Entomology Circular No. 384
September/October 1997

Fla. Dept. Agric. & Consumer Services
Division of Plant Industry

Parasitoids Associated with the Brown Citrus Aphid, *Toxoptera citricida*, in Florida (Insecta: Hymenoptera)[1]

Gregory A. Evans[2] and Lionel A. Stange[3]

INTRODUCTION: The brown citrus aphid (BrCA), *Toxoptera citricida* (Kirkaldy), is one of the most serious pests of citrus. Aside from the damage it causes by direct feeding, it is the most efficient vector of the citrus tristeza closterovirus (CTV). BrCA was responsible for the rapid spread of CTV in Argentina and Brazil in the 1930s and 1940s that caused the destruction of the citrus industry on sour orange rootstock (Knorr and DuCharme 1951). Prior to 1980, BrCA, presumably native to eastern Asia, was known to occur throughout the citrus-growing regions of Asia, Australia and South America (Yocomi *et al.* 1994). The aphid expanded its range throughout most of the Caribbean Basin between 1989 to 1994 and was first discovered in Florida in November 1995 in Dade and Broward counties. Since then, it has rapidly spread throughout most of the citrus-growing areas of southern and Central Florida (Halbert *et al., in press*).

Biological control may be useful in an integrated pest management approach combining other control strategies such as cross protection, tolerant and resistant rootstock and scions, limited pesticide use, and transgenic plants with resistance/tolerance to CTV (Yokomi *et al.* 1993). Preliminary results of a survey of the natural enemies of the BrCA in Florida initiated in 1996 have detected several predators (especially Coccinellidae) and two parasitoid species that attack BrCA. To date, *Lysiphlebus testaceipes* (Cresson), a native parasitoid that attacks several species of aphids, has accounted for the great majority of parasitoid recoveries from BrCA. In addition, *Aphelinus gossypii* Timberlake, which was introduced into Florida from Hong Kong in 1963 for the control of *Aphis spiraecola* Patch, has been recovered from BrCA, but is much more commonly reared from other aphid species. Four species of hyperparasitoids, *Alloxysta megourae* complex, *Ceraphron* sp., *Syrphophagus aphidivorus* (Mayr) and *Pachyneuron aphidis* (Bouché) are assumed to parasitize *L. testaceipes* larvae inside BrCA.

Three exotic parasitoid species have been imported into Florida as biological control agents of BrCA. *Lysiphlebia japonica* Ashmead, imported from Japan in 1996, was released at various sites in southern Florida; however, very few recoveries of this species have been made in subsequent collections. *Lysiphlebia mirzai* Shuja-Uddin was imported into Florida from China in 1996, but has not been field-released. *Aphidius colemani* Vierick, imported from Chile, is currently being tested for efficacy on BrCA and has not been field-released. Plans are currently being made to import other Asian parasitoid species into Florida. One of these, *Lipolexis scutellaris* MacKauer is included herein because it will likely be introduced into Florida in the near future.

We provide a key and illustrations of parasitoids and hyperparasitoids associated with BrCA as it pertains to Florida to assist studies on the biological control of the aphid. Please note that the fore wing of each species is drawn with the wing setae excluded.

Key to Parasitoids Associated with *Toxoptera citricida* in Florida

1. Antennal flagellum 4-segmented (Fig. 1); fore wing with marginal vein long and stigmal vein short (Fig. 2); habitus (Fig. 22); primary parasitoid. ..... Aphelinidae: *Aphelinus gossypii* Timberlake

1'. Antennal flagellum with 8 or more segments, fore wing venation variable, but not as above 2

2. Fore wing base with large, triangular closed cell; costal cell absent; stigma (= radial cell) large and opaque (Fig. 13); all flagellar segments longer than wide; primary parasitoids (Fig. 11). ..... Aphidiidae.. 3

[1] Entomology Contribution No. 384, Bureau of Entomology, Nematology, and Plant Pathology - Entomology Section
[2] Technician, FDACS, Division of Plant Industry, P.O. Box 147100, Gainesville, FL 32614-7100
[3] Taxonomic Entomologist, FDACS, Division of Plant Industy, P.O. Box 147100, Gainesville, FL 32614-7100

2'. Fore wing base without closed triangular cell; costal cell present; stigma lacking and at least some flagellar segments quadrate or transverse, except in *Alloxysta* which has the stigma hyaline and all flagellar segments longer than wide. ..... Hyperparasitoids.. 7

3. Fore wing with recurrent and cubital veins forming large discocubital cell (Fig. 13); propodeum and petiole (Fig. 12); habitus (Fig. 23). ..... *Aphidius colemani* Vierick

3'. Fore wing with recurrent and cubital veins lacking or very weak, not forming discocubital cell. 4

