

**SURVEY OF PARASITOIDS OF *PHYLLOCNISTIS CITRELLA* IN BRAZIL**

L.A.N. DE SÁ<sup>1</sup>, V.A. COSTA<sup>2</sup>, W.P. DE OLIVEIRA<sup>1</sup> et G.R. DE ALMEIDA<sup>1</sup>

<sup>1</sup> Embrapa Meio Ambiente C. Postal 69 - 13820-000 Jaguariúna - SP

<sup>2</sup> Instituto Biológico C. Postal 70 - 13001-970 Campinas - SP

**SUMMARY:**

The citrus leafminer, *Phyllocnistis citrella*, is among the main pests of citrus crop in Brazil. The objective of this paper is to identify the complex of parasitoids of this pest in Jaguariúna, State of São Paulo, Brazil. The collections of new leaves were made weekly at citrus groves from July-1997 to April-1999. During the survey period, *Ageniaspis citricola* (Encyrtidae) was introduced in the area. Before this introduction, *Galeopsomyia fausta* (Eulophidae) was the predominant species (91.83%), but *A. citricola* became predominant after its establishment (60.10% against 38.30% *G. fausta*). Other parasitoids found were *Cirrospilus* sp. C (Eulophidae), *Horismenus* sp. (Eulophidae), *Elasmus* sp. (Elasmidae), *Eupelmus* sp. (Eupelmidae) and *Conura* (*Ceratosmicra*) sp. (Chalcididae).

Key words : *Phyllocnistis citrella*, leafminer, biological control, parasitoids, citrus.

**RÉSUMÉ : RECENSEMENT DES PARASITOÏDES DE *PHYLLOCNISTIS CITRELLA* STANTON, DANS L'ÉTAT DE SÃO PAULO, BRÉSIL**

La mineuse des feuilles, *Phyllocnistis citrella*, est l'un des ravageurs des agrumes les plus importants du Brésil. L'objectif de ce travail a été d'identifier le complexe de parasitoïdes de *P. citrella* à Jaguariúna (Etat de São Paulo), Brésil. Les collectes de nouvelles feuilles furent réalisées dans des vergers d'agrumes hebdomadairement de juillet 1997 à avril 1999. Durant la période de recensement, *Ageniaspis citricola* (Encyrtidae) a été introduit dans l'aire d'étude. Avant cette introduction, *Galeopsomyia fausta* (Eulophidae) était l'espèce dominante (91.83 %), mais *A. citricola* est devenu prédominant après son introduction (60.10 % contre 38.30 % pour *G. fausta*). Les autres espèces retrouvées sont *Cirrospilus* sp., *C. Horismenus* sp. (Eulophidae), *Elasmus* sp. (Elasmidae), *Eupelmus* sp. (Eupelmidae) et *Conura* (*Ceratosmicra*) sp. (Chalcididae).

Mots-clés : *Phyllocnistis citrella*, mineuse des feuilles, lutte biologique, parasitoïdes, agrumes.

## Introduction

The citrus leafminer (CLM), *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae), was first detected in Brazil in 1996 (Feichtenberger & Raga 1996, Gravena 1996, Prates et al. 1996). Some parasitoids species have already been found attacking CLM in this country and in some cases reaching high parasitism level (Perioto 1997, Pentead-Dias et al. 1997; Sá & Costa 1997, Costa et al. 1999). Preliminary results of a survey conducted at Jaguariúna, State of São Paulo, have revealed the occurrence of six species of indigenous parasitoids of CLM, *Galeopsomyia fausta* LaSalle (Hymenoptera: Eulophidae) being far the predominant species (Costa et al. 1999).

The objective of this paper was to conduct a survey of parasitoids attacking CLM in Jaguariúna, one of the citrus production regions in the State of São Paulo, Brazil.

## Materials and methods

The collections of new leaves were made weekly at citrus groves in Jaguariúna, São Paulo, Brazil, from July 1997 to April 1999. The collected leaves were taken to the Laboratório de Quarentena "Costa Lima", at Embrapa Meio Ambiente, and maintained at 25°C, 80±5% relative humidity and a photoperiod of 12h: 12h, light:dark. Parasitoids were identified by using the key of Schauff et al. 1998, and confirmed by Dr. John LaSalle (Unit of Parasitoid Systematics, CABI Bioscience, UK Centre, Ascot). Specimens were deposited in the collection of the Laboratório de Quarentena "Costa Lima" Museum, and in the collection of The Natural History Museum, London, UK.

Constancy were calculated as indicated by Bodenheimer 1955 (*apud* Silveira Neto et al. 1976).

## Results and Discussion

From July 1997 to April 1999, 13065 *P. citrella* immatures were collected from citrus leaves sampled in Jaguariúna region and 48.70% of them were parasitized. But during the survey period (in July 1998), *Ageniaspis citricola* Logvinovskaya (Hymenoptera: Encyrtidae) was introduced in Brazil from USA through Embrapa Meio Ambiente Quarantine Facilities, at Jaguariúna, in cooperation with Fundo Paulista de Defesa da Citricultura (FUNDECITRUS), Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ/USP) and Gravena Manejo Ecológico e Controle Biológico de Pragas Agrícolas Ltda. (Gravena Manecol). In October 1998 this exotic parasitoid was liberated post-quarantine in some citrus orchards in the State of São Paulo including orchards near the area where this survey was being conducted, becoming established in January 1999. Thus, there are two distinct periods: before and after the establishment of *A. citricola*.

