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Scientific Note

New records of hyperparasitism of *Tamarixia triozae* (Burks) (Hymenoptera: Eulophidae) by *Encarsia* spp. (Hymenoptera: Aphelinidae) in California

Introduction

Tamarixia triozae (Burks 1943) (Hymenoptera: Eulophidae) is a primary parasitoid of the potato/tomato psyllid, *Bactericera cockerelli* (Sulc, 1909) (Hemiptera: Triozidae), which is a serious pest of solanaceous crops in North America, Central America, and New Zealand (Liu & Trumble 2007, Gill 2006, Teulon et al. 2009, Crosslin et al. 2010). *T. triozae* has an extensive geographic distribution in the United States (Arizona, California, Colorado, Idaho, Kansas, Montana, New Mexico, Washington) and also has been found in recent years in Mexico (Burks 1943, Pletsch 1947, Jensen 1957, Johnson 1971, Lomeli-Flores & Bueno Partida 2002). In 2009, this parasitoid was imported from Mexico to New Zealand as a potential classical biological control agent against *B. cockerelli* (Workman & Whiteman 2009).

There is only one report documenting the case of hyperparasitism of *T. triozae*, which was reported by Pletsch (1947) of a single, unknown pteromalid that was reared from a *T. triozae* larva. During the summer and fall of 2010 as part of our research to document the identification and impact of natural enemies on the potato psyllid, we documented new records of males of *Encarsia pergandiella* Howard, 1907 (Hymenoptera: Aphelinidae) and a single record of a male tentatively identified as *Encarsia peltata* (Cockerell, 1911) hyperparasitizing *T. triozae* on tomato (*Solanum lycopersicum* Linnaeus, 1753) (Solanaceae) and bell pepper (*Capsicum annuum* Linnaeus, 1753) (Solanaceae) plantings in southern California.

Methods and Materials

The tomato field was located in Oxnard, CA, U.S.A. (Ventura Co.) (3410′33″ N, 11,905′45″ W, elevation 9 m). The bell pepper field was located in Irvine, CA, U.S.A. (Orange Co.) (3341′49″ N, 11,742′59″ W, elevation 135 m). Mummified *B. cockerelli* nymphs were collected and individually placed in #2-sized gelatin capsules (Parke, Davis & Co., Detroit, MI, U.S.A.) to allow for parasitoid adults to complete development. Parasitized *B. cockerelli* nymphs were collected biweekly from 16 July 2010–29 October 2010. Once adults emerged they were killed in 70% ethanol then transferred to 100% ethanol and subsequently chemically dried using hexamethyldisilizane (HMDS) (Polysciences, Inc., Warrington, PA, U.S.A.). The *T. triozae* were point mounted and the *Encarsia* spp. that emerged were card mounted. Pictures were taken of the *Encarsia* (Figs. 1 and 2) and subsamples of *Encarsia* specimens were slide mounted for species identifications. Voucher specimens were deposited at the University of California, Riverside, Entomology Research Museum.

Discussion

Table 1 shows the proportion of *Encarsia* that emerged from *T. triozae* parasitized *B. cockerelli* mummies collected from their respective crops. The proportions of

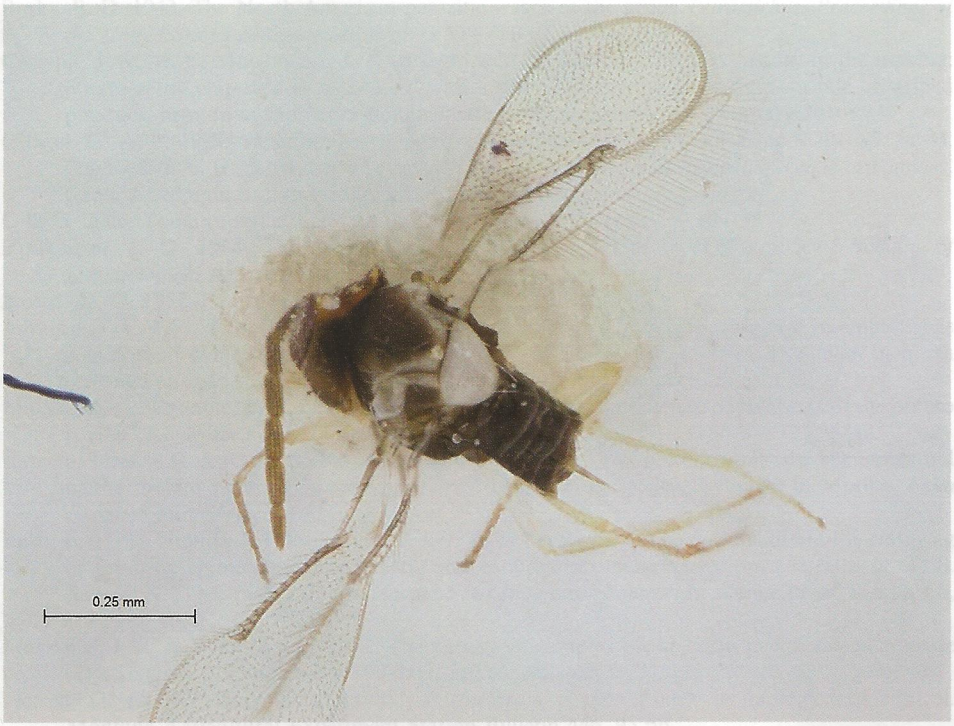

Figure 1. *Encarsia peltata* (Cockerell) (tentative identification) male, which emerged from a *T. triozae* parasitized *B. cockerelli* mummy in Orange Co. (Scale bar = 0.25 mm).

