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Records on indigenous antagonists of *Phyllocnistis citrella* Stainton (Lepidoptera Gracillariidae) new for Italy(*)

Abstract - From December 1997 to March 1999 samples of leaves infested by Citrus Leaf Miner *Phyllocnistis citrella* (CLM) Stainton were collected in several citrus groves around Palermo in order to bred indigenous parasitoids. Among the different species of Eulophid wasps emerged also: *Asecodes delucchii* (Bouček), *Baryscapus* sp., *Elasmus* sp., *Aprostocetus* sp.. This latter species was also obtained by *Stigmella* sp. on *Ulmus* sp.. In Italy these parasitoids were not known to attack the already mentioned Gracillariid. Among those already known all developmental stages of *Semielacher petiolatus* (Girault) were observed during winter 1998-1999. These records highlight a probable permanent establishment of this parasitoid in the Sicilian citrus groves. With the aim of strengthening the natural biological control against the CLM, a strain of *Citrostichus phyllocnistoides* (Narayanan) introduced from Jordan is now bred in order to support its releases into citrus groves of the Island.

Riassunto - *Reperti su parassitoidi di* Phyllocnistis citrella *Stainton finora non segnalati in Italia.*

Da dicembre 1997 a marzo 1999 sono stati periodicamente raccolti in alcuni limoneti del palermitano campioni di foglie infestate dagli stadi preimmaginali di *Phyllocnistis citrella* Stainton. I materiali venivano tenuti in capsule di Petri fino allo sfarfallamento degli eventuali parassitoidi. Oltre a numerose specie già note si sono ottenuti anche: *Asecodes delucchii* (Bouček), *Baryscapus* sp., *Elasmus* sp., *Aprostocetus* sp. Quest'ultima è stata pure ottenuta da *Stigmella sp.* che in Sicilia infesta *Ulmus* sp.. Tra i parassitoidi già conosciuti, *Semielacher petiolatus* (Girault) durante l'inverno 1998-1999 è stato osservato in diversi stadi di sviluppo in quasi tutti i campioni esaminati. Questi reperti evidenziano che tale Eulofide, così come *Cirrospilus pictus,* anche durante l'inverno si sviluppa a spese di *Ph. citrella* e fanno ritenere che si sia definitivamente acclimatato nei nostri areali. In vista di ottenere un più efficace controllo biologico naturale della minatrice degli agrumi è stato introdotto dalla Giordania un ceppo di *Citrostichus phyllocnistoides* (Narayanan), che al momento viene allevato con lo scopo di effettuare dei lanci negli agrumeti dell'Isola.

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Key words: Citrus Leaf Miner, antagonists, alternative host, *Semielacher petiolatus* establishment in Sicily.

INTRODUCTION

From winter 1998 to March 1999 the research on indigenous parasitoids of *Phyllocnistis citrella* Stainton in Sicilian citrus orchards and on their alternative hosts infesting the associated vegetation was continued.

In this article some Eulophid wasps not yet known for the mentioned Gracillariid are reported.

MATERIALS AND METHODS

Samples of CLM infested leaves were collected in several untreated citrus groves of western-Sicily from winter 1997-1998 until March 1999

In order to ascertain the eventual CLM antagonists, such materials were bred into proper Petri dishes, in climatic room until the emergence of the adults of natural enemies. Samples collected during the winters were instead introduced into a proper box with all sides made of net in order to better simulate the natural climatic conditions and put in the field isolated from the soil and protected from the rainfall.

All the adults of the antagonists emerged were preserved in alcohol 70%.

For the identification of genera the keys of Bouček (1988), Graham (1987) and Schauff *et al.* (1998) were used.

RESULTS AND DISCUSSION

From the parasitised CLM individuals collected in 1998 several already known Eulophid species emerged i.e.: *Asecodes erxias* (Walker), *Cirrospilus diallus* Walker, *C. pictus* (Nees) *Neochrysocharis formosa* (Westwood), *Pnigalio agraules* (Walker), *Apotetrastichus postmarginalis* (Bouček) and *Semielacher petiolatus* (Girault). In addition some other species not yet known were obtained and are discussed below.

Aprostocetus sp.[1]

MATERIAL EXAMINED: two males (Balestrate, VIII/98, Sicily) and two males (from samples collected on lemon trees in the garden of our Institute during July-August 1998).

