한국응용곤충학회지
Korean J. Appl. Entomol. 54(3): 281-284 (2015)
DOI: http://dx.doi.org/10.5656/KSAE.2015.08.0.037

pISSN 1225-0171, eISSN 2287-545X

New Records of Aphelinids, *Encarsia* Förster (Hymenoptera: Aphelinidae), in Korea

Soo-Jung Suh* and Gregory A. Evans[1]

QIA/PQTC, 476 Dongtanjiseong-ro, Yeongtong-gu, Suwon 443-400, South Korea
[1]USDA/APHIS/NIS, 10300 Baltimore Avenue, Beltsville, MD 20705, USA

우리나라 *Encarsia* Förster에 대한 보고 (벌목: 면충좀벌과)

서수정* · Gregory A. Evans[1]

농림축산검역본부, [1]미농림부

ABSTRACT: Two species of *Encarsia*, *Encarsia explorata* (Silvestri) from *Aulacaspis rosarum* Borchsenius, *A. yabunikkei* Kuwana and *Lepidosaphes pinnaeformis* (Bouché), and *Encarsia lutea* (Masi) from *Bemisia tabaci* (Gennadius) are newly documented in the Korean fauna of aphelinids (Hymenoptera: Aphelinidae). Brief diagnostic criteria, photographs, and information on the distribution and hosts of these species are provided. Also a key to species of *Encarsia* from Korea is given for correct species identification.

Key words: *Encarsia explorata* (Silvestri), *Encarsia lutea* (Masi), key, distribution

초 록: 각진장미흰깍지벌레, 참식나무흰깍지벌레와 후박나무굴깍지벌레로부터 채집된 *Encarsia explorata* (Silvestri) [후박굴깍지좀벌 (신칭)] 및 담배가루이로부터 채집된 *Encarsia lutea* (Masi) [가루이좀벌 (신칭)] 을 국내분포로 처음 보고한다. 또한 이들 종들의 검색표, 식별형질, 사진자료, 분포 및 기주 정보도 함께 제공하였다.

검색어: 후박굴깍지좀벌, 가루이좀벌, 검색표, 분포

The genus of *Encarsia* (Hymenoptera: Aphelinidae) was described by Förster in 1878 and currently contains 437 species known worldwide (Noyes, 2015). Of these 23% (101 species) were described from the Palaearctic region and 35% (152 species) from the Oriental region. This genus is characterized as having the following characters; 1) fore and hind tarsi always 5-segmented, tarsus of middle leg 4- or 5-segmented, 2) marginal vein of fore wing longer than submarginal vein, postmarginal vein absent, stigmal vein very short and submarginal vein usually with two setae, 3) antennae excluding radical always 8-segmented in the female, sometimes 7-segmented in male when two apical segments are fused, 4) scutellum wider than long, with elongated reticulate or striate sculpture medially, always with two pairs of setae, 5) each axilla always with 1 seta (Huang and Polaszek, 1998). Species of *Encarsia* are mostly primary parasitoids of whiteflies (Aleyrodidae) and armored scale insects (Diaspididae) and have been used as biological control agents for pests of these groups (Evans et al., 1995; Abd-Rabou et al., 2014). In Korea, the following four species have been recorded in the Korean aphelinid fauna; *Encarsia berlesei* (Howard), *E. citrina* (Craw), *E. formosa* Gahan, and *E. perniciosi* (Tower) (Paek, 2010). Of these, *E. formosa* was introduced from Netherlands and USA as part of a biological control project of the invasive species, *Trialeurodes vaporariorum* (Westwood) in 2003

***Corresponding author:** suhsj97@korea.kr
Received July 8, 2015; **Revised** August 2, 2015
Accepted August 10, 2015

(Paek, 2010).

In 2014, we conducted a survey of the species of Aphelinidae associate with armored scale insects and whiteflies, and additional two *Encarsia* species were collected and identified as *Encarsia explorata* (Silvestri) and *Encarsia lutea* (Masi). These species are newly reported from Korean parasitoids fauna.

In this paper, a dichotomous key to species of *Encarsia* known in Korea is presented and diagnoses, photographs, hosts, and distribution of *Encarsia explorata* (Silvestri) and *Encarsia lutea* (Masi) are provided for accurate species identification.