4. Fore wing with rm vein absent; radial vein elongate, reaching more than 0.6x of the length of the disc (Fig. 15); tergite I narrow and parallel-sided; propodeum with 3 distinct areolae in center (Fig. 14). ..... *Lipolexis scutellaris* MacKauer

4'. Fore wing with rm vein present (Fig. 17); radial vein reaching 0.5 or less of disc length; propodeum not as above; tergite I shape and sculpture variable 5

5. Propodeum smooth; posterior base of petiole dilated (Fig. 16); fore wing metacarpus short, not reaching wing apex (Fig. 17); habitus (Fig. 24) ..... *Lysiphlebus testaceipes* (Cresson)

5'. Propodeum with a pair of large areolae; petiole narrow, nearly parallel-sided (Fig. 18); metacarpus elongate, reaching wing apex (Fig. 19). ..... *Lysiphlebia*.. 6

6. Propodeum with strong central carina (= ridge) connecting pair of areolae; each areole with one setae; tergite I elongate and rugose (Fig. 18); fore wing (Fig. 19); habitus (Fig. 25) ..... *Lysiphlebia japonica* Ashmead

6'. Propodeum central carina weak or absent; areolae without setae; tergite I short and dilated at base and not rugose (Fig. 20); body color variable but usually darker than *L. japonica;* fore wing (Fig. 21); habitus (Fig. 26) ..... *Lysiphlebia mirzai* Shuja-Uddin

7. Antennal flagellum 11-segmented (12-segmented in males), all segments longer than wide (Fig. 3) fore wing with hyaline radial cell (Fig. 4); habitus (Fig. 27) ..... Charipidae: *Alloxysta megourae* complex

7'. Antennal flagellum with 8-11 segments, at least some segments wider than long, if 11- segmented then first 3 segments ring-like; fore wing without closed radial cell 8

8. Antennal flagellum 8-segmented consisting of 7 funicle segments and 1 club segment (Fig. 5); marginal vein elongate and slender, stigmal vein (= radial vein) long and hook-like (Fig. 15); habitus (Fig. 28) ..... Ceraphronidae: *Ceraphron* sp.

8'. Antennal flagellum 9-11 segmented, with 3-segmented club; marginal vein short to very short; stigmal vein straight and not as long as in *Ceraphron.* 9

9. Fore wing marginal vein narrow and very short, less than 0.25x as long as submarginal vein (Fig. 8), stigmal and postmarginal veins very short ; antennal flagellum 9-segmented (Fig. 7) consisting of 6 funicle segments and 3 club segments; habitus (Fig. 29). ..... Encyrtidae: *Syrphophagus aphidivorus* (Mayr)

9'. Fore wing marginal vein wide and approximately 0.4x as long as long as submarginal vein, stigmal and postmarginal veins long (Fig. 10); antennal flagellum 11-segmented (Fig. 9) consisting of 3 ring segments, 5 funicle segments and 3 club segments; habitus (Fig. 30) ..... Pteromalidae: *Pachyneuron aphidis* (Bouché)

Table 1. Alternate hosts of *Toxoptera citricida* parasitoids known to occur in Florida

	Parasitoid Species					
Aphid Species	*Aphelinus gossypii*	*Aphidius colemani*	*Lipolexis scutellaris*	*Lysiphlebus testaceipes*	*Lysiphlebia japonica*	*Lysiphlebia mirzai*
Aphis craccivora Koch		*	*	*		
Aphis gossypii Glover	*	*	*	*	*	*
Aphis nerii (B. de Fons.)	*	*	*	*		
Aphis spiraecola Patch		*	*	*	*	
Brachycaudus helichrysi (Kalt.)	*	*		*	*	
Hyalopterus pruni (Geoffroy)		*				*
Myzus persicae (Sulzer)		*		*		
Rhopalosiphum maidis (Fitch)		*		*		*
Rhopalosiphum padi (L.)	*		*			
Toxoptera aurantii (B. de Fons.)	*	*	*	*	*	

DETECTION AND COLLECTION: Aphids parasitized by aphidiid species appear inflated and in the case of BrCA, are usually brownish. Aphids parasitized by *Aphelinus* are blackish and not as inflated. Specimens reared from aphids should be allowed to survive for a few hours, or until the coloration of integument completely develops and they have expanded their wings, before mounting or preserving in 70% alcohol.

