

Research Article

Two chalcidoid parasitoids (Hymenoptera: Encyrtidae & Eulophidae) of two lepidopterous pests on willow in Iran

Hossein Lotfalizadeh^{1*}, Mehri Babmorad² and Farnaz Shafaei²

1. Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection (IRIPP), Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.
2. Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.

Abstract: Two chalcidoid parasitic wasps (Hym.: Chalcidoidea) of two lepidopterous pests on willow trees, *Salix* spp., were collected in Tehran and Alborz provinces, Iran. *Ooencyrtus populicola* Myartseva, 1995 (Hym.: Encyrtidae) and *Colpoclypeus florus* (Walker, 1938) (Hym.: Eulophidae) were reared on *Ceruravinula* (L., 1758) (Lep.: Notodontidae) and *Nycteola asiatica* (Krulikovsky, 1904) (Lep.: Nolidae), respectively. *Ooencyrtus populicola* is a parasitoid of egg and *C. florus* is an ectoparasitoid of larval stage. *Ooencyrtus populicola* is a new record for Iran, but *C. florus* was previously reported as a parasitoid of an unknown leaf-roller larva.

Keywords: Willow, larval ectoparasitoid, egg parasitoid, Chalcidoidea

Introduction

Willows, *Salix* spp. are fast-growing trees widely distributed in Europe and Western and Central Asia. They are characterized by easy propagation, the tendency to transplant, and their beautiful appearance, along with many other uses that make these trees very attractive and useful in providing fiber and fuel wood, restoring degraded lands and forest landscapes, reducing soil erosion, and preventing climate change, and also have some medicinal applications (the pioneer of modern aspirin) (Hageneder, 2005; Belyaeva, 2009; Stettler, 2011).

In central Europe, more than 200 species of stenophagous phytophagous insects are associated with willows (Heydemann, 1982). Kokanova (1992) studied the biology of eight

chewing insects found on *Salix* spp. in Turkmenistan. He found *Trichogramma* sp. and a fungus pathogenic to the larvae, as a reducing agent of *Cerura vinula*. A wide range of pests attack willows in Iran (Abai, 1999). Sadeghi *et al.* (2009) reported 23 species of different orders as common pests of *S. alba*. Babmorad *et al.* (2017) reported 61 species from 28 families of willow collection in Tehran province, while Hashemi Khabir *et al.* (2021) reported 40 species from 26 families of arthropods as pests of willow in the northwest of Iran. Pest damages are exhibited as leaf and wood-feeding, gall-making, or sap-sucking. Rakhshani *et al.* (2007) studied aphids and their parasitoids on willow and poplar in Iran. Two lepidopterous pests are the puss moth, *Cerura vinula* (L., 1758) [Syn. = *Dicranura vinula* (L., 1758)] (Lep.:

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* Corresponding author: h.lotfalizadeh@areeo.ac.ir
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Notodontidae) (Figs. 2A-B) and Eastern Nycteoline, *Nycteola asiatica* (Krulikovsky, 1904) (Lep.: Nolidae) (Figs. 1A-C) were

reported as leaf feeding pests of poplar and willow trees in Iran (Kalantary *et al.*, 2010; Hashemi Khabir *et al.*, 2021).

