DESCRIPTION OF THE MATURE LARVAE OF *CHRYSIS GRACILLIMA* AND *OMALUS BIACCINCTUS* AND NEW DATA ON THE BIOLOGY OF *TRICHRYSIS CYANEA* (HYMENOPTERA: CHRYSIDIDAE)

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ABSTRACT

The mature larvae of *Chrysis gracillima* Förster, 1853 and *Omalus biaccinctus* (Buysson, 1893) are described and compared with others known in the tribes Chrysidini and Elampini, respectively. Additionally, new data are reported on the biology of *Trichrysis cyanea* (L., 1758).

Key Words: Cleptoparasites, biology, preimaginal states.

RESUMEN

Se describen las larvas maduras de *Chrysis gracillima* Förster, 1853 y *Omalus biaccinctus* (Buysson, 1893) y se comparan con otras conocidas de las tribus Chrysidini y Elampini, respectivamente. Adicionalmente, son reportados nuevos datos sobre la biología de *Trichrysis cyanea* (L., 1758).

The family Chrysididae includes some 3,000 species (Kimsey & Bohart 1990), most of which are ectoparasitoids or cleptoparasites of Hymenoptera Aculeata. Their biology is not very well known, most contributions referring to isolated data on their possible hosts. However, particularly outstanding are the workers in the case of the Chrysididae that attack stem-nesting Sphecidae and Eumenidae: Trautmann (1927), Enslin (1929), Clausen (1940), Van Lith (1953, 1955, 1956, 1958), Grandi (1959, 1961), Krombein (1967), Danks (1970), Spradbery (1973), Iwata (1976), and Medvedev (1978).

The mature larvae of 15 Chrysidinae have been described. These species belong to eight genera, five of which are Chrysidini and three are Elampini. Studies on the mature larvae of Palearctic *Chrysis ignita* (L., 1758); *Chrysura dichroa* (Dahlbom, 1854); *Hedychrum rutilans* Dahlbom, 1854; *Praestochrysis shanghaiensis* (Smith, 1874); *Trichrysis cyanea* (L., 1758); or Holarctic *Omalus aeneus* (F., 1758) and *Pseudomalus auratus* (L., 1758)), have been carried out by: Enslin (1929); Maréchal (1923); Soika (1934); Maneval (1936); Parker (1936); Grandi (1959, 1961); Yamane (1976); Evans (1987) and Asís et al. (1994).

Janvier (1933) described the mature larva of a Neotropical species (*Chrysis grandis* (Brullé, 1846)), and Evans (1987) dealt with the major morphological features of all the above mentioned species (with the exception of *Chrysis ignita*, *Hedychrum rutilans* and *T. cyanea*), the Nearctic species *Chrysis cembricola* Krombein, 1958; *Chry-*

sis cessata Buysson, 1891; *Chrysis nitidula* F., 1775; *Chrysis inflata* Aaron, 1885; *Chrysis inaequidens* Dahlbom, 1854, and the Nearctic-Neotropical species *Caenochrysis doriae* (Gribodo, 1874) and *Chrysis smaragdula* F., 1775.

In the course of a study on the fauna of stem-nesting Hymenoptera on the northern subplateau of the Iberian Peninsula, data were obtained on the biology of *T. cyanea*. Mature larvae of *Chrysis gracillima* Förster, 1853 and *Omalus biaccinctus* (Buysson, 1893) were also collected.

For *Omalus* Panzer, Pemphredoninae (Sphecidae) are accepted as hosts (Kimsey & Bohart 1990). For hosts of *T. cyanea*, these authors cite Larrinae and Pemphredoninae (Sphecidae). The mature larvae of *C. gracillima* and *O. biaccinctus* have been previously undescribed.

Materials and Methods

A total of 2,043 trap nests was placed in different sites of the provinces of Burgos, Cuenca, Soria, Teruel and Valencia (Spain). The trap nests, comprising stems of *Ailanthus altissima* (Miller) Swingle and of *Phragmites australis* (Cav.) Trin ex Steudel (length=20-30 cm, diam=2-5 mm), were placed in the field in mid spring of 1992 and 1993 and were collected at the end of autumn of the same year. After opening them in the laboratory, the contents of each cell were transferred to glass vials that were kept at 6-8°C over the winter. During the following spring the vials were transferred to a culture chamber at 28°C to elicit emergence of the imagos; it was thus possible to know the identity of the occupants of the nests and their parasitoids.

