

Notes on the species of the genus *Encarsia* Foerster (Hymenoptera: Aphelinidae) introduced to Mexico for biological control of the blackfly *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae), with description of a new species

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Notes on *Encarsia* species introduced to Mexico for biological control of the citrus blackfly are given. *Encarsia colima* sp. n. is described from Mexico. The new species has been reared from citrus blackfly *Aleurocanthus woglumi* Ashby in the state of Colima.

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Introduction

The genus *Encarsia* Foerster, 1878 with about 280 described species is one of the largest in the family Aphelinidae. Many *Encarsia* species are of great importance for biological control of scale insects (fam. Diaspididae) and whiteflies (fam. Aleyrodidae). In Mexico, 30 species of this genus, including 10 species introduced to control homopteran pests, mainly whiteflies, are known to occur (Myartseva & Ruíz, 2000). Revising the *Encarsia* species of Mexican fauna, I found about 30 non-described species and some species hitherto identified incorrectly.

During the past few years, the citrus blackfly *Aleurocanthus woglumi* Ashby became a dangerous pest in citrus orchards of Mexico and southern Texas, USA. Therefore, introduced and native parasitoids of this whitefly are of great interest for study in terms of biological control.

Notes on introduced *Encarsia* species – parasitoids of the citrus blackfly

The whitefly *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae), or citrus blackfly, is of Oriental origin. It spread via introductions to Africa, Central America, the West Indies, northern South America and southern North America (Clausen, 1978). This species inhabits citrus and fruit trees and causes damage to other plants. Parasitoids of other whiteflies from the local fau-

na do not infect *A. woglumi*. Only introduction of non-indigenous natural enemies of *A. woglumi* has led to successful biological control of this pest in the New World.

Aleurocanthus woglumi was discovered in Mexico in 1935 in El Dorado, Sinaloa as a citrus pest. Several hymenopteran parasitoid species were introduced to Mexico in 1949-1950 from tropical and subtropical Asia for biological control of the citrus blackfly. Most of these species belong to the genus *Encarsia* Foerster from the family Aphelinidae: *E. divergens* (Silvestri, 1926), *E. merceti* Silvestri, 1926, *E. smithi* (Silvestri, 1926), *E. opulenta* (Silvestri, 1927) and *E. clypealis* (Silvestri, 1927). *E. opulenta* and *E. clypealis* were reared in India from *Aleurocanthus woglumi* and *A. incertus* Silvestri (Hayat, 1998).

Among other Hymenoptera, *Amitus hesperidum* Silvestri (fam. Platygasteridae) was also introduced to Mexico and became an effective parasitoid of the citrus blackfly. This species is not discussed here.

Numerous publications contain information on introduction of *Encarsia* species and other parasitoids to Mexico (Jiménez-Jiménez & Smith, 1958; Jiménez-Jiménez, 1963; García-Martell, 1973; Clausen, 1978; etc.). There are no recent publications concerning the rearing of many introduced species. Only *Encarsia perplexa* (as *opulenta*) was recorded reliably as an effective parasitoid of *Aleurocanthus woglumi* (Myartseva & Ruíz, 2000).

The native regions of *E. opulenta* are China and Vietnam (Huang & Polaszek, 1998). Known hosts of *E. opulenta* are *Aleurocanthus incertus*, *A. spiniferus*, *A. woglumi*. *E. opulenta* is used for biological control of whiteflies *A. spiniferus* and *A. woglumi*.

It has been clarified recently (Huang & Polaszek, 1998; Noyes, 2002) that the species of *Encarsia* introduced to Mexico as *E. opulenta* Silvestri, is actually *Encarsia perplexa* Huang & Polaszek. Huang & Polaszek (1998) found that the name *E. opulenta* has been consistently applied to *E. perplexa* in many previous publications and identifications. *E. perplexa* was described from India, China, and Taiwan. It was introduced to Mexico and USA for biological control of *A. woglumi* Ashby (Huang & Polaszek, 1998; Myartseva & Ruíz, 2000; French, 2002). Plausible evidence on introductions of *E. perplexa* is also known from the Dominican Republic (Evans & Serra, 2002), Hawaii, Guatemala (Heu & Nagamine, 2001), Trinidad and Tobago (Hoy, 2002). Known hosts of *E. perplexa* are *Aleurocanthus woglumi*, *Aleuroplatus pectiniferus* and *Aleurotuberculatus kuwani*. *E. perplexa* is used for biological control of *A. woglumi*.