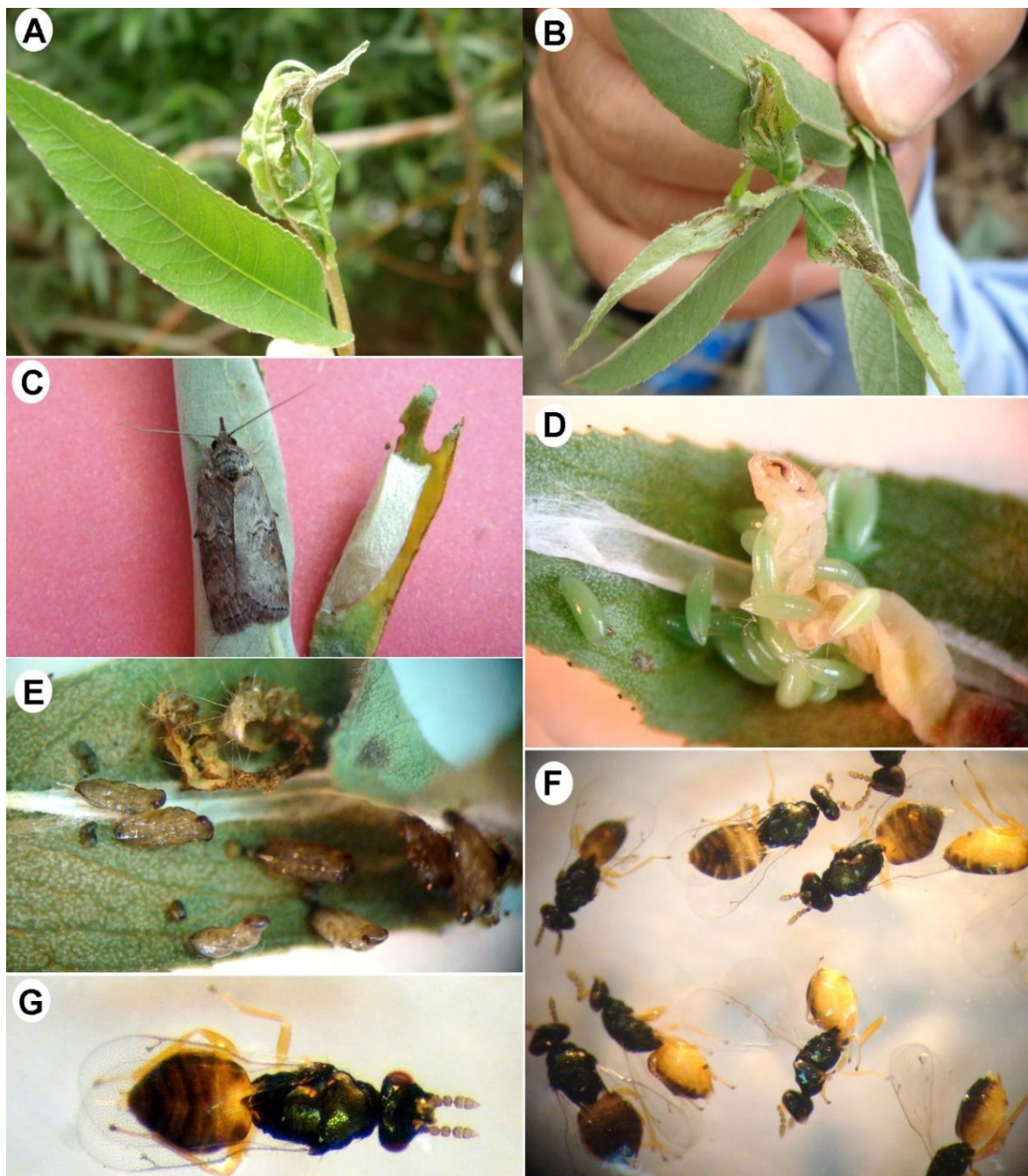


Figure 1 *Nycteola asiatica* and its parasitoid *Colpoclypeus florus*: A- Damage of larval stage of pest; B- Larvae on willow leaves and their damage; C- Adult and pupa of *N. asiatica*; D- Parasitized larva of *N. asiatica* with several external parasitoid larvae; E- Pupae of *C. florus*; F- Emerged wasps of *C. florus*; G- A female of *C. florus*.