LITERATURE CITED

Halbert, S.E., G.A. Evans and D.C. Clinton. 1998. Establishment of *Toxoptera citricida* in Florida. *In* J. M. Nieto Nafria and A. F. G. Dixon, Eds., Aphids in natural and managed ecosystems. Universidad de Leon, Leon, Spain. *(in press)*

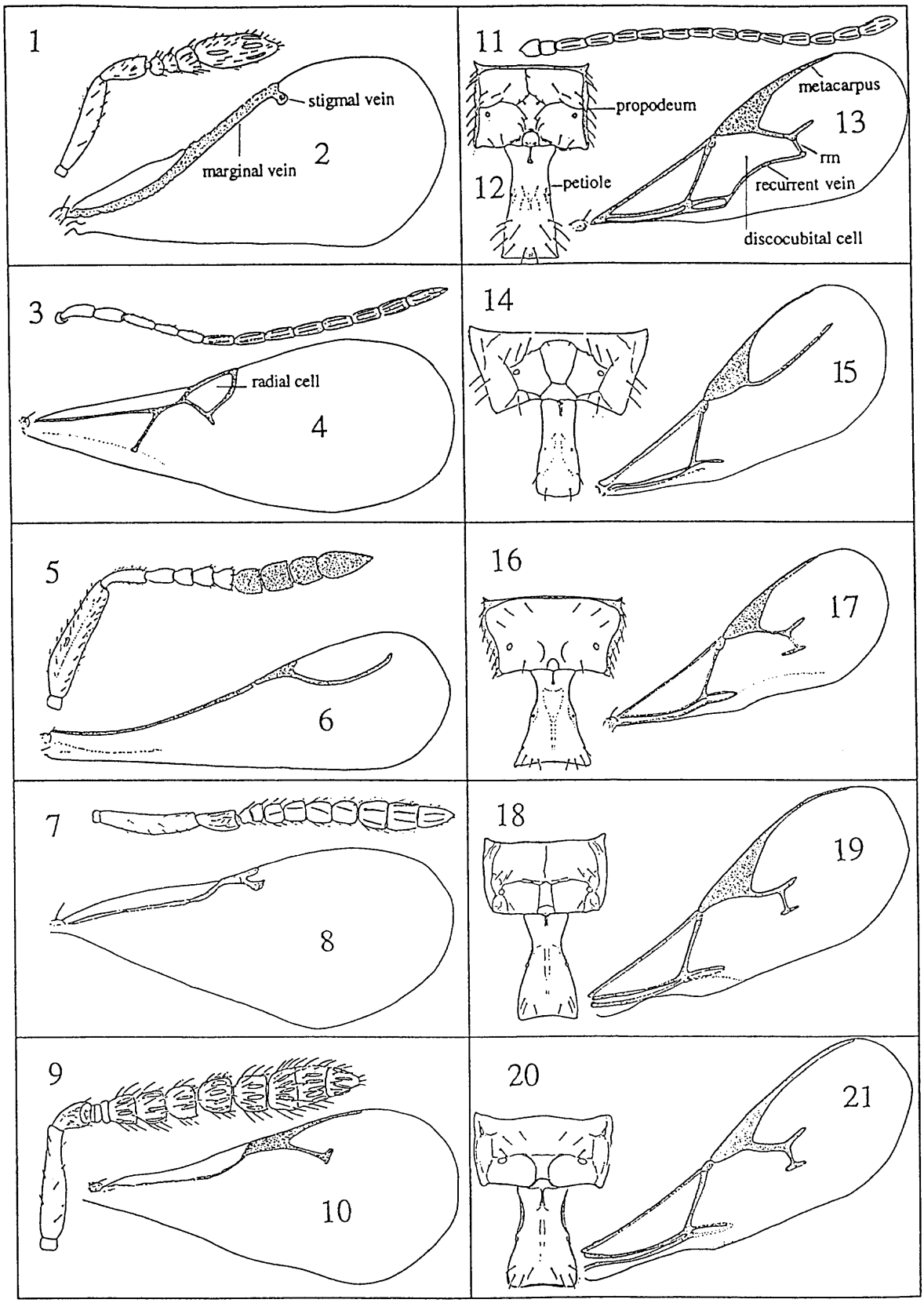
Knorr, L.C. and E.P. DuCharme. 1951. This is tristeza - ravager of Argentina's citrus industry. Citrus Magazine (Florida) 13: 17-19.

Yokomi, R. K., R. Lastra, M.B. Stoetzel, V.D. Damsteegt, R.F. Lee, S.M. Garnsey, T.R. Gottwald, M.A. Rocha-Peña and C.L.Niblett. 1994. Establishment of the brown citrus aphid (Homoptera: Aphididae) in Central America and the Caribbean Basin and transmission of citrus tristeza virus. Journal of Economic Entomology 87(4): 1078-1085.

