First record of *Gonatocerus litoralis* (Haliday) (Hymenoptera: Mymaridae) from *Anoplotettix putoni* Ribaut (Hemiptera: Cicadellidae)

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Abstract

The mymarid *Gonatocerus litoralis* (Haliday) is recorded for the first time as an egg parasitoid of the leafhopper *Anoplotettix putoni* Ribaut. A study of the main morphological characters shows unusual variation in distribution of the multiporous plate sensilla on the antenna and relative length of the ovipositor. The parasitoid overwinters as an immature within the host egg and the adult emerges from late April to early July, which coincides with oviposition by the leafhopper into grapevine bark.

Introduction

During studies of the leafhopper *Anoplotettix putoni* Ribaut (Hemiptera: Cicadellidae) in vineyards of southern Italy (Di Luca & Viggiani, 2007; Viggiani & Rillo, 2007) an egg parasitoid was found. It was identified initially as belonging to the *litoralis* group of *Gonatocerus* (Hymenoptera: Mymaridae) (Viggiani *et al*., 2008). The genus *Gonatocerus* Nees includes 287 species worldwide (Noyes, 2013), classified in several subgenera and species-groups. *Gonatocerus litoralis* (Haliday) is widely distributed in all biogeographical regions and belongs to the subgenus *Lymaenon* Walker (Triapitsyn *et al*., 2010; Triapitsyn, 2013). The species has been redescribed several times (Debauche, 1948; Matthews, 1986; Baquero & Jordana, 2002; Triapitsyn *et al*., 2010; Triapitsyn, 2013), but remains difficult to define because of substantial morphological variability. To date, this variability of *G. litoralis* has been evaluated using only specimens collected by sweeping or by trapping.

Triapitsyn (2013) reported the species in several locations in Italy (Campania, Lazio, Molise and Sicily).

In spite of its abundance and very wide distribution, the biology of *G. litoralis* still remains poorly known. Known hosts are eggs of *Cicadula sexnotata* (Fallén), *Acocephalus* sp. (Matthews, 1986), *Neoaliturus* (*Circulifer*) *tenellus* (Baker) (Bayoun *et al*., 2008; Triapitsyn, 2013) and *Zyginidia sohrab* Zachvatkin (Hemiptera, Cicadellidae) (Fallahzadeh & Huber, 2011).

In the present paper the morphological variability of *G. litoralis*, reared from eggs of a single host (*A. putoni*), is analyzed and the life cycle of the parasitoid is outlined.

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Materials and methods

Pieces of vine bark were randomly collected in some vineyards of the Campania and Basilicata regions of Italy (Taurasi, BN; Rivello, PZ), mostly during winter and spring 2005-2006 (Viggiani *et al*., 2008). Eggs of *A. putoni* were placed singly in small vials and maintained at room temperature (18-25°C). Twenty-two *Gonatocerus* specimens, all females, emerged from these eggs and were dissected and mounted on slides in Canada-phenol balsam. Specimens were measured by using a Zeiss Axiophot microscope. Specimens are deposited in the collection of the entomological collection of Dipartimento di Agraria, Università degli Studi di Napoli Federico II.

Results and discussion

Gonatocerus litoralis (Haliday)

Measurements of the main morphological characters of the reared specimens are presented in Tables 1 and 2. Those concerning the antennal segments (Figure 1A and Table 1), forewing, mesotibia and ovipositor (Table 2), may be compared in detail with the data reported by Baquero & Jordana (2002). Except for the scape, all other antennal segments are relatively longer in our specimens. Baquero & Jordana (2002) give the following distribution of multiporous plate sensilla (mps) on the funicular segments: F5 (1), F7 (1 or 2), F8 (2). In contrast, the results here (Table 3) show that the presence of mps on F5 is rare (9%) (Figure 1D), but on F6 1or 2 mps are present rather fre-

Figure 1. Female antenna of *G. litoralis*. A) Antenna from distal end of scape to clava. B) Antenna without multiporous plate sensilla on F5 and F6. C) Antenna with multiporous plate sensilla on F6 and not on F5. D) Antenna with multiporous plate sensilla on F5 and not on F6.

Table 1. Measurements (mm) of the female antenna segments.