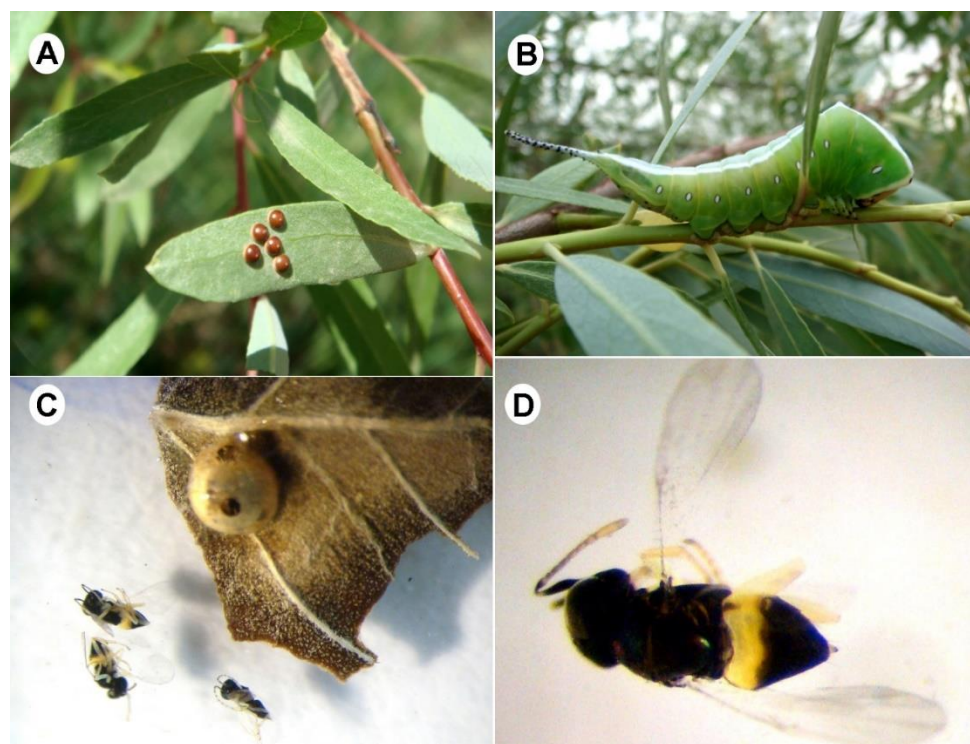


Figure 2 *Cerura vinula* and its parasitoid *Ooencyrtus populicola*: A- Eggs of *C. vinula* on leaf of *Salix*; B- A larva of *C. vinula*; C- Parasitized egg of *C. vinula* with three parasitoids; D- A female wasp of *O. populicola* in ethanol.

Cerura vinula has an extraordinary-looking caterpillar that feeds on willow (*Salix*), aspen, and poplar (*Populus*) in sunny places. It is mainly native to Europe and temperate Asia to China (Wieser et al., 2002). Regarding this species, Rajaei et al. (2023) believe it is not distributed in Iran and is probably confused with *C. intermedia* (Teich, 1896); therefore, its more accurate identification requires detailed investigations. Kalantary et al. (2010) analyzed damage of *C. vinula* on ten native and exotic poplar clones. Considering its severe damage to host plants, 15 chalcidoid species of the families Chalcididae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae, and Pteromalidae were listed as its natural enemies around the world (Noyes, 2019).

Nycteola asiatica was reported as destructive pests of *Populus* spp. and *Salix* spp. trees in the Palearctic region, especially in temperate areas (Krachhenko et al., 2009). Recently it was reported on *Salix alba* L. in northwestern Iran (Hashemi Khabir et al., 2021). In Turkey it has

two generations that. The second one is extensively destructive during July and August (Gümüş and Avcı, 2015). Prior to this study, two chalcidoid parasitoids of the families Eulophidae and Eurytomidae were reported as parasitoids of *N. asiatica* (Bouček, 1977; Haeselbarth, 1983).

Parasitoids of willow pests have received less attention previously in Iran. This research reports two chalcidoid parasitic wasps reared from the aforementioned lepidopterous pests.

Materials and Methods

The studies were conducted during the period 2011–2013. Insects were reared under laboratory conditions from damaged leaves of *Salix* spp., collected from different localities in Tehran and Alborz provinces, Iran.

Most collections were done in early spring during March-May. Eggs of *Cerura vinula* were also collected and studied in 2013. *Nycteola asiatica* and *C. vinula* were reared on *Salix alba* and *S. excelsa-rodini*, respectively. Obtained

parasitoids of the different stages were conserved in ethanol 75%.