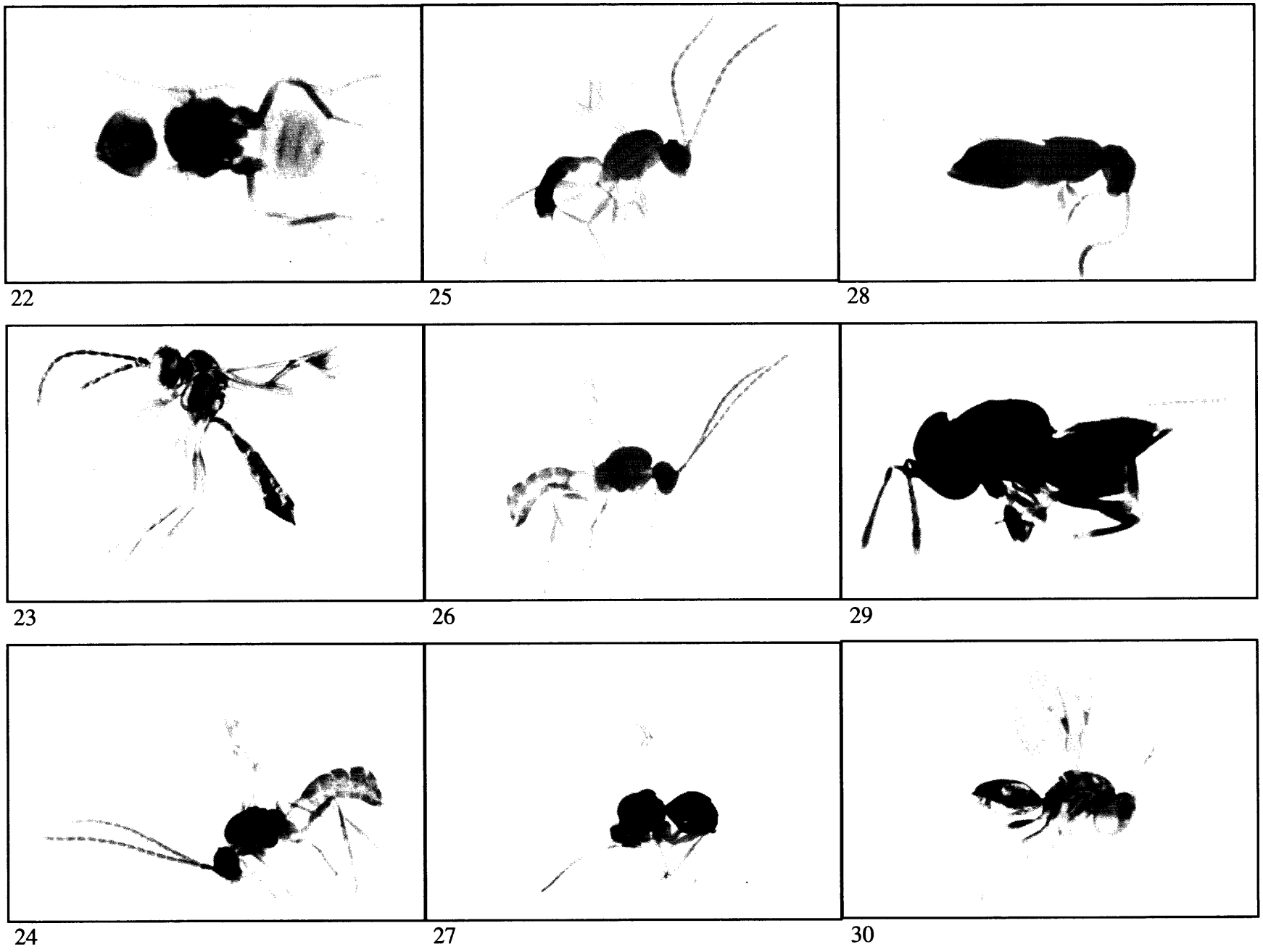
Yokomi, R.K., Tang, Y.Q., L. Nong, and M.L. Kok-Yokomi. 1993. Potential mitigation of the threat of the brown citrus aphid, *Toxoptera citricida* (Kirkaldy), by integrated pest management. Proceedings of the Florida State Horticultural Society 106: 81-85.

PI-98T-03

Ento 384
Sept/Oct 1997



Figures 1-21. (1,2) *Aphelinus gossypii*, (3,4) *Alloxysta megourae* complex, (5,6) *Ceraphron* sp., (7,8) *Syrphophagus aphidivorus*, (9,10) *Pachyneuron aphidis*, (11-13) *Aphidius colemani*, (14,15) *Lipolexis scutellaris*, (16,17) *Lysiphlebus testaceipes*, (18,19) *Lysiphlebia japonica*, (20,21) *Lysiphlebia mirzai*.



Figures 22-30. (22) *Aphelinus gossypii*, (23) *Aphidius colemani*, (24) *Lysiphlebus testaceipes*, (25) *Lysiphlebia japonica*, (26) *Lysiphlebia mirzai*, (27) *Alloxysta megourae* complex, (28) *Ceraphron* sp., (29) *Syrphophagus aphidivorus*, (30) *Pachyneuron aphidis*.