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On two Italian Gall Midges (Diptera Cecidomyiidae) and their parasitoids*

ABSTRACT

Some biological data on *Cystiphora sonchi* (Bremi) and *Asphondylia trabuti* Marchal in Italy are reported. *C. sonchi*, previously known only for N Italy, is also recorded for S Italy, Sardinia and Sicily. It induces galls on the leaves of *Sonchus* spp. (Compositae) all the year around, except for the second half of July and August. The number of galls per leaf was higher in summer (11.6) than in winter (7.4). Overall 5-6 generations per year were observed, with a maximum number of individuals in spring-summer. Larvae often merge in the same gall, pupating inside it and emerging from the lower leaf surface; in winter they can leave galls and pupate outside them. On the whole 426 *C. sonchi* and 381 parasitoids were reared; 359 were *Aprostocetus microscopicus* (Rondani) (Hymenoptera Eulophidae) and 22 *Synopeas larides* (Walker) (Hymenoptera Platygasteridae); the latter has not been previously quoted for Italy.

A. trabuti, previously known as phytophagous on fruits of *Solanum tuberosum* L., is here recorded for the first time in Italy and as phytophagous of *S. nigrum* L. Larvae live gregariously, developing and pupating inside fruits between May and December. They emerge in about two weeks, their number peaking in spring; at least 5 generations per year were observed. On the whole 100 *A. trabuti* and 91 parasitoids were reared; 88 were *Eurytoma dentata* Mayr (Hymenoptera Eurytomidae), previously unrecorded as parasitoids of this gall midge, and 3 were unidentified Pteromalidae.

Key words: *Cystiphora sonchi, Asphondylia trabuti, Sonchus* spp., *Solanum nigrum*.

INTRODUCTION

This paper deals with some biological, distributional and behavioural notes recorded on two gall midges, *Cystiphora sonchi* (Bremi) and *Asphondylia trabuti* Marchal, the former previously known in Italy only in the northern regions, the latter still unrecorded.

The genus *Cystiphora,* including only gall midges, is associated with species of several genera of Cichoriaceae (Compositae). *C. sonchi* (Bremi), wide-

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spread in Europe (SKUHRAVA in SOÖS & PAPP, 1986; SKUHRAVA & SKUHRAVY, 1994, 1997; SKUHRAVA *et al.*, 1996), is strictly linked to plants of the genus *Sonchus* and in 1981 it was introduced in Canada for the biological control of these weeds (DE CLERCK & STEEVES, 1988). The larval trophic activity induces on the leaves some small galls 4-6 cm wide, convex or hemispherical on the upper surface, flat on the lower one; every round pustule caused by separation of the parenchyma from the lower leaf epidermis is upperly green, surrounded by a violet circular patch, which after some day becomes dark purple and yellow; the lower surface is withish-grey (BREMI, 1847; LÖW, 1875; GOIDANICH, 1954; PELLIZZARI SCALTRITI, 1988) (figs 1a, 1b).

A. trabuti is a mediterranean species till now known only from Algeria and Israel (SKUHRAVA in SOÖS & PAPP, 1986). It is the sole gall midge species known to develop gregariously inside the fruits of potato (*Solanum tuberosum* L.) (MARCHAL, 1896; BARNES, 1946). The potato was introduced into Europe from South America in 16th century, where, however, any species of *Asphondylia* is known to infest its fruits (GAGNÉ, 1994).

MATERIALS AND METHODS

Cystiphora sonchi (Bremi)

From July 1997 to December 1998 plants of the gen. *Sonchus,* holding galls of *C. sonchi*, were collected in different localities of Sicily; in order to know the phenology and the behaviour of the gall midge, as well as the incidence of its parasitoids, regular samplings were carried out in two localities (Menfi, province of Agrigento and Borgo Molara, province of Palermo). Moreover, some occasional samples were collected in Sardinia and Italian peninsula. Gall midges were reared in Petri dishes, on wet paper at 25°C, 65% R.U. and 12:12 photoperiod, as well as at ambient conditions. Adults of *C. sonchi* were then placed in rearing boxes with a mixture of sugar, honey and water, to evaluate the life span at room conditions. Both *C. sonchi* and its parasitoids emerged from galls were counted and identified. The incidence of parasitoids here reported is the ratio between their number and that of *C. sonchi* emerged from the galls.