Air-dried specimens were card-mounted and examined with a Leica M205C stereo microscope and a Leica CLS 150X fiber optic light source.

Identification of the reared parasitic wasps was done using the key descriptions of Bouček (1977), Myartseva (1995), and Sanchez-Garcia *et al.* (2011).

Abbreviations

F1-n first funiculars, second funiculars, etc.

OD ocellus diameter

OOL ocello-ocular length

Result and discussion

We reared two chalcidoid wasps, *Colpoclypeus florus* (Walker, 1938) and *Ooencyrtus populicola* Myartseva, 1995 on *Nycteola asiatica* and *Cerura vinula*, respectively.

***Colpoclypeus florus* (Walker, 1938) (Hymenoptera: Eulophidae)** (Figs. 1E-F).

Material examined: Iran, Tehran, Damavand, 29.5.2013, ex *Nycteola asiatica* on *Salix alba*, Babmorad, M. leg., 8♀ & 21♂.

Diagnosis. Body black, legs completely yellowish. In female head 1.18 times as wide as height; scape 4.5 times as long as width; mesopleural suture curved; supracoxal flange present. In male fore femur not swollen, about 4.4–5.0 times as long as wide; fore tarsus with basal 3 tarsomeres all longer than wide; digitus of genitalia with two apical teeth and without basal tooth; without a pyramidal-shaped raised interantennal process.

Myartseva (1995) compared *Ooencyrtus populicola* with three other species of the genus, including *O. vinulae* (Masi, 1909), *O. daritshevae* Myartseva, 1981, and *O. telenomicida* (Vassiljev, 1904). Their comparative characters are as follows: in *O. populicola* F1, about 1.5 times as long as broad (as long as broad in *O. vinulae*); clava distinctly shorter than four precalval segments (as long as four precalval segments in *O. vinulae*); scape 7

times as long as broad (4 times as long as broad in *O. daritshevae*); linea calva closed (opened in *O. daritshevae* and *O. telenomicida*); legs whitish-yellow, without darkening (with dark rings in *daritshevae* and *O. vinulae*); eyes about 1.5 times as long as frons (4 times as long as frons in *O. telenomicida*) and mesoscutellar sculpture non elongated cells in the discal area (distinctly as elongated cells in *O. telenomicida*).

Distribution. It is widely distributed in Europe, Caucasus region, North Africa (Noyes, 2019), and Iran (Darsouei *et al.*, 2018). This species has been introduced into North America (Brunner, 1993 and 1996; Pfannestiel and Unruh, 2002; Noyes, 2019).

Biological associations. *Colpoclypeus florus* is a gregarious larval ectoparasitoid of *Nycteola asiatica* (Krulikovsky, 1904) (Lepidoptera: Nolidae) (Figs. 1 A-E). It has been reported as a parasitoid of several leaf-rollers species of the family Tortricidae (Lepidoptera) (Gruys and Vaal, 1984; Brunner, 1993; Schauff *et al.*, 1997). Darsouei *et al.* (2018) reported it as a parasitoid of an unknown leaf-roller larva in the pome orchards in Mashhad, Razavi Khorasan province. Its biology, ecology, application in biological control programs and behaviors were studied by Sanchez-Garcia *et al.* (2011).

***Ooencyrtus populicola* Myartseva, 1995 (Hymenoptera: Encyrtidae)** (Figs. 2C-D, 3)

Material examined: Iran, Alborz province, Khojir, 14.5.2013, ex *Cerura vinula* egg on *Salix excelsa-rodini*, M. Babmorad leg, 2♀ & 1♂.

Diagnosis. Female body length: 1-1.2 mm. The body is black, with a metallic sheen - dark green on the forehead and vertex, blue-green on the mesonotum shield, bronze-violet on the scutellum, green on the scutellum apex; scape black, pale apically; flagellomeres and club yellow; legs, including coxae, whitish yellow, abdomen yellow basally.