Antenna	Length min.-max. (AV± SD)	Width min.-max. (AV±SD)	Ratio L/W min.-max. (AV±SD)
Radicle	0.060-0.110 0.087±0.0197	0.015-0.022 0.020±0.0014	3.25-5.6 4.383±0.8977
Scape	0.125-0.175 0.148±0.0177	0.035-0.050 0.044±0.0051	3.11-3.66 3.333±0.2285
Pedicel	0.040-0.065 0.058±0.0053	0.020-0.045 0.039±0.0049	1.33-2.00 1.508±0.1477
F1	0.030-0.045 0.038±0.0050	0.017-0.025 0.022±0.0026	0.8-2.25 1.730±0.3058
F2	0.025-0.045 0.036±0.0066	0.015-0.027 0.022±0.0030	1.25-2.33 1.645±0.2969
F3	0.030-0.055 0.040±0.0079	0.020-0.027 0.023±0.0024	1.55-2.00 1.728±0.1834
F4	0.040-0.060 0.044±0.0055	0.020-0.035 0.024±0.0035	1.66-2.25 1.944±0.1469
F5	0.045-0.065 0.054±0.0047	0.020-0.035 0.027±0.0043	1.71-2.75 2.074±0.2842
F6	0.045-0.065 0.056±0.0072	0.025-0.037 0.031±0.0040	1.63-2.16 1.825±0.1465
F7	0.045-0.065 0.058±0.0054	0.025-0.040 0.033±0.0055	1.5-2.00 1.755±0.1551
F8	0.040-0.065 0.055±0.0070	0.030-0.050 0.040±0.0051	1.2-1.85 1.382±0.1607
Clava	0.160-0.215 0.187±0.0180	0.050-0.070 0.060±0.0071	2.66-3.72 3.100±0.2651

AV, average; SD, standard deviation; Ratio L/W, ratio length/width; F, funicular segment.

Table 2. Measurements (mm) of the forewing, mesotibia and ovipositor.

	Min.-max.	AV±SD
FWL	0.920-1.080	1.013±0.0490
FWW	0.250-0.350	0.314±0.0263
L/W	2.94-3.68	3.23±0.187
MFL	0.050-0.100	0.070±0.0104
MLF/FWW	3.40-5.83	4.51±0.523
MTL	0.250-0.320	0.289±0.0173
OVL	0.480-0.550	0.519±0.0171
OVL/MTL	1.56-2.03	1.79±0.107

AV, average; SD, standard deviation; FWL, forewing length; FWW, forewing width; L/W, ratio forewing length/forewing width; MFL, maximum fringe length; MFL/FWW, ratio maximum fringe length/maximum forewing width; MTL, mesotibia length; OVL, ovipositor length; OVL/MTL, ratio ovipositor length/mesotibia length.

Table 3. Distribution of multiporous plate sensilla on the female antenna segments.

Sp.	F5	F6	F7	F8	Clava
1	0	0	2	2	10
2	0	1	2	2	10
3	0	0	1	1	10
4	0	1	1	2	10
5	0	1	0	2	10
6	0	0	2	2	10
7	0	1	1	2	10
8	1	1	1	2	10
9	0	0	1	2	10
10	0	1	1	2	10
11	0	1	1	2	10
12	0	0	1	1	10
13	0	1	1	2	10
14	0	1	1	2	10
15	0	0	1	2	10
16	0	1	1	2	10
17	0	0	2	3	10
18	0	2	2	3	10
19	1	0	2	2	10
20	0	0	1	2	10
21	0	2	2	2	10
22	0	2	2	2	10

Sp., specimen; F, funicular segment.

quently (59%) (Figure 1C). Several specimens (37%) (Figure 1B) show any mps on F5 and F6.

The ratio L/W of the forewing is similar, but the ratio MFL/FWW is markedly different, as is the ratio OVL/MTL.

The measurements and ranges of variation presented here fall within the broad concept of G. *litoralis* given by Triapitsyn *et al.* (2010) and Triapitsyn (2013). However, without additional evidence from more material reared from known hosts, combined with an analysis of molecular data, it is difficult to determine whether Triapitsyn's (2013) concept represents a species complex or a single variable species.

Biology

In southern Italy, *A. putoni* overwinters as an egg inserted into the rough bark of the grapevine. Eggs hatch in March and April and the nymphs migrate to wild and cultivated plants (mainly Fabaceae), where they feed and develop. Adults appear in late May; their population increases during June and July and then progressively declines. There is one generation per year, similar to the allied species *A. fuscovenosus* (Ferrari), a possible host of *G. litoralis*, distributed in central and northern Italy (Alma, 1995). *G.litoralis* overwinters as an immature in the host eggs and the adults emerge from late April to early July. The life cycle of the parasitoid seems to be synchronized with that of the host.

As with other parasitoids associated with grapevine bark, it is likely that *G. litoralis* can also develop in the egg of *Scaphoideus titanus* (Ball) (Arzone & Alma, 1994).

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