Several other males emerged from *Stigmella* sp. during August-November and December 1998 on *Ulmus* sp.; the leaves infested by this leafminer were collected from different trees mostly located at "Favorita" park of Palermo.

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(1) The identification of this material was made by prof. Gennaro Viggiani (*in verbis*, 1999). According to Schauff et *al.* (l..c.) only an unidentified species of this genus is so far known from Tunisia as attacking *Ph. citrella.*

Asecodes delucchii (Bouček)

MATERIAL EXAMINED: two males (Balestrate,VIII/98, Sicily).
REMARKS: Delucchi (1958) first mentions this species as parasitising *Phyllonorycter messaniella* (Zeller) on oak in Italy. It was also bred from *Stigmella aurella* Stainton, *Caliroa cerasi* L. (Bouček, 1969), and *Stigmella malella* Stainton (Navone & Vidano, 1983).

It is interesting to note that one of the two mentioned males pupated without consuming all the host tissues. Furthermore both pupae of *A. delucchii* were sticked to the floor of the pupal cell or to the meconium by a whitish cord. It seems that similar anchorage was first observed by Mellini (1950-51) for *Entedon insignis* Erdos and also recorded by Celli (1962) for *Pnigalio agraules* Walker. In relation to the CLM, *A.delucchii* was only known from Japan and perhaps from Thailand (Schauff *et al.*,1.c.)(2).

Table 1 - Date of emergence of CLM and of parasitoids during the winter 1997/1998 from samples exposed in the field.

Locality	Date of sampling	Date of emergence	CLM emerged	Parasitoid emerged	Number and sex
Bagheria	25.II.1998	9.III.1998	-	C.p.	1♂
(P.p.)			2	C.p.	1♀
		23.III	-	C.p.	1♂, 2♀♀
	2.III	20.III	-	C.p.	2♀♀
		27.III	-	C.p.	1♂♂
		3.IV	-	C.p.	2♂♂
		6.IV	1	C.p.	2♂♂, 1♀
		14.IV	-	C.p.	1♂, 1♀
Partinico	2.III	20.III	-	C.p.	3♀♀
(P.p.)		25.III	1	C.p.	3♂♂
S. Flavia	3.III	20.III	-	C.p.	1♂, 2♀♀
(P.p.)		26.III	2	C.p.	3♀♀
		29.III	-	C.p.	2♂♂
		6.IV	-	C.p.	2♂♂

C.p. = *Cirrospilus pictus*; P.p. = Palermo province.

(2) During laboratory examination of samples of parasitised CLM collected in the field, it was confirmed that similar type of anchorage of the pupa is common to all the Chalcidoid antagonists related to CLM (Mineo *et al.*,1998*a*). More recently it was also seen in another chalcidoid wasp belonging to Tetrastichinae parasitising *Monarthropalpus buxi* Lab. Nevertheless it must be pointed out that in such a strategy, looking at making easier the emergence of adult from the pupal case, only few individuals of the same species are usually involved.

Baryscapus sp.

MATERIAL EXAMINED: one female (Balestrate, VII/VIII/98 Sicily).
REMARKS: some species belonging to *Baryscapus* attacking *Ph. citrella* are known only from Egypt and from Spain (Schauff *et al.*,1. c.). The genus was already known in Italy; *B. nigroviolaceus* (Nees), is known on *Phyllonorycter robiniellus* (Clemens) (Gibogini *et al.*,1996).

Table 2 - Date of emergence of CLM and of parasitoids during the winter 1998/1999 from samples exposed in the field.

Locality	Date of sampling	Date of emergence	CLM emerged	Parasitoid emerged	Number and sex
Balestrate (P.p.)	26.XII.1998	12.I.1999	-	C.p.	3♀♀
Bagheria (P.p.)	6.I.1999	18.I	-	C.p.	3♂♂
		19.I	-	C.p.	5♂♂
		20.I	-	C.p.	4♂♂, 2♀♀
		22.I	2	C.p.	1♂, 1♀
		18.III	-	C.p.; S.p.	2♀♀, 2♀♀
Palermo	12.I	26.II	1	C.p.	3♀♀
Palermo	12.I	18.I	-	S.p.	1♀
		20.I	-	S.p.	2♀♀
		26.I	-	S.p.	1♀
		2.III	-	S.p.	1♀
Bagheria (P.p.)	3.III	4.III	2	S.p.; C.p.	1♀, 1♀
		9.III	2	S.p.	2♀♀
		11.III	-	S.p.; C.p.	1♂, 1♂
		26.III	-	C.p.	1♂
		30.III	-	C.p.	1♀ , 2♂♂
		1.IV	2	S.p.; C.p.	2♀♀, 1♂
S. Flavia (P.p.)	3.III	11.III	-	C.p.	3♂♂
		16.III	1	S.p.; C.p.	1♀, 2♂♂
Partinico (P.p.)	17.I	16.III	-	C.p.	2♀♀, 3♂♂
Bagheria (P.p.)	3.III	16.III	-	S.p.	1♂
		16.III	-	C.p.	2♀♀, 1♀