The head is convex, slightly wider than the chest and its height, and more than twice as wide as its length; the frons and vertex are slightly longer than wide, about 1/3 of the head width; occiput edge concave and sharp; ocelli in a moderately acute-angled triangle; OOL

less than the length of OD, and distance of lateral ocelli from occiput edges about twice OD; eyes slightly less than 3 times the length of malar space.

Antennal toruli in the level of ventral edge of eyes; distance between antennal toruli slightly less than 1.5 times distance of antennal toruli to lower margin of clypeus and about 1.5 times to the edge of the eye; scape 7 times as long as broad, pedicel twice as long as broad, 4 times shorter than scape and slightly shorter than F1 + F2; flagellum thin, about 1.5 times as long as broad; club about 3 times as long as broad and slightly shorter than 4 preclaval flagellomers.

Mesoscutum more than 1.5 times as wide as long; mesoscutellum slightly shorter than mesoscutum and slightly wider than long; sculpture of mesoscutum, axilla and

mesoscutellum, mesopleuron finely reticulate, apex of scutellum smooth and shiny.

Fore wing hyaline, bare in basal half, slightly more than twice as long as their greatest width; submarginal vein with 8 long and thin setae along the margin; marginal vein (Fig. 3F) with 4-5 setae along the margin; postmarginal vein as long as marginal vein and half as long as stigmal vein; lineae calva closed, submarginal vein with very thin sparse pubescence behind lineae calva.

The spur of the middle tibia shorter than the mid-basitarsus, slightly longer than the three subsequent segments combined.

Gaster is shorter and wider than the thorax (Fig. 2D), slightly narrowed towards the apex; pigostils located at the basal 1/3 of gaster; ovipositor slightly protruding.