On the whole we studied the following samples.

Friuli: Trieste 19.VII.98 (*S. oleraceus* L.); Apulia: Bari 24.VII.98 (*S. oleraceus, S. asper* L. Hill); Basilicata: Maratea (Potenza) 22.VI.98 (*S. asper*); Sardinia: Alghero (Sassari) 10.X.97 (*S. asper*); Sicily: Menfi (Agrigento) 3.X.97, 3.IV.98, 8.V.98, 12.VI.98, 18.XII.98 (*S. asper*); Borgo Molara (Palermo) 27.IX.97,

16.XI.97, 11.I.98, 14.V.98, 7.VI.98, 7.VII.98 (*S. oleraceus, S. asper*); Palermo-Cruillas 16.XI.97 (*S. asper*); Balestrate (Palermo) 13.VII.97 (*S. asper*); Terrasini (Palermo) 13.XII.97 (*S. asper*); Zucco Montelepre (Palermo) 10.VI.98, 29.VIII.98, 2.IX.98 (*S. asper*); M. Pellegrino (Palermo) 23.V.98 (*S. oleraceus, S. asper*); Mondello (Palermo) 22.XI.98, 5.XII.98 (*S. oleraceus*); Palermo, garden of Istituto Entomologia agraria 10.XI.97 (*S. oleraceus*); Ustica Is. 25.IV.98 (*S. asper*). All samples have been collected by the authors, with the exception of that from Ustica, provided by G. Lo Verde and those from Balestrate and Palermo-Cruillas, collected by G. Mineo.

Asphondylia trabuti Marchal

From July 1997 to January 1999 hundreds of fruits of *Solanum nigrum* L. were collected in different localities of Sicily and once in peninsular Italy; they were reared in wide boxes (24 x 16 x 7 mm), with the same criteria used for *C. sonchi*. Adults of *A. trabuti* and its parasitoids emerged were counted and identified. The incidence of parasitoids below cited has been obtained as previously reported for *C. sonchi*.

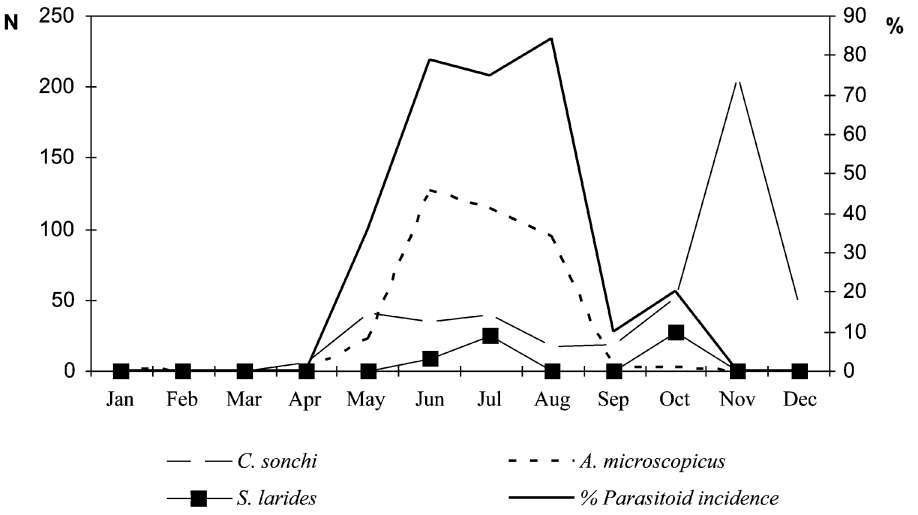
On the whole we examined fruits of *S. nigrum* collected in the following localities of Sicily: Balestrate (Palermo) 20.VII.97; Zucco Montelepre (Palermo) 11.VIII.98; Borgo Molara (Palermo) 6.I.98; 17.XII.98, 20.XII.98, 13.I.99; Menfi (Agrigento) 3.X.97; 12.XI.97; 18.XII.97; 13.I.98; 8.V.98; 12.VI.98; 18.XII.98. An occasional sample was also collected in North-Italy (Friuli, Trieste 19.VII.98).

