Pest Alert

FDACS-P-01744
Pest Alert created 15-September-2010

Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Charles H. Bronson, Commissioner of Agriculture

Ash Whitefly, Siphoninus phillyreae (Haliday), a New Exotic Whitefly (Hemiptera: Aleyrodidae) in Central Florida, and Encarsia inaron, its parasitoid (Hymenoptera: Aphelinidae)

Ian C. Stocks, Ian.Stocks@freshfromflorida.com, Biological Scientist IV, Florida Department of Agriculture and Consumer Services, Division of Plant Industry

Greg Hodges, Greg.Hodges@freshfromflorida.com, Bureau Chief - Entomology, Nematology and Plant Pathology, Florida Department of Agriculture and Consumer Services, Division of Plant Industry

INTRODUCTION: In May 2010, Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS-DPI) staff were alerted to the possible presence of ash whitefly at Lake Buena Vista (Fig. 1). A subsequent inspection of containerized pomegranate trees (*Punica granatum*) revealed a moderate infestation of the ash whitefly on several trees. In early September 2010, DPI Entomologist Dr. Susan Halbert collected specimens from a pomegranate at a private residence in Panama City, Florida. This species had not previously been collected in Florida, although concern of its possible introduction and impact prompted DPI staff in 1990 to prepare an entomology circular (No. 337) and fact sheet (EENY-147) that presented photographs, a description and a discussion of its biology and potential agricultural and horticultural impact (http://edis.ifas.ufl.edu/pdffiles/IN/IN30400.pdf).

Ash whitefly was first detected in the continental United States California in Los Angeles County, California, in 1988, and was later found in Nevada, New Mexico and Arizona. An extensive infestation of ash whitefly on Bradford pears (*Pyrus calleryana*) was found in Raleigh, North Carolina in 1993 (Hackney *et al*., 1997), and it has been reported from Texas, South Carolina and Georgia (McDonald *et al*., 1996). A wide host range, which includes many species of agriculturally and horticulturally important plants, and ability to build-up massive populations, resulted in millions of dollars of economic loss in California (http://cisr.ucr.edu/ash_whitefly.html). The economic impact of the ash whitefly prompted California officials to import, rear and release *Encarsia inaron* (Aphelinidae) (Fig. 4), a parasitoid wasp, in a bio-control effort. The bio-control effort was immensely successful, and ash whitefly in California is currently at nearly undetectable levels. A similar bio-control program was initiated in North Carolina in 1994 to eliminate a large population that was infesting urban Bradford pears. A study that addressed the effectiveness of the program found that while there were initially high rates of parasitism (McDonald *et al*., 1996), the wasp had only a limited impact on the ash whitefly population (Hackney *et al*., 1997). Although there are numerous naturally occurring hosts in North Carolina, and apple and pear are cultivated intensively in parts of North Carolina, for unknown reasons there appears to have been little long-term economic impact as a result of this pest. In Florida, a more favorable climate and the wider availability in the central and southern parts of the state of *Citrus* spp. hosts, cause concern that the ash whitefly could easily become established once introduced.

BIOLOGY: Following the establishment of ash whitefly in California, researchers studied basic life-history parameters, such as developmental time, survival, fecundity, longevity and sex ratio (Leddy et al, 1995). They concluded that the optimal temperature for development was 25°C (77°F), with lower and upper temperature thresholds of 10°C (50°F) and 30°C (86°F), respectively, and that the sex ratio of 1:1 was unaffected by temperature. Longevity of females was highly variable, ranging from 30 to 60 days, depending on temperature, and male longevity averaged 9 days. Female fecundity also varied by temperature, with the highest number of eggs per female of 141 at 25°C (77°F). The rapid development time of 25 days and initial absence of parasitoids resulted in many more generations per year in California than the two to three reported in Egypt (Sorenson *et al*. 1990). Sorensen *et al*. (1990), based on comparative ecological data from

populations in Europe, further speculated that the ash whitefly could certainly tolerate a range in North America that extends to the -1°C (30°F) isotherm, and possibly to the -7°C (20°F) isotherm, which is essentially all of the United States. Enhancing the capacity to build high populations quickly is the ability of ash whitefly in all stages to facultatively overwinter on non-deciduous hosts when the preferred deciduous hosts are barren.

Following the introduction of ash whitefly into California, and the subsequent importation and release of *En. inaron* from Israel, Gould *et al* (1995) studied the life history of the parasitoid. Development time to adulthood took from 55-60 days at 15°C (59°F) to approximately 15 days at 30°C (86°F). Female longevity averaged approximately 19 days, with females laying an average of approximately 150 eggs. Pre-adult survival at 25°C (77°F) was approximately 59%, with a female to male sex ratio of 3:1. Females oviposited in all pre-adult whitefly stages, but preferred to oviposit in fourth instar nymphs.

After the accidental introduction of ash whitefly into Egypt, the efficacy of various bio-control agents was studied in infested pomegranate orchards. Abd-Rabou (2006) reared and released seven parasitoids wasps (Abd-Rabou 1998) and the predator *Clitostethus arcuatus* (Coccinellidae) (Abd-Rabou 2006), and found very high control levels, primarily due to the aphelinid wasp *Encarsia inaron*.