C.p. = *Cirrospilus pictus*; S.p. = *Semielacher petiolatus*; P.p. = Palermo province.

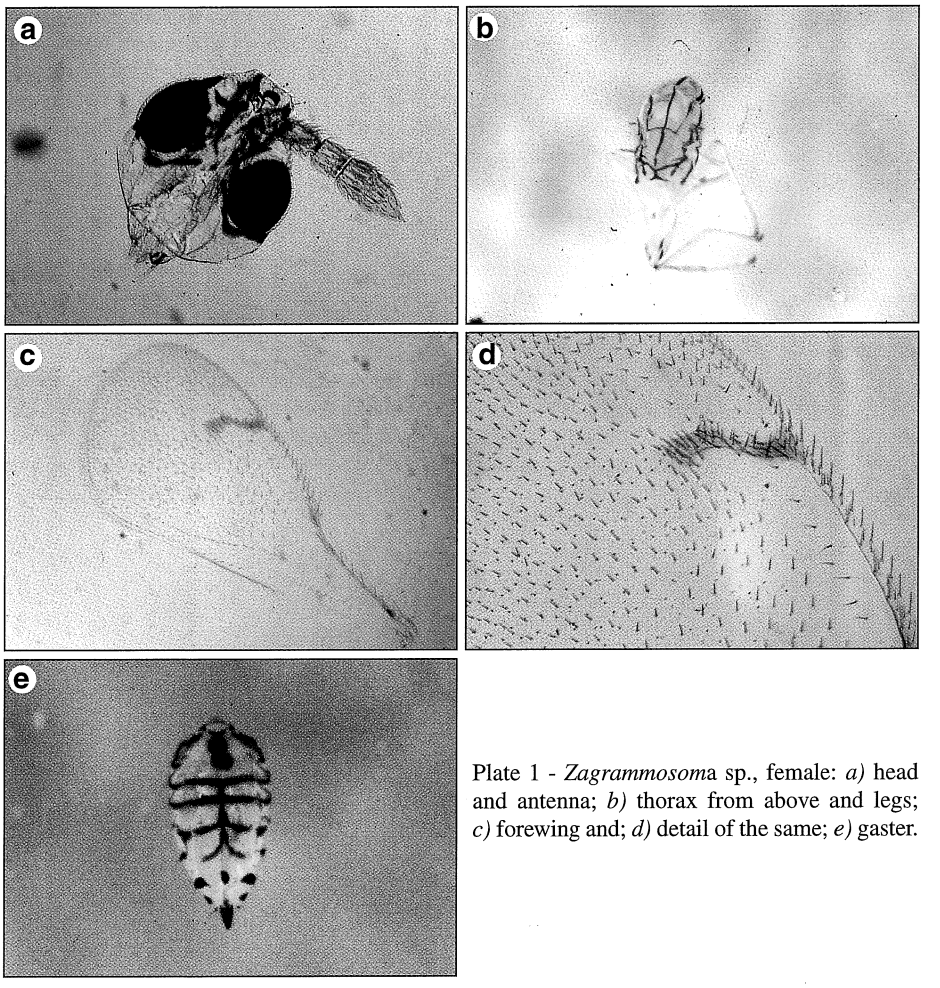

Plate 1 - *Zagrammosoma* sp., female: *a)* head and antenna; *b)* thorax from above and legs; *c)* forewing and; *d)* detail of the same; *e)* gaster.

Elasmus sp.

MATERIAL EXAMINED: two males. (Balestrate, IX/98 Sicily).
REMARKS: no species belonging to this genus in the Mediterranean Basin was known parasitising CLM.

Taking into account the characters illustrated by Viggiani and Lasalle (1994) in order to separate *Elasmus flabellatus* (Fonscolombe) from *E. steffani* Viggiani, our specimens seem closer to this latter one.