Some of the mature larvae were fixed and preserved in 70% alcohol for later study and description. The methodology used in their preparation was similar to that employed by Asís et al. (1994). The descriptions employ the terminology and organization used by Evans (1987).

The cells were numbered from the exterior to the interior (cell 1 outermost) even though chronologically the innermost cell was the one first completed.

Results

In all of the nests examined by us that contained two or more parasitized cells, the parasites were always of the same species.

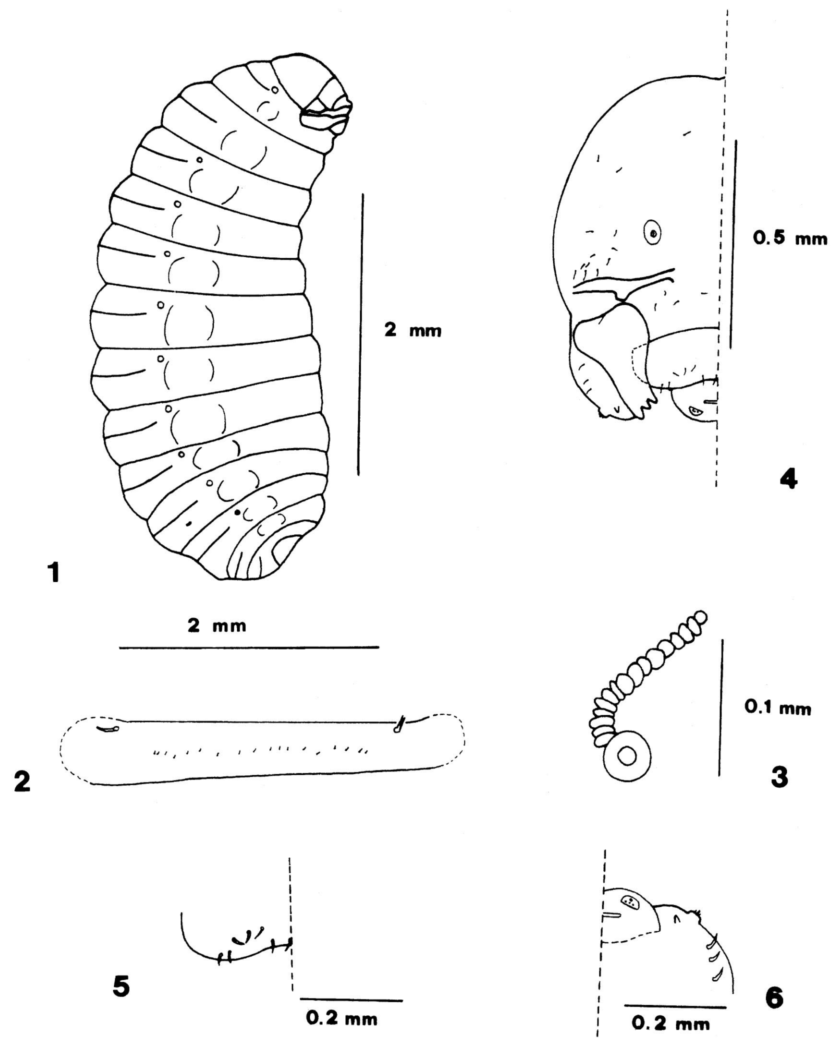
Chrysis gracillima Förster

Three larvae were collected from a nest with three cells, all of them parasitized. Of these, two were reared to obtain imagos while the other one was placed in 70% alcohol for the description that follows. The absolute measurements refer to the specimen from Vilviestre (Soria) (reference: 93010101).

Mature larva. *General aspect* (Fig. 1). Body robust (length = 4.3 µm, width = 1.9 µm), with the abdominal segments divided into two annulets by a transverse crease. Anus small, terminal, as a transverse slit. Pleural lobes developed. Integument with eighteen minute setae (l = 12 µm) on each segment, distributed in a line between spiracles (Fig. 2).

Spiracles (Fig. 3). With a well-developed peritreme; atrium simple, naked. First pair (mean diam = 42 µm, n=10) slightly larger than the rest (mean diam = 35.7 µm, n=18).

Head (Fig. 4). Width = 838 mm, height = 600 µm, with sparse and short setae (l = 19 µm) very numerous near insertion of mandibles. Coronal suture and parietal



Figures 1-6.- Mature larva of *C. gracillima* Förster: 1, general aspect; 2, segment (dorsum) with the distribution of setae; 3, spiracle (atrium and subatrium); 4, head in frontal view; 5, labrum; 6, labium and maxilla (oral face). Mature larva of *Omalus biaccinctus* (Buysson).

bands absent. Antennal orbits elliptical (57 µm × 47 µm); antennal papilla short (l=9.5 µm), with three sensillae at center.

