایجان شرقی، تبریز، ایران.
* پست الکترونیکی نویسنده مسئول مکاتبه: yarahmadi@ramin.ac.ir
دریافت: ۱ اسفند ۱۳۹۴؛ پذیرش: ۲۵ خرداد ۱۳۹۵

چکیده: این اولین گزارش دو گونه زنبور پارازیتویید خارجی *Elachertus inunctus* (Nees, 1834) در ایران و *Elachertuspulcher* (Erdös, 1961) از خانواده Eulophidae در جهان از روی لارو مینوز برگ گوجه‌فرنگی، *Tuta absoluta* (Meyrick, 1917) (Lep.: Gelechiidae) می‌باشد. این گونه‌ها از مزارع و گلخانه‌های گوجه‌فرنگی در استان خوزستان، اهواز (جنوب غربی ایران) جمع‌آوری شدند. هر دو گونه برای فون ایران جدید می‌باشند. اطلاعات کافی در مورد این دو پارازیتوئید وجود ندارد. کارایی بالقوه این پارازیتوییدها برای کنترل بیولوژیک *T. absoluta* در مزارع و گلخانه‌های گوجه‌فرنگی می‌بایست مورد بررسی قرار گیرد.

واژگان کلیدی: مینوز برگ گوجه‌فرنگی، پارازیتوییدها، شناسایی، کنترل بیولوژیک