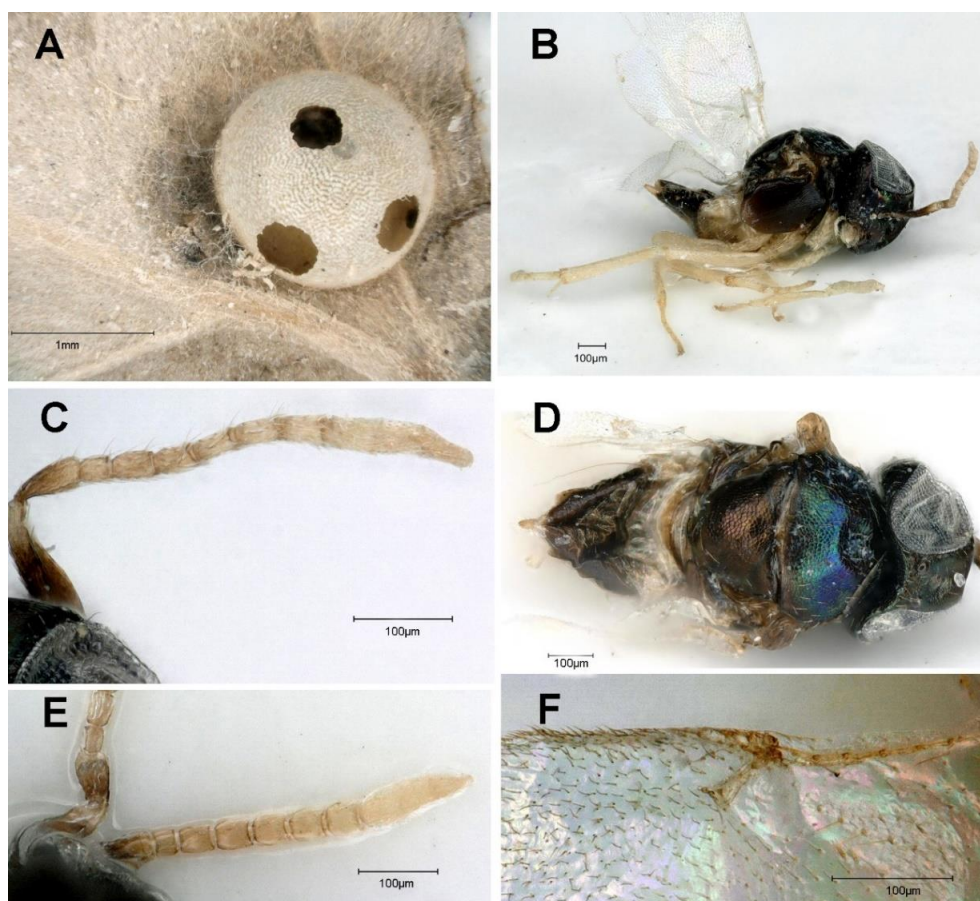


Figure 3 A- Parasitized egg of *Cerura vinula* with three emergence holes; B-F- *Ooencyrtus populicola*: A- Female in lateral view; C- Female antenna; D- Body in dorsal view; E- Male antenna; F- Fore wing venation.

Male. Looks like the female. Body length: 1 mm; scape slightly darkened; gaster completely black; ocelli on wider vertex in right triangle; OOL about the length of the ocellus diameter and 1.5 times further from the edge of the occiput; antennal toruli above the level of the lower edge of the eyes.

Distribution: Kazakhstan (Myartseva, 1995), and new record for Iran.

Discussion

In this research, we obtained *Ooencyrtus populicola* for the first time on *Cerura vinula*, while six families of Chalcidoidea including 16 species of Chalcididae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae and Pteromalidae were previously reported as parasitoids of different life stages of *C. vinula* (Noyes, 2019). Within these parasitoids, the Pteromalidae, with five species and the Chalcididae with only one species, are most and least species-rich families on *C. vinula*. The association of *O. populicola* and *C. vinula* as parasitoid and host is new.

Likewise, we reared *Colpoclypeus florus* for the first time on *Nycteola asiatica*. While two other chalcidoids, *Cirrospilus pictus* Nees, 1834 (Hym.: Eulophidae) (Bouček, 1977) and *Eurytoma goidanichi* Bouček, 1970 (Hym.: Eurytomidae) (Haeselbarth, 1983) were reported as parasitoids of *Nycteola asiatica*.

Disclosure Statement

The authors declare that there are no interests to declare.

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دو گونه زنبور پارازیتوئید (Hymenoptera: Encyrtidae & Eulophidae) روی دو آفت پروانه‌ای بید در ایران

حسین لطفعلی‌زاده^{۱*}، مه‌ری باب‌مراد^۲ و فرناز شفایی^۲

۱- بخش تحقیقات رده‌بندی حشرات، مؤسسه تحقیقات گیاه‌پزشکی کشور، سازمان تحقیقات و آموزش کشاورزی و ترویج کشاورزی، تهران، ایران.

۲- بخش تحقیقات حمایت و حفاظت، مؤسسه تحقیقات جنگل و مرتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران.

پست الکترونیکی نویسنده مسئول مکاتبه: h.lotfalizadeh@areeo.ac.ir

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چکیده: دو گونه زنبور پارازیتوئید از بالاخانواده Chalcidoidea روی دو گونه آفت پروانه‌ای درخت بید در استان‌های تهران و البرز جمع‌آوری گردید. گونه *Ooencyrtus populicola* Myartseva, 1995 از خانواده Encyrtidae و گونه *Colpochypeus florus* (Walker, 1938) از خانواده Eulophidae، به‌ترتیب از روی *Cerura vinula* (L., 1758) (خانواده Notodontidae) و *Nycteola asiatica* (Kruslikovsky, 1904) (خانواده Nolidae) پرورش داده شدند. گونه *O. populicola* پارازیتوئید تخم و *C. florus* پارازیتوئید خارجی مرحله لاروی میزبان‌های خود بودند. گونه اخیر قبلاً به‌عنوان پارازیتوئید یک نوع لارو پیچاننده برگ از ایران گزارش شده است ولی گونه *O. populicola* گزارش جدید برای فون ایران می‌باشد.

واژگان کلیدی: بید، پارازیتوئید خارجی لارو، پارازیتوئید تخم، بالاخانواده Chalcidoidea