Mouthparts. Labrum (Fig. 5) (w = 209 mm) emarginate, with fourteen marginal setae (l = 19 µm). Epipharynx naked. Mandibles (l = 266 µm, w = 142 µm) tridentate. Maxillae (l = 260 µm, w = 104 µm), with three setae on external part (l = 28.5 µm), mesal margin papillose. Maxillary palpi much wider than long (l = 9.5 µm, w = 28.5 µm);

galeae present (l = 9.5 µm, w = 9.5 µm). Labium (Fig. 6) (l = 95.2 µm, w=228 µm) with short palpi (l=19 µm, w=38 µm); spinneret a transverse slit (l = 57.1 µm). Maxillae and labium with pigmented bands.

Omalus biaccinctus (Buysson)

Imagos were obtained from three nests: one of *Passaloecus gracilis* (Curtis, 1834) which had six cells (cell 1 being parasitized, from which a male emerged). Another nest of *Passaloecus* sp. contained three cells, all of them parasitized; the mature larva of cell 2 was transferred to 70% alcohol for later study; a male emerged from cell 1 and in cell 3 the development of the chrysidid was not completed although its larva did construct a cocoon. The third nest contained nine parasitized cells; the mature larvae of cells 1, 2 and 3 were transferred to 70% alcohol for later study; two females emerged from cells 4 and 9, and in cells 5, 6, 7, and 8 the development of the chrysidid was not completed, although the larvae did construct a cocoon. The absolute measurements of the description of the larva refer to the specimen from Cofrentes (Valencia) (reference: 3I94004A1).

Mature larva. General aspect (Fig. 7). Body robust (l =4.3 µm, w = 1.8 µm); abdominal segments not divided into annulets. Fourth abdominal segment humped dorsolaterally. Anus terminal, as a transverse slit. Pleural lobes scarcely developed. Integument microspinulose (l = 4 µm), with sparse minute setae (l = 14 µm) (Fig. 8a).

Spiracles (Fig. 8b) with a well-developed peritreme; atrium simple, lined with weak ridges. First pair (mean diam = 75.3 µm, n = 10) slightly larger than the rest (mean diam = 66.6 mm, n = 18).

Head (Fig. 9). W = 914 µm, h = 885 µm with sparse, short setae (l = 19 µm). Coronal suture and parietal bands present. Antennal orbits circular (d = 47.5 µm) located below middle of head; antennal papilla (l = 19 µm, w = 18 µm) rather long, with three small sensillae at center (Fig. 10). Clypeolabral suture slightly emarginate.

