

First Report on the Occurrence of the Braconid parasitoid *Opius monilicornis* on the Chickpea Leaf Miner *Liriomyza cicerina* in Tunisia

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ABSTRACT

Soltani, A., Beyareslan, A., Haouel-Hamdi, S., Bousselmi, A., Amri, M., and Mediouni-Ben Jemâa, J. 2018. First report on the occurrence of the braconid parasitoid *Opius monilicornis* on the chickpea leaf miner *Liriomyza cicerina* in Tunisia. *Tunisian Journal of Plant Protection* 13 (1): 93-100.

Surveys were conducted during 2016 and 2017 in chickpea crops to document the parasitoid species of the chickpea leaf miner (*Liriomyza cicerina*) in Beja and Kef sites (north-west of Tunisia). One braconid wasp species namely *Opius monilicornis* was recorded for the first time as parasitoid on *L. cicerina* larvae. Larvae parasitism was observed from the end of March onwards and reached its peak during April coinciding with the second annual generation of the pest. Parasitism was noticed only on the second and third instars leaf miner larvae. The parasitoid abundance was higher in Beja site compared to Kef. In winter chickpea crops, parasitism rates during 2016 and 2017 ranged from 11.44 to 17.95% while in spring they fluctuated from 11.96 to 19.77%.

Keywords: Braconidae, chickpea, leaf miner, *Opius monilicornis*, parasitism

Leaf miner flies are a highly diverse group of exclusively phytophagous species and occur worldwide (Shahreki et al. 2012). The genus *Liriomyza* comprises numerous species that are economically important pests of many agricultural crops including

chickpea (Naresh and Malik 1986). *Liriomyza cicerina* is the most important pest that causes significant damages on chickpea crops in West Asia and North Africa and the Mediterranean region (Cardona 1983; Çikman and Civelek 2006; El-Bouhssini et al. 2008; Soltani et al. 2016). Damages are caused by larvae consuming the mesophyll of leaves and the formation of holes and galleries with different shapes in the leaf tissue which reduce the photosynthetic capacity of infested leaves (Çikman 2006).

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In Tunisia, chickpea is ranked as the second major cultivated food legume crop after faba bean (Ouji et al. 2016). Fewer insecticidal treatments were undertaken in chickpea crops. Thus, as reported by Minkenberg and van Lenteren (1986), in such agricultural systems using infrequent pesticide applications, partial to complete control of agromyzid leaf miners is often the result of the abundant parasite fauna action. Consequently, in this work, we undertake a first survey to identify natural occurring parasitoids on *L. cicerina* larvae. In these regards, Heimpel and Meloche (2001) reported that a number of parasitoids of leaf miners have been recorded throughout the world. In addition, more than 140 species of parasitoids as natural enemies of *Liriomyza* have been reported (Liu et al. 2009). Braconid species (Hymenoptera: Braconidae) are among natural enemy's assemblages of agromyzid leaf miners (Gratton and Welter 2001). Among braconids, *Opius monilicornis* is a primary parasitoid on agromyzid leaf miners including *L. cicerina* (Çikma et al. 2008).

This paper reports first investigations on *L. cicerina* parasitoid species from the Braconidae family. Herein, we report the key morphological characters of *Opius monilicornis* and we present its parasitism rates in two regions of north-west Tunisia (Kef and Beja).

MATERIALS AND METHODS

Study sites.

The study was carried out over a 2-year period (2016 and 2017) in chickpea fields from two sites located in north-west of Tunisia: Beja (36°44'56.83"N 9°12'50.24"E) and Kef (36°07'13.96"N 8°43'21.39"E). The sites belonged respectively to sub-humid and semi-arid bioclimatic stages. For this study, the sampling was made from Beja

1 and Amdoun varieties (winter and spring varieties, respectively).

Sampling.

Sampling was carried out during the period from March to May each year. Thirty chickpea leaves (\approx 360-450 leaflets) harboring insect mines were weekly sampled from the two sites Beja and Kef. Samples were kept in a transparent plastic boxes closed with cotton ball and covered with muslin at $25 \pm 2^\circ\text{C}$, $70 \pm 5\%$ RH and 14:10 h (L:D) photoperiod until the emergence of adults of both the pest and the parasitoids. After emergence, both pest and parasitoids specimens were conserved in 70% ethanol and stored at -4°C until identification.

Identification.