Materials and Methods

The specimens used in this study were reared from the armored scale insects [*Aulacaspis rosarum* Borchsenius, *A. yabunikkei* Kuwana and *Lepidosaphes pinnaeformis* (Bouché)], and the whitefly [*Bemisia tabaci* (Gennadius)]. The specimens of these species were mounted on microscope slides in Hoyer's mounting medium for identification and the others were stored in alcohol. All materials are deposited in the Collection of Plant Quarantine Technology Center, Korea.

Silvestri (1930) and Masi (1909) gave the descriptions and illustrations of *Encarsia explorata* (Silvestri) and *Encarsia lutea* (Masi), respectively. Also John Noyes' Universal Chalcidoidea Database provided a comprehensive summary of information on the nomenclature, hosts and distribution of aphelinids of the world (Noyes, 2015). Herein we provide a brief diagnosis and photographs of major characters, based on morphological characters of the adult female and male reared from their hosts. With respect to hosts of the two species, the primary hosts are only addressed here. Terminology for the morphological structures used in diagnoses follows that of Hayat (1998). Codes for the zoogeographic regions recognized are as follows: Nearctic (NE), Neotropical (NT), Afrotropical (AF), Palaearctic (PA), Oriental (OR), and Australasian (AU). Photographs were taken using an AxioCam MRc5 camera through ZEISS Axio Imager M2 Microscope. An asterisk (*) is used to indicate a new host and distribution record.

Results and Discussion

Systematic accounts

***Encarsia explorata* (Silvestri)** 후박굴깍지좀벌(신칭)

Prospaltella explorata Silvestri, 1930: 61.

Diagnosis. Body generally yellow except for pronotum, anterior mesoscutum, axillae, posterior mesosoma, T1 (tergite of gaster), T4-T6 and lateral sides of T7 brown to dark (Fig. 1); placoid sensilla on scutellum separated by more than 2x their diameter; F1 (flagellar segments) quadrate and F1 shorter than F2; F2 with a longitudinal sensillum (Fig. 2); mid lobe of mesoscutum with 4 setae (Fig. 3); ovipositor shorter than middle tibia and basitarsus combined, third valvulae pale; all tarsus 5-segmented; fore wing without asetose area around stigmal vein. Male unknown.

Material examined. Korea. Gyeonggido: 19, Taejang-ro 71 beon-gil, Yeongtong-gu, Suwon-si (37º14′8.3″N/127º3′18.7″E), 39 females, ex. *Aulacaspis rosarum* Borchsenius on *Rosa hybrida* L., 4-vii-2014 (S.J. Suh). Jeollanamdo: Bogildo (34º9′37.5″N/126º33′15.9″E), 5 females, ex. *Aulacaspis yabunikkei* Kuwana on *Neolitsea sericea* (Blume) Koidz., 19-xii-2014 (S.J. Suh); Bogildo (34º9′46.3″N/126º33′22.0″E), 23 females, ex. *Lepidosaphes pinnaeformis* (Bouché) on *Persea thunbergii* (Siebold and Zucc.), 19-xii-2014 (S.J. Suh)

Distribution. PA: Japan (Noyes, 2015), Korea*.

Hosts. Diaspididae: *Lepidosaphes* sp. (Noyes, 2015), *Aulacaspis rosarum* Borchsenius*, *Aulacaspis yabunikkei* Kuwana*, *Lepidosaphes pinnaeformis* (Bouché)*.

Remarks. This species is similar to *Encarsia inquirenda* (Silvestri), but distinguished by the presence of a longitudinal sensillum on F2, and F1 being shorter than F2 (Silvestri, 1930).

***Encarsia lutea* (Masi)** 가루이좀벌(신칭)

Prospaltella lutea Masi, 1909: 25.