RESULTS AND DISCUSSION

Cystiphora sonchi (Bremi)

In Italy *C. sonchi* is recorded only from the northern regions (Skuhrava & Skuhravy, 1994); we report it for the first time in Sicily, Sardinia and southern regions of Italy, where it may be considered quite common. Even if this gall midge is known to infest *S. oleraceus*, *S. arvensis* L., *S. asper*, *S. maritimus* L. and *S. tenerrimus* L. (Peschken, 1982; Skuhrava *et al.*, 1996), in Italy has been hiterto recorded only on *S. oleraceus* and *S. arvensis* (Skuhrava & Skuhravy, 1994); we also report it on *S. asper*. We did not find galls on *S. tenerrimus*.

S. asper and *S. oleraceus* are present in Sicily all the year around with the exception of the period from middle July to late August, when they become



Graf. 1 - Population trend of *Cystiphora sonchi* and its parasitoids.

rare. On the whole we obtained 426 adults; infestation trend (graf. 1) is bimodal, showing a first peak in spring-summer (May-middle July), followed by the decreasing of the species to late August, depending on the scarce availability of *Sonchus* plants, which in turn is due to the summer drought. After the autumnal rains and the grass renewal, in October-November a second peak occurs. In the winter the presence of plants leading galls is local and sporadic. The total number of generations per year occurred during our study was 5-6. In the Czech Republic, where the vegetative season is much shorter than in Sicily lasting from May to the end of September, SKUHRAVA & SKUHRAVY (1973) observed only three generations per year, peaking three times, the first in June, the second one (higher) in August, and the third in September.

According to PESCHKEN (1982) adults do not feed and live only few hours; we instead reared individuals for 18-36 hours (fig. 1c). The biological cycle, from the oviposition to the adult emergence, lasts 18 days (PESCHKEN, 1982); the adult generally emerges in the first hours of the morning.

Differently from other phytophagous insects, *C. sonchi* lays its eggs into the lower leaf epidermis via the stomata (DE CLERK & STEEVES, 1988); the newborn larva induces the separation of the epidermis from the parenchyma. The coexistency of differently aged larvae in the same leaf is probably due to the oviposition by different females.