The emerged braconids were identified by Professor Ahmet Beyarslan (Department of Biology, Faculty of Arts and Sciences, Bitlis Eren University, Bitlis, Turkey). Specimens were morphologically identified based on taxonomic identification keys (Fischer 1972, 1977, 1986, 1987).

Assessment of parasitism rate.

For *O. monilicornis*, parasitism rate was determined according to Russell (1987) formula as following:

Rate of parasitism (%) =

$$\frac{\text{Total parasitoids that emerged}}{\text{Total parasitoids that emerged} + \text{Total host emerged}} \times 100$$

Statistical analysis.

All statistical analyses of individual number of parasitoids *O. monilicornis* were performed using the "SPSS statistical software version 20.0. Armonk, NY: IBM Crop". Differences in values of each year or season-sown crops and sites were tested by one-way ANOVA followed by Duncan test. All values given were the means of three

replications and were expressed as the mean \pm standard deviation. Significant differences are reported as $P < 0.05$.

RESULTS

Parasitoid identification.

Opius monilicornis belongs to the order of Hymenoptera, super family Chalcidoidea, family Braconidae and subfamily Opiinae. This species has been reported as a parasitoid of *L. cicerina* in Syria (El-Bouhssini et al. 2008), Turkey (Çikman et al. 2006), Iran, Jordan, Morocco, Moldova, Spain, and Algeria (Ghahari et al. 2010; Khajeh et al. 2014).

O. monilicornis had long antennae as body, 16- or 17-flagellomeres (Fig 1.1). The basal flagellomeres are 1.8 times as long as wide, middle flagellomeres and the rest not more than 1.5 times as long as wide; most flagellomeres clearly separated from each other, like a string of pearls, 2 or 3 sensillae visible in lateral view, the numerous hairs shorter than the flagellomeres wide (Fig 1.2).

The mesosoma is one-third times as long as high, upper side rather flat. The mesoscutum is about as wide as long, lateral lobes weakly rounded, declivity straight, dorsal fovea punctiform, notauli only anteriorly indicated; sides on posterior half margined. Only a few hairs occurred on the declivity and along the imaginary course of the notauli (Fig 1.3). The scutellum is longer than wide, axillae are absent. The rest of the mesosoma is smooth (Fig 1.4). Propodeum is fused with the metapleuron, no suture between them, lateral spiracles are present. All furrows of the side are smooth (Fig 1.5). Hind femur is 5 times as long as wide, also the other ones are short and thick (Fig 1.1).

For wings, pterostigma is cuneiform; radius arising from basal third. First section of radius is one-third as long as pterostigma wide, while second

section of radius is about half as long as cubital vein; the third section of radius, is 2 times as long as second section of radius, curved inwards, radial cell ending before tip of wing, second radial cell narrowed distal, discoideus hardly long than nervus recurrens, nervus almost interstitial, brachial cell closed, nervus parallelus arising from the middle of the distal side of brachial cell (Fig 1.7). For the metasoma, first tergite 1.5 times as long as hind wide, parallel-sided behind, a little narrowed in front, smooth and shining, dorsal carinae developed on basal third (Fig 1.6). Ovipositor sheaths hidden or clearly visible, the rest of metasoma without sculpture, the projecting part a third as long as the metasoma, the hypopygium retracted (Fig 1.8).

Hosts and distribution.

This species has been reported as a parasitoid of *L. cicerina* in Turkey (Çikman et al. 2008). It was also reported from *L. congesta*, *L. pusilla*, *Ophiomyza* sp., *Phytomyza atricornis*, *Asphondylia verbasci* (Fischer and Koponen 1999). This parasitoid occurred in Syria, Jordan, Turkey (Çikman et al. 2008), Iran (Ghahari et al. 2012), Morocco (Lahmer and Zeouienne 1987), and Algeria (Papp 1982).

Parasitism rate.

Results regarding the parasitism rates of the braconid *O. monilicornis* during 2016 and 2017 were reported in Fig. 2. Results revealed that this species was very abundant in both sites (Beja and kef). The correspondent parasitism rates during 2016 were 23.2% in Beja and 21.05% in Kef for winter variety, while for the spring one parasitism rates were 18.5%, in Beja and 17.3% in Kef. During 2017, an increase in parasitism rates was observed during June. Indeed, the peaks

of parasitism rates were 35.8% for winter variety and 35.11% for spring variety in Beja. Regarding Kef site, parasitism rates

were 21.4% for winter variety against 28% for spring variety.