Judging by examination of several samples reared from the citrus blackfly, *E. perplexa* Huang & Polaszek is widely distributed in Mexico and, according to published data, in other countries of the New World too. The transferring of this parasitoid from one citrus orchard to another for biological control of the citrus blackfly is frequently applied in Mexico, however no published evidences of this transfer exist. *E. perplexa* now is a common parasitoid of the citrus blackfly throughout Mexico: in the states of Colima, Morelos, Jalisco, San Luis Potosí, Sinaloa, Veracruz, Tamaulipas, Nuevo León. Our materials confirm that the release of *E. perplexa* in Mexico was successful. Altieri & Nicholls (1999) referred results of this introduction to successes of classical biological control in Latin America.

Encarsia clypealis is distributed in India, Pakistan, Vietnam, Indochina, Malaysia, Philippines; it is introduced to Mexico, USA (Florida, Texas) and Guam (Hayat, 1998; Noyes, 2002). Known hosts of *E. clypealis* are *Aleurocanthus incertus*, *A. spiniferus*, *A. spinosus*, *A. woglumi*, *A. sp. E. clypealis* is used for biological control of *A. spiniferus* and *A. woglumi*.

Material

Numerous samples of parasitoids reared from the citrus blackfly in the states of Colima, Nuevo León, Sinaloa, Veracruz and Tamaulipas have been received for identification in 2004. Two species of *Encarsia* from Colima, Tecomán were

sent as *E. opulenta* and *E. clypealis*. Specimens, sent from Montemorelos and Linares, Nuevo León, were identified as *E. opulenta* too. The author collected thousands parasitoids of the citrus blackfly in the states of Tamaulipas, Sinaloa and Nuevo León and in Texas, USA in 1998–2004. Based on taxonomic examination of prepared slides, species were determined as *E. perplexa* Huang & Polaszek (not *E. opulenta* Silvestri, 1927) and *Encarsia* sp. aff. *clypealis* (not *E. clypealis* Silvestri, 1927). The latter proved to be a new species, which is described below.

The F1–F6 abbreviations are used in the text for flagellar segments from first to sixth.

Encarsia colima sp. n.

(Figs 1–8)

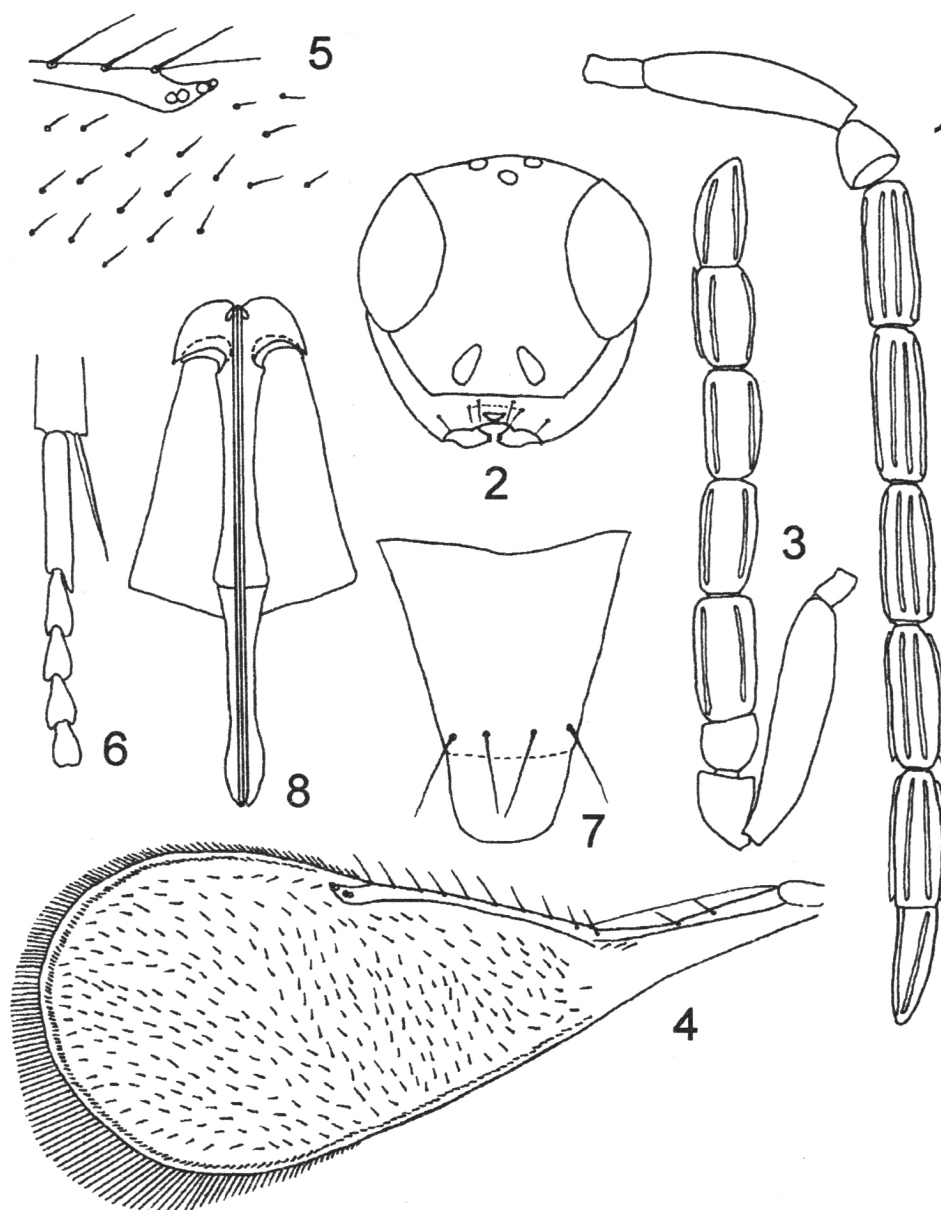
Holotype. ♀, **Mexico**, Colima, Tecomán, ex *Aleurocanthus woglumi* Ashby on *Citrus* spp., 16.II.2004 (coll. C.M. Díaz Hernández), deposited at the Entomological Museum of University of California (Riverside, California, USA).