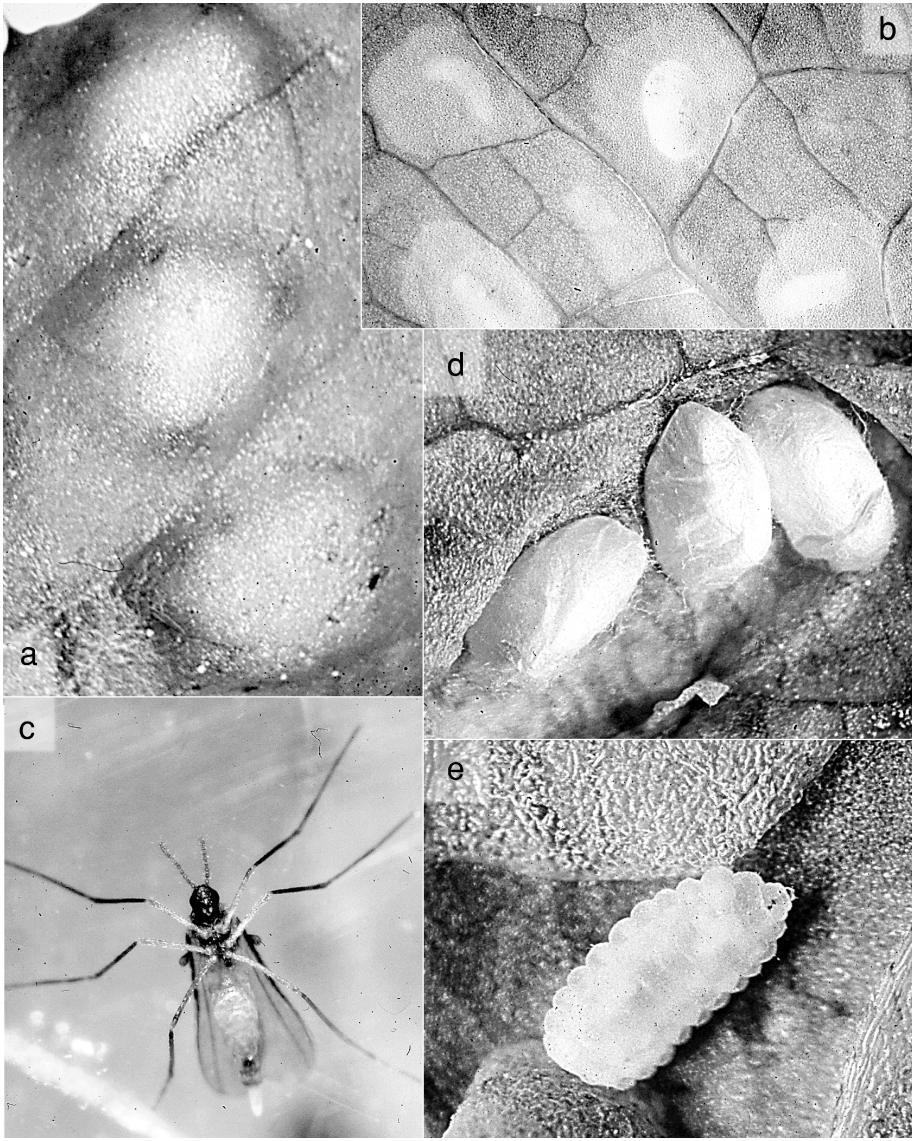


Fig. 1 - a) Galls of *Cystiphora sonchi* on *Sonchus oleraceus*, upper leaf surface; b) lower leaf surface; c) Adult female of *Cystiphora sonchi*; d) Many pupae can be found close to each other when larvae of *Cystiphora sonchi* merge in a single gall (gall opened on purpose); e) Young larva of *Cystiphora sonchi* (gall opened on purpose).

The gall number per leaf is much variable; in June-July the mean number was 11.6 (± 7; min. 2, max 31), and the galls were evenly distributed in different leaves, while in November-December their number resulted significantly lower (7.4 ± 6.4; min. 1, max 24) (t of Student = - 1.995; fd = 44; P = 0.05) and galls were distributed only on the leaves close to the soil. BREMI (1847) recorded about 20-30 galls per leaf, SKUHRAVA & SKUHRAVY (1973) found up to 50 galls per plant, while we observed up to 110 in June-July and 70 in November-December on *S. oleraceus* and *S. asper*. PESCHKEN (1982) in the laboratory obtained up to 245 galls per leaf and 721 on a single plant of *S. arvensis*. BREMI (1847), GOIDANICH (1954), and PELLIZZARI SCALTRITI (1988) agree that only one larva lives inside each gall and after more larvae may partially merge in a single gall (fig. 1d). Observing the upper leaf surface where is likely detectable each single gall and thus the galls very close to each other, and the lower surface where larvae may be easily observable through the epidermis, it is possible to recognize different larvae joined in a single gall. We found leaves containing galls with a single larva, as well more than one larva met in the same gall; in one sample, consisting of 98 galls (in 17 leaves), collected in June 1998, we detected 87% of galls holding only one larva and 13% with 2, 3 or 4 larvae joined together.

The larva, withish in the first days, becomes ochraceous during its growth; it pupates in a cocoon (fig. 1e, fig. 2a). As other authors observed (BREMI, 1847; LÖW, 1875; PESCHKEN, 1982), the adult emerges from the lower gall surface, leaving from the emergency hole the exuvia partially protruding (fig. 2b).

According to some authors (NIJVELDT, 1969; SKUHRAVA & SKUHRAVY, 1973; PELLIZZARI SCALTRITI, 1988) larvae developing in summer pupate in the gall, whereas autumnal ones winter as pupae in the soil. PESCHKEN (1982) in the laboratory observed larvae to pupate both in the galls and outside them. During our study in summer all the adults emerged directly from galls, while in winter, both in conditioned room and at ambient conditions, we observed adults emerging from the galls, and, at the same time, larvae emerging from the galls and pupating outside them (fig. 2c). The lower surface of the latter galls shows a transverse incision on the side of the emergency hole.