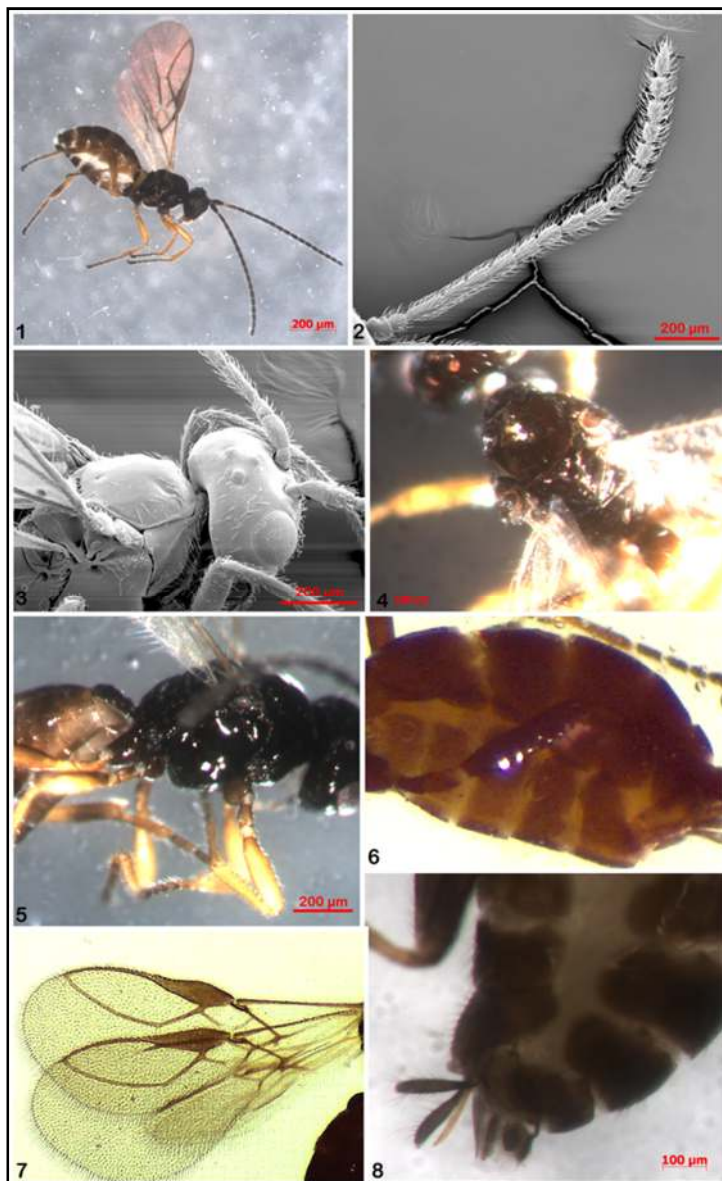


Fig. 1. (1) *Opius monilicornis* (adult ♂) (1) Antenna, (2) Mesoscutum (3) Mesosoma (4) Scutellum (5) Hind Femur (6) Lateral view of metasoma, and (7) Wings (8) Ovipositor.