Paratypes. 1 ♀, 7 ♂, same data as in holotype. Paratypes (1 ♀, 7 ♂) are deposited at Entomological Museum of University of California (Riverside, California, USA); National Museum of Natural History (Washington, USA); Museum of Natural History (London, U.K.); Zoological Institute of the Russian Academy of Sciences (St. Petersburg, Russia) and Insect Museum of UAM Agronomía y Ciencias, University of Tamaulipas (Ciudad Victoria, Tamaulipas, México).

Description. *Male*. Body length 0.60 mm.

Coloration as in female, but scutellum slightly infusate with setae dark.

Morphology. Head slightly higher than wide. Frontovortex transversely striate, about 0.6 times as wide as head. Ocelli forming small obtuse triangle. Eyes 1.6–1.7 times as long as cheeks. Clypeus with small, short tooth-like projection. Antennae (Fig. 1) inserted immediately under the level of lower margin of eyes. Antennal scape about 4.5 times as long as wide. Pedicel subquadrate. First and second funicular segments elongate and not united to form a large oval structure. Flagellar segments with following ratios of length to width: F1 – 2.8, F2 – 2.7, F3 – 3.0, F4 – 3.0, F5 – 3.0, F6 – 3.2. All segments with four longitudinal sensilla, except sixth with two sensilla. Midlobe of mesoscutum with 8–10 setae. Distance between anterior pair of setae on scutellum slightly greater than that between posterior pair of setae (19 : 16). Fore wing 2.4 times as long as wide; its marginal fringe about 1/4 of wing width. Marginal vein with five setae along anterior margin and only slightly longer than submarginal vein; disc with very small asetose area beneath stigmal vein. Hind wing about 9 times as long as wide; its marginal fringe 1.4 times as long as maximum width of wing; disc weakly setose, its base with two setae under apical part of sub-



Figs 1-8. *Encarsia colima* sp. n., male (1) and female (2-8): 1, antenna; 2, head in front; 3, antenna; 4, fore wing; 5, venation of fore wing (part); 6, middle tarsus and tibial spur; 7, seventh gastral tergite; 8, ovipositor.

marginal vein. Gaster not longer than mesosoma. Seventh tergite very slightly elongate.

Female. Body length 0.80-0.90 mm.

Coloration. Head yellowish brown; cheeks and clypeus brownish; frontovertex with orange tinge; antennae yellow. Mesosoma brownish black; scutellum, side lobes of mesoscutum except api-

ces, and metanotum yellow. Fore wings hyaline; veins slightly infuscate. Fore and middle femora except apices, hind femora, hind tibiae basally brownish; fore and middle tibiae and all tarsi yellowish white. Petiole yellow. Gaster black; apical half of ovipositor black; apex of seventh tergite white.