parasitism by *Encarsia* spp. on *T. triozae* were between 5.3–6.9%. *E. peltata* (tentative identification) was the specimen that emerged from a potato psyllid mummy on bell peppers in Orange county (Fig. 1). The remaining parasitized potato psyllid mummies were hyperparaisitized by *E. pergandiella*, which were collected on tomatoes from Ventura county (Fig. 2).

The family Aphelinidae is one of the most important chalcidoid families for biological control, however examples of aphelinids hyperparasitizing other chalcidoids are known to exist (Gibson 1993). The genus *Encarsia* is one of the eight genera of Aphelinidae to have species that are heteronomous parasitoids (i.e., female is a primary parasitoid and the male is a hyperparasitoid) (Luck et al. 1999). All of the specimens that emerged from *B. cockerelli* mummies were males. The whitefly, *Bemisia tabaci* (Gennadius, 1889) (Hemiptera: Aleyrodidae), was common in the agricultural fields visited (Butler and Trumble, unpublished data) and we suspect that *Encarsia* females were ovipositing male eggs into parasitized *B. cockerelli* mummies. Future studies are needed to determine the degree in which *Encarsia* hyperparasitoids can decrease biological control efforts using *T. triozae* given that hyperparasitoids have been noted as a disrupting factor of other psyllid biocontrol projects (McDaniel & Moran 1972, Hodkinson 1974, Aubert 1987). In light of these results, biological control efforts that also use the primary parasitoid *Tamarixia radiata* (Waterston) against the Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae), in the United States may want to be vigilant of hyperparasitism by *Encarsia* spp. as well.

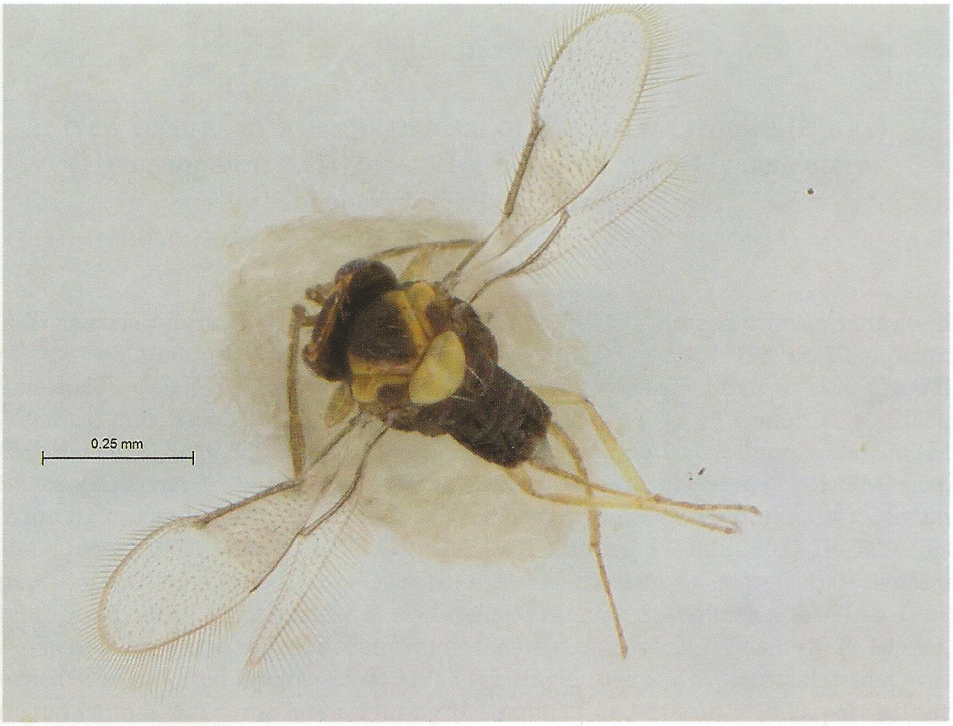

Figure 2. *Encarsia pergandiella* Howard male, which emerged from a *T. triozae* parasitized *B. cockerelli* mummy in Ventura Co. (Scale bar = 0.25 mm).

Table 1. Proportion of parasitized *T. triozae* by *Encarsia* spp. by location and crop.

County	Crop	Species	Proportion
Orange	Bell pepper	*E.* poss. *peltata*	1/19 = 5.3%
Ventura	Tomato	*E. pergandiella*	12/175 = 6.9%

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