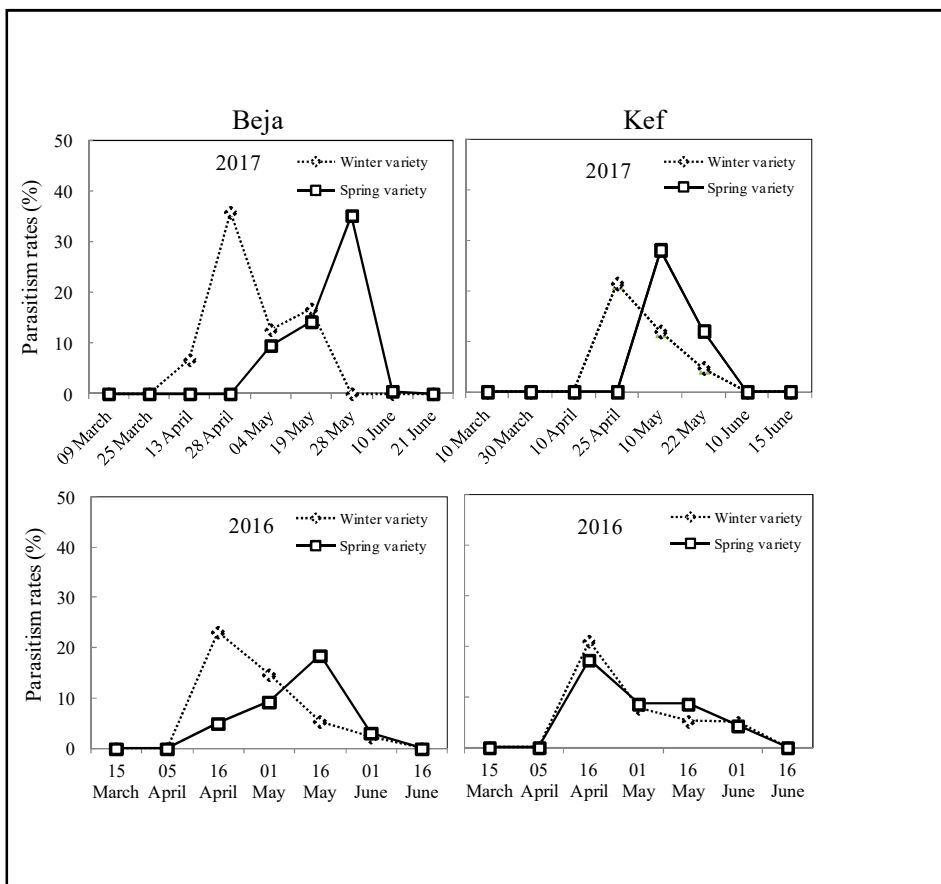


Fig. 2. Evolution of parasitism rates (%) *Opius monilicornis* during 2016 and 2017 in Beja and Kef sites.

Fig. 3 reported the emergence of *O. monilicornis* according to season-sown crops and sites. Results showed that the distribution depends on crops (winter or spring chickpea) and year. Statistical analysis showed the presence of high significant differences between the two sites ($F = 37.91$, $P < 0.01$). Additionally, statistical analysis revealed that in Beja site, *O. monilicornis* presented significant differences between winter and spring chickpea varieties for 2017, while no

significant differences between winter and spring crops were observed for 2016.

The braconid *O. monilicornis* represented 44.09 and 43.2% of the total emerged insects in Beja and Kef, respectively, during 2016 and 52.5 and 44.9% during 2017. Furthermore, results indicated that Beja site differed from Kef by the number of individual parasitoids during both years for winter and spring varieties.

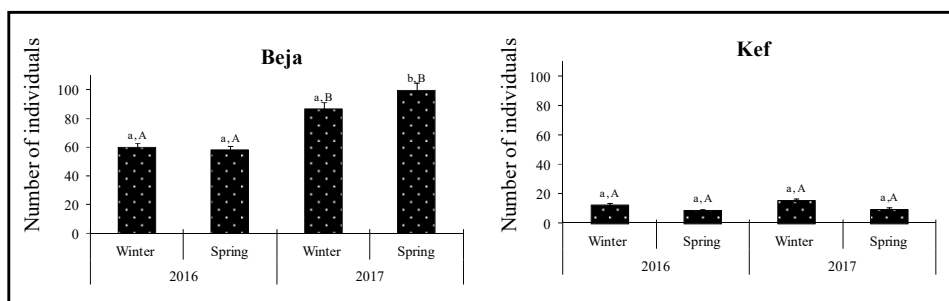


Fig. 3. Distribution of *Opius monilicornis* according to cropping season and years in Beja and Kef sites. Different letters indicated significant differences ($P < 0.05$) for each year among winter and spring chickpea varieties (lowercase letters); and among years for each winter or spring crops (uppercase letters). Each value is the mean \pm SD of three replicates.

DISCUSSION

Agromyzid leaf miners are known to have rich natural enemy communities (Gençer, 2004). Numerous studies have been reported on the natural enemies of the Agromyzidae including *L. cicerina* in various countries (Asadi et al. 2006; Baideng 2016; Fathipour et al. 2006; Heinz and Parrella 1990; Lahmar and Zeouienne 1990; Sivapragasam et al. 1999). However, no previous studies were conducted on the natural enemies of the chickpea leaf miner in Tunisia. Thus, the present work carried out the first investigations on parasitoids occurring on *L. cicerina* in chickpea fields in Tunisia. This study reported the first occurrence of the braconid wasp *O. monilicornis* with an interesting parasitism rate of 19.77% in Beja during 2017. According to previous records, this parasitoid belongs to the superfamily of Ichneumonidea (Murphy and LaSalle 1999). Previous investigations on *L. cicerina* parasitoid fauna revealed that *O. monilicornis* is one of the parasitoid complex of chickpea leaf miner. In this regards, Çikman et al. (2008) reported that in Sanhurfa region in Turkey, the braconid *O. monilicornis* was one of the *L. cicerina* parasitoid fauna. Earlier, Hincal et al. (1996) and Gençer (2004) reported respectively *O. monilicornis* as parasitoid attacking *L.*