Morphology. Head (Fig. 2) about as wide as long. Frontovortex transversely striate, about half as wide as head. Ocelli forming small rectangular triangle. Eyes finely setose, 1.4–1.5 times as long as cheeks. Cheeks with malar sulcus. Mandible with three teeth. Antennae (Fig. 3) inserted immediately under the level of lower margin of eyes. Distance between toruli about 1.5 times as long as distance between torulus and mouth margin, while shorter than distance between torulus and eye margin. Clypeus with small, short, tooth-like projection medially and with three pairs of setae. Scape about 4.5 times as long as wide. Pedicel slightly longer than wide (5 : 4). First funicular segment short and subquadrate, about 0.7 times as long as pedicel. All other segments of funicle and club with following ratios of length to width: F2 – 1.8, F3 – 2.2, F4 – 2.0, F5 – 1.7, F6 – 1.8. Second to sixth flagellar segments with two, fifth with three longitudinal sensilla. Mesosoma with reticulate sculpture distinctly visible on midlobe of mesoscutum and axillae. Midlobe with five pairs of setae; side lobes each with three setae; axillae each with one seta. Scutellum about twice as wide as long. Scutellar placoid sensilla widely spaced. Distance between anterior pair of scutellar setae less than distance between posterior pair (5 : 6). Fore wing (Fig. 4) 2.3 times as long as wide; its marginal fringe about 1/6–1/5 of wing width; disc uniformly setose; base with three setae under apical part of submarginal vein. Marginal vein with eight setae along anterior margin longer than submarginal vein (7 : 5). Stigmatal vein (Fig. 5) sessile, close to wing margin. Hind wing about 8 times as long as wide, its marginal fringe subequal in length to wing width; disc with scattered setose. Midtibial spur (Fig. 6) slightly shorter than basitarsus; basitarsus subequal in length to three next tarsal segments. Gaster longer than mesosoma; seventh tergite (Fig. 7) slightly longer than wide (11 : 10). Ovipositor (Fig. 8) with base inserted at level of first tergite and very protruded, twice as long as middle tibia and 1.5 times as long as middle tibia and basitarsus combined. Third valvula about 0.7 times as long as second valvifer.

Comparison. *Encarsia colima* sp. n. is close to *E. clypealis* Silvestri, but can be easily distinguished by the structure of the male antenna. Male of *E. clypealis* was described in 1989 by Hayat. He has shown that the male antenna of *E. clypealis* is similar to that of *E. opulenta*: first and second funicle segments “united to form a large oval structure”. This feature is absent in male of *E. colima* sp. n. Furthermore, the first and second funicular segments in *E. colima* are longer than in *E. clypealis*: ratio of length to width is 2.8 and 2.7, and 1.1 and 1.25, respectively; third and fourth flagellar segments in *E. colima* 3.0

times as long as wide, whereas in *E. clypealis* they are 1.8 and 1.7 times as long as wide, respectively. In female of *E. colima*, fifth and sixth flagellar segments combined are distinctly shorter than two preceding segments lumped together, whereas this relation is opposite in *E. clypealis*, according to figure by Hayat (1989, 1998).

It was found that both sexes of *E. colima* and *E. clypealis* have a tooth on clypeus, however the apex of this prominence is roundish in *E. colima*, and triangular in *E. clypealis*.

Females of *E. colima* sp. n. were compared with the original description and figures of *E. clypealis* females in Silvestri (1927) and with the description and figures of *E. clypealis* females in Hayat (1989), which differ from those by Silvestri. According to Silvestri’s figure (1927), antennal toruli of *E. clypealis* situated distinctly lower than the level of the lower margin of eyes; in *E. clypealis* by Hayat (1989) and *E. colima*, toruli are situated distinctly higher, immediately under the level of the lower margin of eyes. In *E. clypealis* of Silvestri (1927) and *E. colima*, the torulus is subequal in length to the distance from torulus to the mouth margin; in *E. clypealis* of Hayat (1989) the torulus is longer than distance from torulus to the mouth margin.

Comments. According to Hayat’s classification (1998), *Encarsia colima* sp. n. belongs to the *opulenta* species group in the genus *Encarsia*. This group includes 17 species, among them only *E. clypealis* and *E. colima* are characterized by the triangular prominence on the clypeus (in both sexes), which is a unique structure for *Encarsia* as a whole; and only *E. opulenta*, *E. perplexa* and *E. clypealis* are characterized by the fused and enlarged first and second funicle segments in the male antenna.

It is possible to suppose that *Encarsia* species known from Mexico as *E. clypealis* (Silvestri, 1927) is, actually, *E. colima* sp. n. The native area of *E. colima* is, perhaps, the Oriental Region, from which the species was introduced to Mexico as *E. clypealis* Silvestri together with *E. perplexa* Huang & Polaszek introduced as *E. opulenta* Silvestri. Unfortunately, it was impossible to find and examine original primary samples of parasitoid species which were introduced to Mexico more than 50 years ago.

Etymology. The name of the new species comes from the state of Colima, the type locality in Mexico.

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