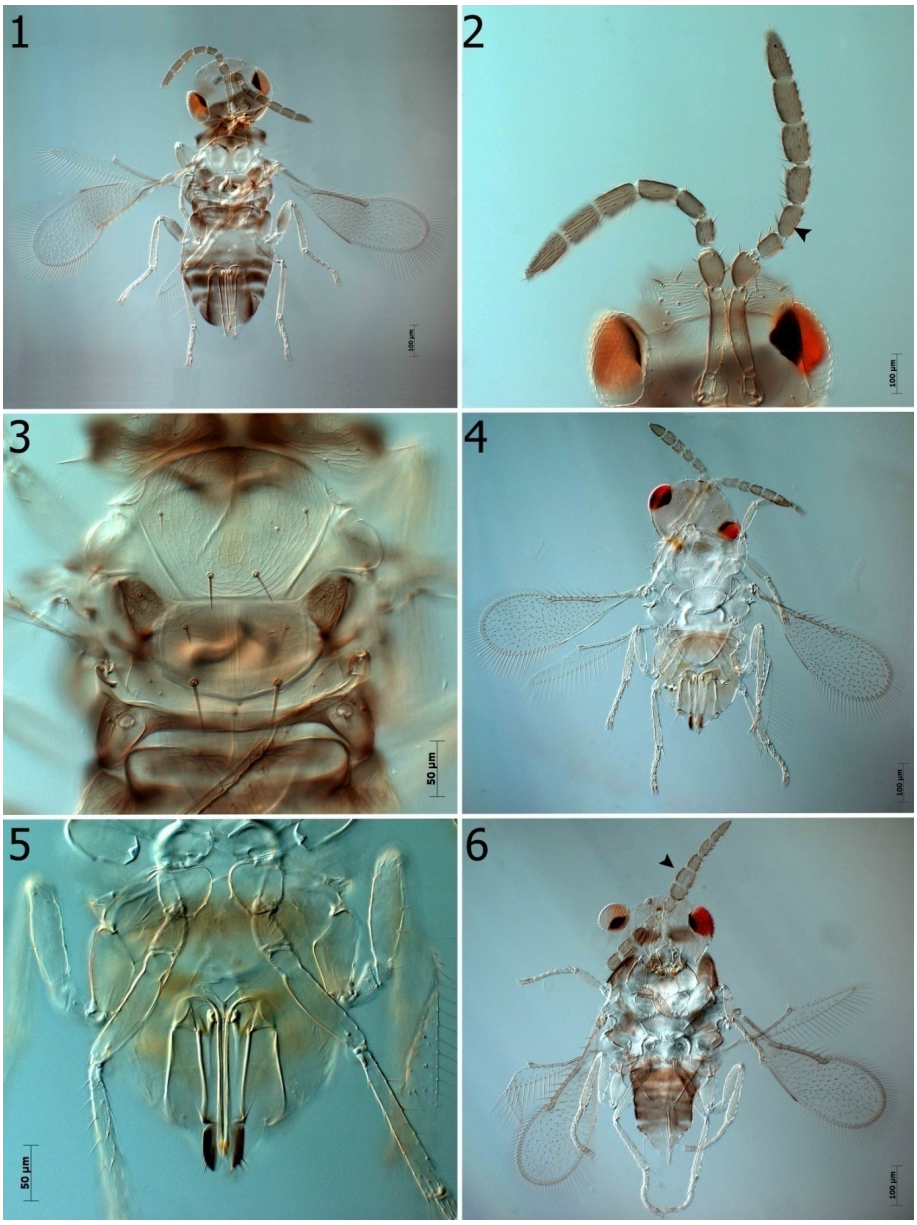
Diagnosis. Body largely yellow except for black terminal valvulae (Fig. 4); placoid sensilla on scutellum separated by more than 2x their diameter; F1 and F2 quadrate, F1 shorter than F2; F2 without a longitudinal sensillum; mid lobe of mesoscutum with 6-8 setae; ovipositor shorter than middle tibia and basitarsus combined, third valvulae (terminal sheaths)

dark in contrast to rest of body (Fig. 5); all tarsus 5-segmented; fore wing without asetose area around stigmal vein. Males have the first 3 funicular segments enlarged and club-like (Fig. 6).

Material examined. Korea. Gyeonggido: 203 Cheoncheon-ro, Jangan-gu, Suwon-si (37º15′34.70″N/126º58′34.0″E), 3 females and 1 male, ex. *Bemisia tabaci* (Gennadius) on *Echinacea purpurea* (L.) Moench, 4-ix-2014 (S.J. Suh).

Distribution. NE: USA. NT: Brazil. AF: Sudan, Zimbabwe. OR: Bangladesh, India, Pakistan. AU: Australia, Cook Islands, Nauru, Niue Islands, Tonga. PA: Canary Islands, Caucasus, China, Cyprus, Czech Republic, Egypt, France, Greece, Iran, Israel, Japan, Kazakhstan, Madeira, Malta, Moldova, Russia, Serbia, Slovakia, Spain, Syria, Turkmenistan, UK (Noyes, 2015), Korea*.

Hosts. Recorded from 59 hosts species belonging to Aleyrodidae and Coccidae (Hemiptera) (Noyes, 2015).