cicerina in Izmir, Denizil, Uşak and Ankara province (Turkey). Besides, our results agreed with those obtained in Syria which revealed that the parasitoid *O. monilicornis* was found to be the most effective against the chickpea leaf miner, compared with *Diglyphusisaea*, as the parasitism reached about 70% (El-Bouhssini et al. 2008). In Morocco, Lahmar and Zeouienne (1990) identified *O. monilicornis* as the only parasitoid of *L. cicerina* achieving a parasitism rate of 20.35%. Such activity seems to be important compared to results accomplished in Turkey where *O. monilicornis* occurred with a low parasitism rate of 3.27% (Çikman et al. 2008). The relatively higher parasitism rate can suggest that this parasitoid is an important mortality factor in the dynamics of leaf miner populations. For this reason, it can be considered as a potential biocontrol agent against this pest.

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RESUME

Soltani A., Beyareslan A., Haouel-Hamdi S., Bousselmi A., Amri M. et Mediouni-Ben Jemâa J. 2018. Premier signalement du parasitoïde Braconidae *Opius monilicornis* sur la mineuse du pois chiche *Liriomyza cicerina* en Tunisie. *Tunisian Journal of Plant Protection* 13 (1): 93-100.

Des prospections ont été menées en 2016 et 2017 dans les cultures de pois chiche pour étudier les parasitoïdes de la mineuse (*Liriomyza cicerina*) du pois chiche dans les sites de Béja et du Kef (Nord-Ouest de la Tunisie). Une espèce de Braconidae *Opius monilicornis* a été enregistrée pour la première fois comme parasitoïde sur les larves de *L. cicerina*. Le parasitisme des larves a été observé à partir de la fin du mois de mars et a atteint son pic en avril, coïncidant avec la deuxième génération annuelle du ravageur. Le parasitisme n'a été observé que sur les larves des deuxième et troisième stades. L'abondance du parasitoïde était plus élevée dans le site de Béja que dans celui du Kef. Dans les cultures de pois chiche d'hiver, les taux de parasitisme durant 2016 et 2017 ont varié de 11,44 à 17,95% tandis que dans celles de printemps, ils ont fluctué de 11,96 à 19,77%.

Mots clés: Braconidae, mineuse des feuilles, *Opius monilicornis*, parasitisme, pois chiche

ملخص

سلطاني، عيبر وأحمد بيرسلان وسمية حوال-حمدي وعربية بوسالمي ومعز عمري وجودة مديوني-بن جماعة. 2018. تقرير الأول عن وجود طفيل براكونيدي *Opius monilicornis* على حشرة نافقة أوراق الحمص *Liriomyza cicerina* في تونس. *Tunisian Journal of Plant Protection* 13 (1): 93-100.

أجريت دراسة استقصائية سنتي 2016 و2017 في مزارع الحمص حول طفيليات الحشرة نافقة أوراق الحمص (*Liriomyza cicerina*) في موقعي باجة والكاف (الشمال الغربي لتونس). وقد تم تسجيل نوع من البراكوندي (*Opius monilicornis*) لأول مرة كطفيل على يرقات *L. cicerina*. وقد لوحظ تطفل اليرقات من نهاية مارس ثم بلغ ذروته خلال شهر أفريل بالتزامن مع الجيل السنوي الثاني للأفة. وقد لوحظ التطفل فقط على يرقات الطور الثاني والثالث للحشرة العائلة. وكانت وفرة الطفيل أعلى في موقع باجة مقارنة بموقع الكاف. وتراوح معدلات التطفل في مزارع الحمص الشتوي خلال 2016 و2017 من 11,44 إلى 17,95% ومن 11,96 إلى 19,77% في مزارع الحمص الربيعي.

كلمات مفتاحية: تطفل، حمص، نافقة الأوراق، Braconidae، *Opius monilicornis*

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