On Tables 1 and 2 are reported the parasitoids that emerged during winter 1997-1998 and 1998-1999 from the samples of CLM individuals exposed in the field.

It seems hazardous to think that the emergence of *C. pictus* recorded in both winters have a seasonal synchronism with suitable stages of *P.citrella*, although such a synchronism could be virtually ensured by the longevity of adults. This hypothesis could be supported by the records on CLM parasite in the citrus groves registered at the end of April/beginning of May in previous years and that the parasite was almost exclusively represented by eggs and new hatching larvae of *Cirrospilus pictus*. Considering that the beginning of CLM natural infestation is usually registered in June, more consistent appears to suppose that the assumption of some alternative hosts provide the link i.e. *Cosmopterix pulcherrima* Chambers infesting *Parietaria* spp. and that are also associated to vegetation of *Citrus*.

Semielacher petiolatus (Girault), first time intercepted on CLM during last summer (Mineo *et al.,*1998b) has been observed overwintering on this host. It could be of interest to point out that such a parasitoid was observed by microscopic examinations in all its developmental stages during January-February 1999.

The above reported records increase both the list of indigenous parasitoids previously recognized in Italian citrus groves as attacking CLM and that one of alternative hosts infesting their associated vegetation. Probably the biodiversity of this pool of parasitoids will become more conspicuous in the future. At present such a list encloses 17 species; nevertheless there is no evidence that their combined efficacy brings to a resolutory CLM control on the field.

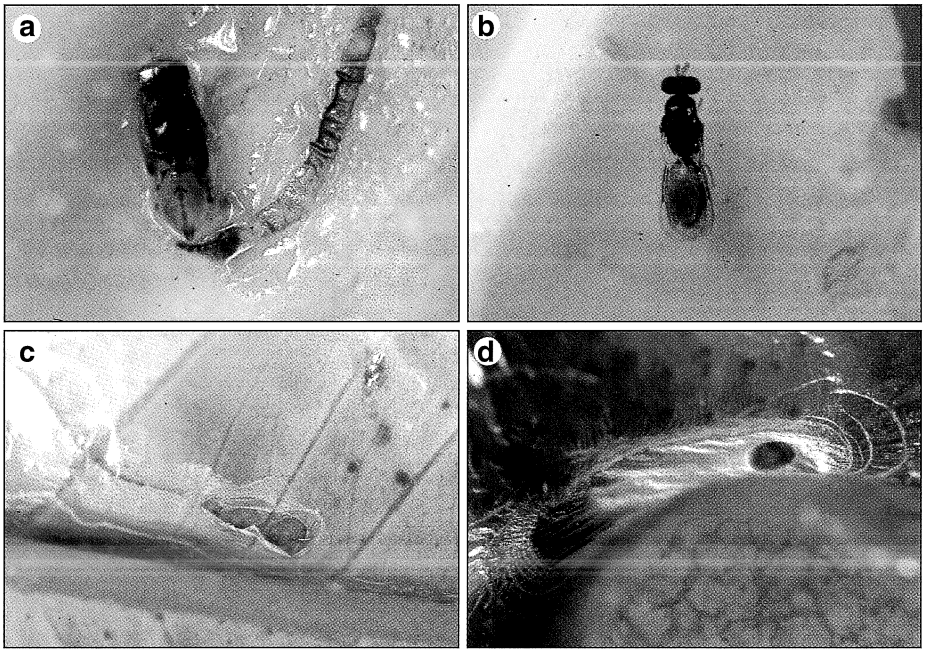

Plate 2 - *Semielacher petiolatus: a)* pupa; *b)* adult female; *c)* the larva of *Phyllocnistis citrella* developing onto the citrus leaf tissues was preyed from an ant as shows from the open glare epidermis; *d)* the brownish spot marking the white cocoon was due to the internal liquid flowed from CLM larval body during the time of host-feeding of an unidentified Eulophid wasp: such a record results very rare in the nature.