On the whole we obtained 381 parasitoids; 359 of them were *Aprostocetus microscopicus* (Rondani) (Hymenoptera Eulophidae), while 22 were *Synopeas larides* (Walker) (Hymenoptera Platygasteridae). Population dynamics is given in graf. 1. They peaked in spring-summer months, with a very low occurrence in October, the only month in which *S. larides* prevailed. We observed the maximum incidence of parasitization (84%) in August, mostly due to *A. microscopicus*.

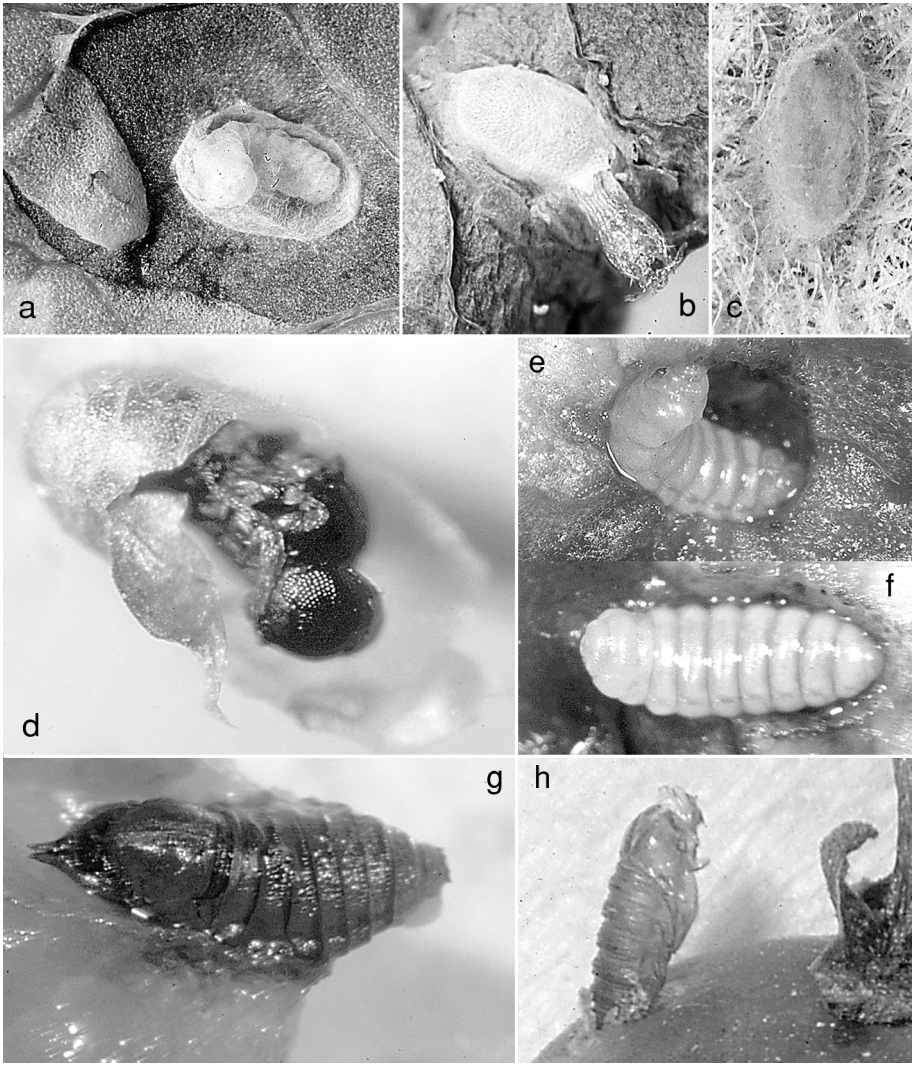


Fig. 2 - a) Mature larva of *Cystiphora sonchi* building its cocoon to pupate inside the gall (gall opened on purpose); b) Emergency hole of an adult of *Cystiphora sonchi* showing the exuvia partially protruding from the gall. c) Larvae of *Cystiphora sonchi* reared in winter pupate both inside the galls and outside them, as in this case on the lower surface of the rearing paper sheet of Petri dish; d) *Synopeas larides* emerged from the pupa of *Cystiphora sonchi*; e) Young larva of *Asphondylia trabuti* inside a fruit of *Solanum nigrum* (fruit opened on purpose); f) Mature larva of *Asphondylia trabuti* inside its pupating niche (fruit opened on purpose); g) Pupa of *Asphondylia trabuti* (fruit opened on purpose); h) Emergency hole of *Asphondylia trabuti* showing the exuvia partially protruding from a fruit of *Solanum nigrum*.

A. microscopicus is known as endophagous specific parasitoid of *C. sonchi* from the time of its description (RONDANI, 1877); according to GRAHAM (1987) its recordings as parasitoid of another Cecidomyiid, *Monarthropalpus flavus* (Schrank) (= *M. buxi* Laboulbène) (DOMENICHINI, 1966a, 1966b), are to be considered incorrect. Described on specimens collected in north Italy, *A. microscopicus* has been exaustively redescribed by BOUCEK (1974). Because GRAHAM (1987) considers all the other localities quoted for this species in the literature are to be referred to other species, only its typical series (2 males and 5 females) is hiterto known. Our specimens allow to confirm its presence in north Italy (Trieste) and to ascertain it in south Italy (Bari and Maratea), in Sardinia (Alghero) and Sicily (all the localities quoted for *C. sonchi*, excluding Ustica isle). It peaked in June-August.