DESCRIPTION: Pupal case size 0.9 mm long by 0.65 mm wide, and tan or beige in color (Fig. 1). A noticeable median patch of white wax runs longitudinally along the dorsum. Hand lens: 40-50 projecting tubes terminate in small droplets of clear liquid wax, which detach if the pupa is disturbed. Slide-mounted specimens: tube-like projections from the dorsum that are most numerous marginally and submarginally (Fig. 2), polygonal reticulations on the cuticle of the operculum and a crenulated posterior margin immediately posterior to the last pair of siphons (Fig. 3).

NATURAL ENEMIES: Data excerpted from Dooley 2010.
Coccinellidae: *Clitostethus arcuatus*, *Menochilus sexmaculatus*, *Scymnus pallidvestis*.
Drosophilidae: *Acletoxenus formosus*, *A. indicus*
Empididae: *Drapetis ghesquierei*
Aphelinidae: *Encarsia inaron, Encarsia partenopea, Encarsia siphonini, Encarsia pseudopartenopea, Encarsia formosa, Encarsia galilea, Encarsia punicae; Eretmocerus siphonini, Eretmocerus corni, Coccophagus eliaphilus, Prospaltella* sp.

The polyphagous parasitoid *Encarsia inaron* (Fig. 4), which is extremely effective at controlling ash whitefly, was recovered from the population at Lake Buena Vista, and an unidentified parasitoid was found parasitizing the population in Panama City.

HOSTS: Taken from Nguyen and Hamon (1990).
Bignoniaceae: *Catalpa* X *Chilopsis* (X *Chitalpa*), catalpa hybrid
Leguminosae: *Afzelia* sp., pod mahogany; *Cercis occidentalis*, western redbud; *C. siliquastrum*, Judas tree
Lythraceae: *Lagerstroemia indica*, crape myrtle
Magnoliaceae: *Liriodendron tulipifera*, tulip tree; *Magnolia stellata*, star magnolia
Oleacaceae: *Fraxinus excelsior*, European ash; *F. latifolia*, Oregon ash; *F. ornus*, flowering ash; *F. syriaca*, Syrian ash; *F. uhdei*, Shamel ash; *F. uhdei* 'Tomlinson', Tomlinson ash; *F. velutina* 'Modesto', Modesto ash; *F. velutina* var. *glabra*, Arizona ash; *F. velutina* var. *coriacea*, velvet ash; *Ligustrum* spp., privets; *Olea africana*, wild olive; *O. europaea*, common olive; *Phillyrea latifolia*, mock privet; *Syringa* x *hyacinthiflora*, hyacinth lilac; *S. laciniata*, cut-leaf lilac; *S. vulgaris*, common lilac
Punicaceae: *Punica granatum*, pomegranate
Rhamnaceae: *Rhamnus alaternus*, Italian buckthorn; *Ziziphus spina-christi*, crown of thorns
Rosaceae: *Amelanchier denticulata*, serviceberry; *Chaenomeles speciosa*, flowering quince; *Crataegus mollis*, downy hawthorn; *C. monogyna*, common hawthorn; *C. laevigata*, English hawthorn; *Cydonia oblonga*, quince; *Eriobotrya deflexa*, bronze loquat; *Heteromeles arbutifolia*, California Christmas berry; *Malus domestica*, apple; *M. floribunda*, Japanese flowering crabapple; *M. fusca*, Oregon crabapple; *Malus* 'Hopa', Hopa crabapple; *Malus* 'Red Jade', Red Jade crabapple; *Malus* x *scheideckeri*, Scheidecker crabapple; *Mespilus* sp., medlar; *Prunus armeniaca*, apricot; *P.* x *blireiana*, flowering plum; *P. persica*, peach; *P. salicina*, Japanese plum; *P. virginiana* var. *melanocarpa*, choke cherry; *Pyracantha* sp., pyracantha; *Pyrus calleryana*, ornamental pear; *P. communis*, pear; *P. kawakamii*, evergreen pear; *P. pyrifolia*, sand pear
Rubiaceae: *Cephalanthus occidentalis* var. *californicus*, buttonbush
Rutaceae: *Citrus reticulata*, tangerine; *C. limon*, lemon; *C. sinensis*, navel orange; *C. sinensis*, Valencia orange; *Fortunella* sp., kumquat

DISTRIBUTION: Established in California, but at low levels, and reported from Arizona, New Mexico, Nevada, South Carolina and Georgia. Formerly established in parts of North Carolina, but not currently of any economic concern. The two populations mentioned above are currently the only ones known in Florida.

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Figure 1. Ash whitefly, *Siphonius phillyreae*, puparia and juveniles on Pomegranate.
Photograph: Lyle Buss, University of Florida, Department of Entomology and Nematology.

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Figure 2. Photomicrograph of a slide-mounted *Siphoninus phillyreae* pupa showing the characteristic siphons.
Photograph: Ian Stocks, Florida Department of Agriculture and Consumer Services, Division of Plant Industry

Figure 3. Close-up photomicrograph of posterior of *Siphoninus phillyreae* pupa.
Photograph: Ian Stocks, Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

Figure 4. Adult *Encaria inaron*.
Photograph used by permission of Center for Invasive Species Research. Photograph: Mike Rose.