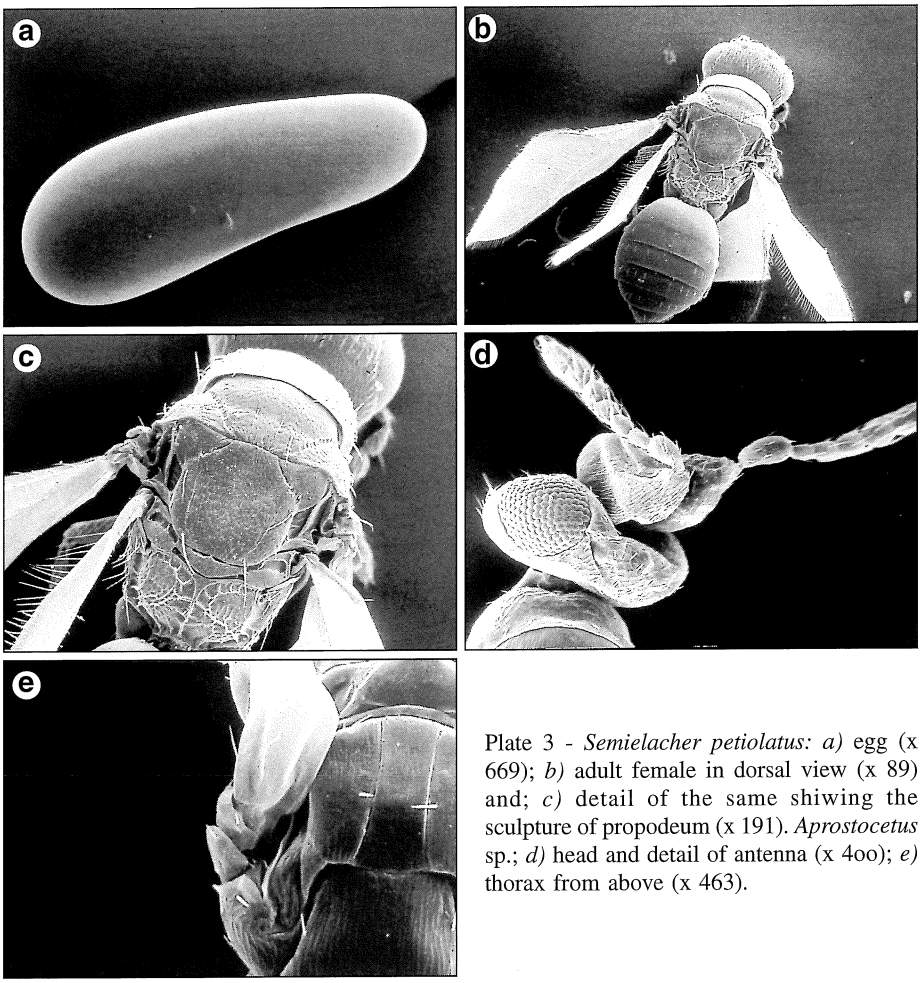

Plate 3 - *Semielacher petiolatus: a)* egg (x 669); *b)* adult female in dorsal view (x 89) and; *c)* detail of the same shiwing the sculpture of propodeum (x 191). *Aprostocetus* sp.; *d)* head and detail of antenna (x 4oo); *e)* thorax from above (x 463).

Mineo *et al.* (1998b) last year stressed the accidental introduction in Sicily of *Semielacher petiolatus* (Girault). This Australian parasitoid, first introduced in Israel (Argov and Rossler, 1996) and in Morocco (Nia et *al.*,1994), is now present in about all the citriculture of the Mediterranean Basin. The Author recently identified CLM parasitoids from Jordan. Among them some indigenous species like *Baryscapus* sp., *Closterocerus* sp.(3), *Neochrysocharis formosa* (Westwood) *Zagrammosoma* sp. (Plate 1), and also some exotic species were found, probably spread from Israel where they were recently introduced (Argov and Rossler, 1998), i.e. *Citrostichus phyllocnistoides* (Narayanan), *Cirrospilus ingenuus* Gahan and *Semielacher*

(3) The Jordanian material does not agree with the description of *Closterocerus trifasciatus* Westwood that according to Schauff *et al.* (l.c.) is so far known attacking CLM only in Japan and in Thailand.

petiolatus (Plates 2-3). This latter Eulophid is now spread all over the citrus orchards of our Island (Mineo *et al.*, 1998b) and the records collected during winter 1999 suggest that it could be considered as established.

It must be stressed that 2nd and 3rd instar CLM larvae are poorly parasitized by indigenous species recorded in Sicily all year round. So the first step of our future program will be the introduction of known species operating at this biological niche.

One of these species, *C. phyllocnistoides* recently sent from Jordan by the courtesy of Dr. Mazen Ateyyat (University of Amman), is now bred in our laboratory for releases purpose in the Sicilian citrus groves.

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