DOMENICHINI (1966b) recorded *C. sonchi* as host of another species, *Aprostocetus eleuchia* (Walker), but GRAHAM (1987) believes that this finding needs to be confirmed. FULMEK (1968) reported also *Holcopelte obscura* Foerster (Hymenoptera Eulophidae) as parasitoid of the gall midge in Italy, but we did not found it during our study.

As regards *Synopeas larides*, they emerged from *C. sonchi* collected in Sicily (Menfi and Balestrate) and Apulia (Bari) (fig. 2d). This species emerged always from the host pupae; its numbers were evenly distributed in July and October. According to Huggert (pers. comm.) *S. larides* was hiterto known only for the two typical specimens from Ireland, but he obtained it from *C. sonchi* in Denmark.

Asphondylia trabuti Marchal

This species emerged only from sicilian samples; it was previously unrecorded for Italy and as phytophagous of *S. nigrum*[1]. On the whole we reared 100 individuals. Larvae develop inside the fruits (fig. 2e), infesting them between May and December, peaking in spring and fluctuating onwards (graf. 2); between January and April any adult has been reared due to the lack of fruits. 1-3 larvae live gregariously, pupating in a niche produced by themselves inside the fruits (figs 2f, 2g) and completing the cycle within two weeks. Adults emerge from a hole leaving the exuvia protruding from its borders (MARCHAL, 1896) (fig. 2h). During our study we observed at least 5 generations per year.

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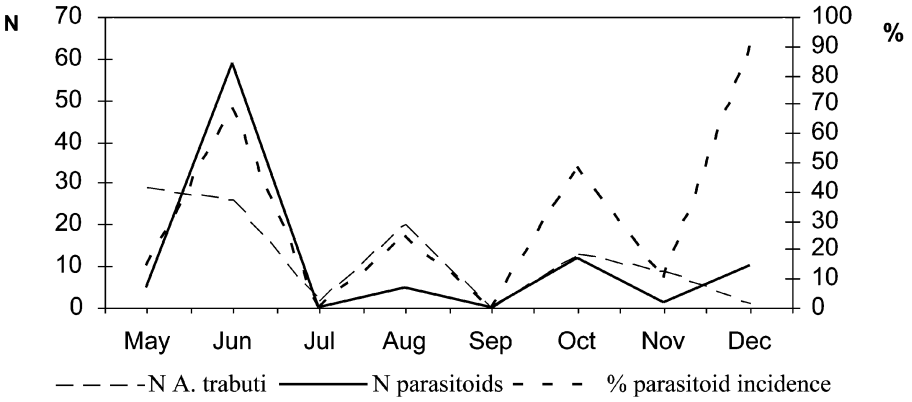
[1] Recently TRAVESET (in press) reared *A. trabuti* from fruits of *S. nigrum* in the isle of Mallorca.