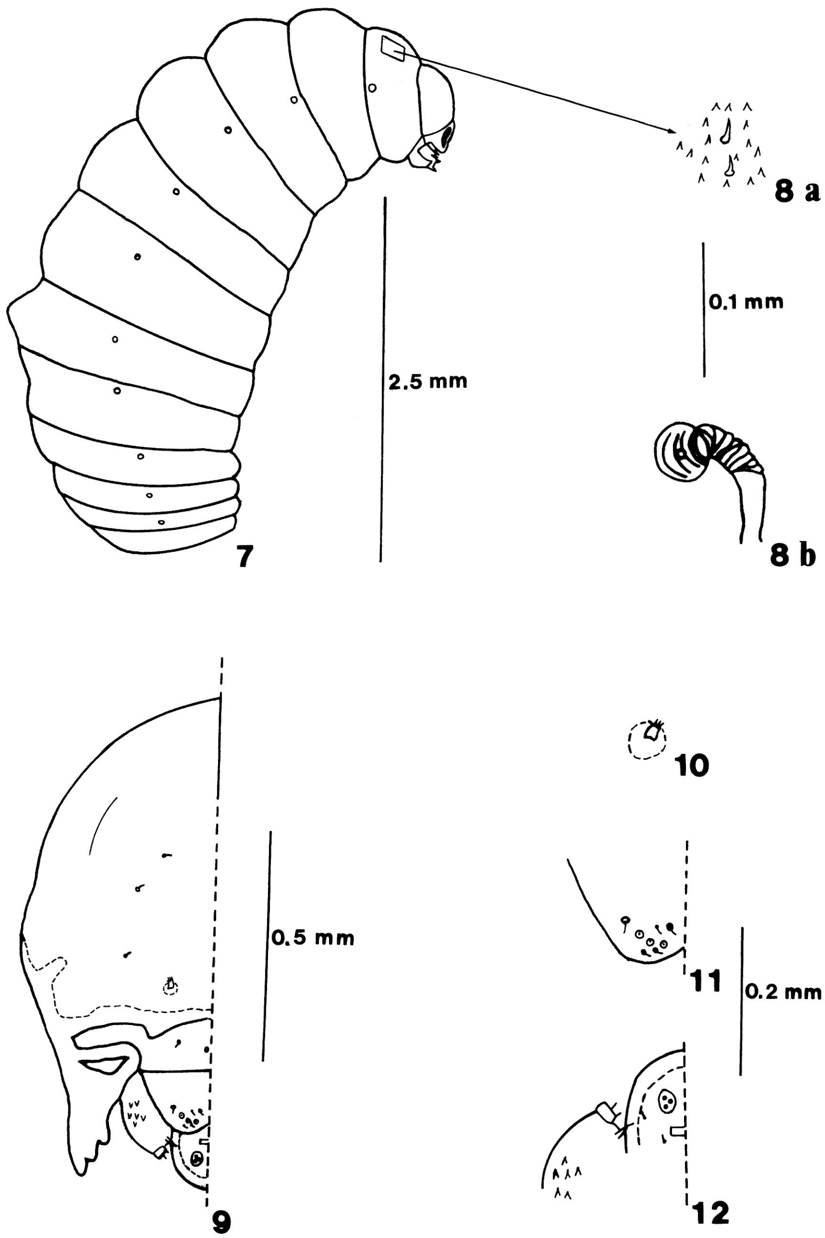
Mouthparts. Labrum (Fig. 11) W = 324 µm, emarginate, with ten short setae (l = 10 µm) and six marginal sensillae (w = 9 µm). Epipharynx naked. Mandibles (l = 257 µm, w = 125 µm) tridentate. Maxillae (l = 105 µm, w = 63 µm) with a few setae on external part (l = 9 µm); margin mesally papillose. Maxillary palpi slightly wider than long (l = 29 µm, w = 30.4 µm); galeae present (l = 19 µm, w = 9 µm). Labium (Fig. 12) (l = 142 µm, w = 171 µm) with four setae at lower face (l = 10 µm); palpi short (l = 19 µm, w = 29 µm); spinneret a transverse slit (l = 42 µm). Hypopharynx with four sensory pores (d = 7 µm). Maxillae and labium with strong, pigmented bands.

Trichrysis cyanea (Linnaeus)

Data on the biology of this species (hosts, mechanisms of parasitism, sex-ratio) have been provided by Enslin (1929) and Danks (1970). Various hosts have been cited by Trautmann (1927), Micheli (1929), Hamm & Richards (1930), Grandi (1931), and Medvedev (1978).

Individuals were obtained from nests of *Trypoxylon attenuatum* Smith, 1851; *T. beaumonti* Antropov, 1991; *T. figulus* (L., 1758); *Trypoxylon* sp.; *Pemphredon lethifera* (Schuckard, 1837) and *Psenulus pallipes* (Panzer, 1978). Table 1 shows the incidence of the Chrysididae in each of the hosts.

This was the most abundant cleptoparasite, occurring in 42 nests with 177 cells, of which 62 were parasitized (35%). The number of cells affected per nest and the parasitism index as a function of the position of cell in the nest are shown in Tables 2 and 3, respectively. With respect to the mortality observed in the 62 parasitized cells, in 7



Figures. 7-12. Mature larvae of *O. biaccinctus*: 7, general aspect; 8a, setae of integument (detail); 8b, spiracle (atrium and subatrium); 9, head in frontal view; 10, antennal papilla; 11, labrum; 12, labium and maxilla (oral face).

TABLE 1. NUMBER OF NESTS AND CELLS OF THE DIFFERENT HOSTS AFFECTED BY *TRICHRYSIS CYANEA*.