Figs. 1-6. Two species of aphelinids. *Encarsia explorata* (Silvestri), 1-3; 1. female, 2. antennae, 3. mesosoma. *Encarsia lutea* (Masi), 4-6; 4. female, 5. third valvulae, 6. male.

Key to species of *Encarsia* from Korea (slide mounted adult female)

1. Middle tarsi 4-segmented; host Aleyrodidae ····· ····· ***Encarsia formosa* Gahan** (introduced species)
- Middle tarsi 5-segmented ····· **2**
2. Marginal fringes of fore wing longer than wing width, stigmal vein with an evident asetose area proximally; host Diaspididae ····· ***Encarsia citrina* (Craw)**
- Marginal fringes of fore wing shorter than wing width, stigmal vein without an evident asetose area proximally · **3**
3. Third valvulae dark; F1 and F2 quadrate or transverse; reared from Aleyrodidae ····· ***Encarsia lutea* (Masi)**
- Third valvulae pale; F1 and F2 variable; reared from Diaspididae ····· **4**
4. Marginal fringe of fore wing relatively long, more than 0.4x wing width; abdomen dark brown with pale band along tergite I and II ····· ***Encarsia explorata* (Silvestri)**
- Marginal fringe of fore wing relatively short, less than 0.3x wing width; abdomen entirely dark brown ····· **5**
5. Head pale with a dark brown, transverse band between the eyes; F1 oblong and distinctly shorter than F2, the latter with a longitudinal sensillum ····· ***Encarsia perniciosi* (Tower)**
- Head pale except for dark brown occiput and without a dark brown, transverse band between the eyes; F1 cylindrical and subequal to F2, the latter without a longitudinal sensillum ····· ***Encarsia berlesei* (Howard)**

Discussion

Encarsia explorata (Silvestri) and *Encarsia lutea* (Masi) are added to Korean aphelinid fauna through the project recently conducted. Additional information provided in this paper should be helpful to understand the genus *Encarsia* in Korea. Especially, *Encarsia* species have played a prominent role in the history of the control of Aleyrodidae and Diaspididae pests on a broad range of agricultural crops or plants. Thus, the native *Encarsia explorata* (Silvestri) and *Encarsia lutea* (Masi) discovered through this survey would be useful as a biological control agent for pests of the armored scales and whiteflies.

Acknowledgments

This project was partly supported by QIA research fund (I-1543086-2015-16-01).

Literature Cited

Abd-Rabou, S., Ahmed, N., Evans, G.A., 2014. *Encarsia* Forester (Hymenoptera: Aphelinidae) - Effective parasitoids of armored scale insects (Hemiptera: Diaspididae) in Egypt. Acta Zool. Bulg. Suppl. 6, 7-12.

Evans, G.A., Polaszek, A., Bennett, F.D., 1995. The taxonomy of the *Encarsia flavoscutellum* species-group (Hymenoptera: Aphelinidae) parasitoids of Hormaphididae (Homoptera: Aphidoidea). Oriental insects 29, 33- 45.

Hayat, M., 1998. Aphelinidae of India (Hymenoptera: Chalcidoidea): a taxonomic revision, Memoirs on Entomology, International 13. Associated publishers, Gainesville, Florida.

Huang, J., Polaszek, A., 1998. A revision of the Chinese species of *Encarsia* Förster (Hymenoptera: Aphelinidae): parasitoids of whiteflies, scale insects and aphids (Hemiptera: Aleyrodidae, Diaspididae, Aphidoidea). J. Nat. Hist. 32, 1825-1966.

Masi, L., 1909. Contribuzioni alla conoscenza dei Calcididi Italiani (parte 3a). Bollettino del Laboratorio di Zoologia Generale e Agraria della R. Scuola Superiore d'Agricoltura, Portici 4, 3-37.

Noyes, J.S., 2015. Universal Chalcidoidea Database. World Wide Web electronic publication. http://www.nhm.ac.uk/chalcidoids (accessed 4 July, 2015).

Paek, M.K., 2010. Family Aphelinidae, in: Ku, D.S. (Ed.), Checklist of Korean insects. Nature and Ecology, Seoul, pp.170-171.

Silvestri, F., 1930. Contributo alla conoscenza della species orientali del genere *Prospaltella* (Hym. Chalcididae). Bollettino del Laboratorio di Zoologia Generale e Agraria della R. Istituto Superiore d'Agricoltura, Portici 25, 49-68.