Graf. 2 - Population trend of *Asphondylia trabuti* and its parasitoids. Months during which neither *A. trabuti* nor parasitoids emerged are not reported.

Overall we detected 91 parasitoids, whose trend followed that of their host peaking in June, when their number reached the maximum (59 individuals, parasitization incidence 69%); in December we obtained only ten individuals of them with the highest parasitization incidence (90%) (graf. 2). 88 of them were *Eurytoma dentata* Mayr (Hymenoptera Eurytomidae), an ectophagous solitary parasitoid that we record here for the first time in Sicily and as antagonist of *A. trabuti*. It was already known as parasitoid of *A. lupini* Silvestri infesting *Lupinus albus* L., on which the Eurytomidae reaches about 80% of total parasitization (Silvestri, 1909); Mayr (1878 in Silvestri, 1909) also recorded it as parasitoid of other Cecidomyiidae, namely *A. sarothamni* Loew living on *Sarothamnus scoparius* (L.), *A. verbasci* (Vallot) on *Verbascum* spp., and *Contarinia loti* (De Geer) on *Lotus* spp.

Three other specimens parasitizing *A. trabuti* belonged to a species of Pteromalidae yet not identified.

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We thank very much Dr. Marcela Skuhrava (Praha, Czech Republic), who identified the gall midges and provided interesting comments on the manuscript, Dr. Lars Huggert (Dalby, Sweden) who identified *Synopeas larides*, Dr. Jean-Yves Rasplus (Versailles, France) who confirmed the identification of *Eurytoma dentata*, and Prof. Gennaro Viggiani (Portici, Italy) who identified *Aprostocetus microscopicus*. Prof. Giovanni Mineo (Palermo, Italy) critically reviewed the first draft.

RIASSUNTO

SU DUE SPECIE ITALIANE DI CECIDOMIDI GALLIGENI E SUI LORO PARASSITOIDI

Si riportano alcuni dati biologici su *Cystiphora sonchi* (Bremi) ed *Asphondylia trabuti* Marchal (Diptera Cecidomyiidae) in Italia. *C. sonchi* era nota solo per le regioni settentrionali e viene riportata ora anche per l'Italia meridionale, la Sardegna e la Sicilia; essa induce galle sulle foglie delle specie del gen. *Sonchus* (Compositae) durante tutto l'anno divenendo rara nel periodo metà luglio-agosto. Il numero di galle estive per foglia (11,6) è risultato più alto di quelle invernali (7,4). In totale sono state osservate 5-6 generazioni per anno con un picco numerico in primavera-estate. Le larve spesso confluiscono nella stessa galla e vi si impupano, sfarfallando dalla pagina inferiore; in inverno alcune larve abbandonano le galle e si impupano aldifuori di esse. In totale sono stati allevati 426 *C. sonchi* e 381 parassitoidi, 359 dei quali sono risultati *Aprostocetus microscopicus* (Rondani) (Hymenoptera Eulophidae), 22 *Synopeas larides* (Walker) (Hymenoptera Platygasteridae). Quest'ultima specie viene segnalata per la prima volta in Italia.

Asphondylia trabuti, nota già come fitofago dei frutti di *Solanum tuberosum*, viene riportata per la prima volta in Italia e su *Solanum nigrum*; le larve sono gregarie, si sviluppano tra maggio e dicembre con un picco in primavera e si impupano all'interno dei frutti, completando il ciclo in circa due settimane. Sono state osservate almeno 5 generazioni per anno. In totale sono stati ottenuti 100 *A. trabuti* e 91 parassitoidi, 88 dei quali sono risultati *Eurytoma dentata* Mayr (Hymenoptera Eurytomidae), riportata per la prima volta come suo parassitoide, e 3 Pteromalidae.

Parole chiave: *Cystiphora sonchi, Asphondylia trabuti, Sonchus* spp., *Solanum nigrum*.

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