Host	Number of Nests Affected	Total Number of Cells	Number of Parasitized Cells
Trypoxylon attenuatum	12	60	16(27%)
Trypoxylon beaumonti	14	67	28(42%)
Trypoxylon figulus	5	23	5(22%)
Trypoxylon sp.	9	17	11(65%)
Pemphredon lethifera	1	2	1(50%)
Psenulus pallipes	1	8	1(13%)

(11%) the development of the Chrysididae was not completed, although in all cases the larva constructed a cocoon. Of the 51 imagos obtained (four larvae were preserved in 70% alcohol), 21 were male and 30 female. Although the sex-ratio obtained is 0.7 m: 1.0 f, this is not significantly different from a 1:1 ratio as observed in many haplo-diploid species (X^2= 1.607; d.f.= 1; 0.3 > p > 0.2). Furthermore, no significant differences were seen in the sex-ratio as a function of the position of the parasitized cell (X^2= 9.82; d.f.= 6; 0.2 > p > 0.1).

Comparing these data with those obtained by Krombein (1967) for other species of Chrysididae, it may be concluded that *T. cyanea* has a low degree of host specificity and that it is quite effective as a parasitoid. The proportion of parasitized nests with respect to the total number of nests of each species obtained was as follows: *T. attenuatum* (16%), *T. beaumonti* (10%), *T. figulus* (38%), *Trypoxylon* sp. (38%), *P. lethifera* (2%), and *P. pallipes* (17%); only 8 of the 38 affected nests with two or more cells had 50% or more of the cells parasitized and the mean number of cells affected per parasitized nest was 1.48 (35%). The sex-ratio was similar to that reported by Danks (1970).

DISCUSSION

Like the rest of the described species of Elampini (*Hedychrum rutilans*, *O. aeneus* and *Pseudomalus auratus*), *O. biaccinctus* displays antennal orbits located near or below middle of head; well-developed antennal papillae; and entire (not divided into two rings) body segments that are slightly humped in the dorsolateral direction. In this species, the back of the abdominal segments is very humped.

The scanty and protuberant marginal sensilla of the labrum and the presence of galeae are morphological characters shared with *O. aeneus* and *Pseudomalus auratus*.

TABLE 2. NUMBER OF CELLS AFFECTED PER PARASITIZED NEST BY *TRICHRYSIS CYANEA*.

Nests with 1 affected cell	28 (67%)
Nests with 2 affected cells	10 (24%)
Nests with 3 affected cells	3 (7%)
Nests with 4 affected cells	0
Nests with 5 affected cells	1 (2%)

TABLE 3. INDEX OF PARASITISM AND NUMBER OF MALES AND FEMALES OBTAINED FROM CELLS ACCORDING TO THEIR POSITION IN THE NEST (C1 IS THE EXTERNAL ONE) IN *TRICHRYSIS CYANEA*.

Cell Position	Total Number of Cells	Number of Parasitized Cells	Sex	
			male	female
C1	42	23 (55%)	9	12
C2	38	14 (37%)	2	9
C3	32	13 (41%)	3	7
C4	20	5 (25%)	5	—
C5	16	3 (19%)	—	1
C6	13	3 (23%)	1	1
C7	5	1 (20%)	1	—
Total	166	62 (36%)	21	30

Although their presence is quite probable in *Hedychrum rutilans*, these characters are not noted in the work of Maneval (1936).

The number of mandibular teeth is variable: 4-5 in *Pseudomalus auratus*, 3 in *Hedychrum rutilans* and *O. biaccinctus*, and 2 in *O. aeneus*.

Chrysis gracillima has the segments of the body divided into two annulets, antennal orbits situated in normal position and marginal sensillae of the labrum numerous and minute. These characteristics are shared by the described species of Chrysidini: *Caenochrysis doriae*, *Chrysis cembricola*, *C. cessata*, *C. grandis*, *C. ignita*, *C. inaequidens*, *C. inflata*, *C. nitidula*, *C. smaragdula*, *Chrysura dichroa*, *Praestochrysis shangaiensis*, and *T. cyanea*. All species have tridentate mandibles with the exception of *T. cyanea*, in which the mandibles are quadridentate.

Other generalized characters are the presence of galeae and short antennal papillae, although both structures are absent in *Chrysura dichroa* (Grandi, 1961). *Praestochrysis shangaiensis* does not have antennal papillae, and Parker (1936) does not represent the galeae.

Our scanty knowledge of the mature larvae of the Chrysidoidea does not permit the establishment of primitive vs. specialized states of the various characters. In this respect, it is highly significant that in his cladistic analysis of the Chrysidoidea, Carpenter (1986) did not use any preimaginal morphological character. However, from the characters studied it may be deduced that in some Chrysidinae (sensu Kimsey & Bohart 1990), the galeae are apparently lacking, thus a specialized feature. In the Elampini the low position of the antennal orbits and long antennal papillae may also represent states of specialized character.

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