The first period (July 1997 - December 1998) was characterized by the predominance of *G. fausta*, which accounted for 91.83% of the parasitoids collected. Other parasitoids found were *Cirrospilus* sp. C (Hymenoptera: Eulophidae), *Horismenus* sp. (Hymenoptera: Eulophidae), *Elasmus* sp. (Hymenoptera: Elasmidae), *Eupelmus* sp. (Hymenoptera: Eupelmidae) and *Conura* (*Ceratosmicra*) sp. (Hymenoptera: Chalcididae) (Table 1). *G. fausta* and *Cirrospilus* sp. C were present in 96.85 and 49.61% of the samples, respectively, while the other species were only accidentally found. All of these species have already been reported by Costa et al. 1999. The situation was greatly modified after the establishment of *A. citricola* in the area, from January 1999 on (Table 1). This endoparasitoid soon became the predominant species, accounting for 60.10% of the species composition. The frequency of *G. fausta* and *Cirrospilus* sp. C was lowered to 38.30 and 1.60%, respectively, while the other parasitoids were not found. Also, *A. citricola* was observed in 84.62% of the samples. These numbers may indicate a good adaptation of *A. citricola* to the citrus ecosystem of Jaguariúna region. More studies are needed to precisely evaluate the consequences of *A. citricola* introduction in the State of São Paulo. In the U.S.A. and in Australia, *A. citricola* was introduced and established with success ( Neale et al. 1995 and Hoy et al. 1997a, b).

Table 1. Relative frequency and constancy of *P. citrella* parasitoids in Jaguariúna, São Paulo, Brazil, before (July 1997 - December 1998) and after (January - April 1999) the introduction of *A. citricola*.

Parasitoid Species	July 1997 - December 1998			January - April 1999		
	Number	Relative Frequency (%)	Constancy (%)	Number	Relative Frequency (%)	Constancy (%)
<i>Galeopsomyia fausta</i>	2775	91.83	96.85	72	38.30	92.31
<i>Cirrospilus</i> sp. C	157	5.20	49.61	3	1.60	23.08
<i>Horismenus</i> sp.	62	2.05	22.05	0	0.00	0.00
<i>Elasmus</i> sp.	26	0.86	8.66	0	0.00	0.00
<i>Eupelmus</i> sp.	1	0.03	0.79	0	0.00	0.00
<i>Conura (Ceratosmicra)</i> sp.	1	0.03	0.79	0	0.00	0.00
<i>Ageniaspis citricola</i>	-	-	-	113	60.10	84.62

In spite of the results obtained after *A. citricola* introduction, *G. fausta* still is a serious candidate for biological control of the citrus leafminer in this region of Brasil. This species has repeatedly been identified as one of the most important indigenous parasitoids of *P. citrella* in the New World (Cano, 1996; Cano et al., 1996; Castaño et al., 1996; Cave, 1996; Cobo, 1996; de la Llana, 1996; Frias & Diez, 1996; Martinez, 1996; Ruíz et al., 1997: all as *Galeopsomyia* sp.).

## References

- CANO, E., 1996: *Phyllocnistis citrella* y sus parasitoides nativos en Nicaragua. In: Reunion Centroamericana sobre el manejo integrado de plagas de los citricos con énfasis en minador de la hoja. Proyecto FAO / TCP / NIC / 4551 (A), Managua, Nicaragua, 4- 6 June 1996. 29 p.
- CANO, E., DE LA LLANA, A., HERNANDEZ, J.; RUÍZ, F.; PEÑA, J.E.; EVANS, G., 1996: Dynamics and biological control of the citrus leafminer in Nicaragua. In M. HOY (ed.), *Managing the Citrus Leafminer*. Proceedings from an International Conference, Orlando, Florida, April 23-25 1996, p. 76 [Abstract].
- CASTAÑO, O.; GARCIA R., F.; TROCHEZ, A.; ROJAS, L.; PEÑA, J.E.; EVANS, G., 1996: Biological control of the citrus leafminer, *Phyllocnistis citrella*, in Colombia. In M. HOY (ed.), *Managing the Citrus Leafminer*. Proceedings from an International Conference, Orlando, Florida, April 23-25 1996, p. 76 [Abstract].

- CAVE, R.D., 1996: Biological control of citrus leafminer in Honduras. In M. HOY (ed.), *Managing the Citrus Leafminer. Proceedings from an International Conference*, Orlando, Florida, April 23-25 1996, p. 78 [Abstract].
- COBO N., G.M., 1996: Ciclo biológico del minador de las hojas de los cítricos *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) y su relación con sus hospederos y enemigos naturales en el Valle del Cauca, Universidad Nacional de Colombia, Palmira, Colombia. 158 p. B.Sc. Thesis.
- de la LLANA, A., 1996: Evaluación de factores biológicos de mortalidad de *Phyllocnistis citrella* en Nicaragua, 16 pp, in Reunión Centroamericana sobre el manejo integrado de plagas de los cítricos con énfasis en minador de la hoja, Proyecto FAO / TCP / NIC / 4551 (A), Managua, Nicaragua, 4-6 June 1996.
- COSTA, V.A.; SÁ, L.A.N. DE; LA SALLE, J.; NARDO, E.A.B. DE; ARELLANO, F.L.; FUINI, L.C. 1999. Indigenous parasitoids (Hym.: Chalcidoidea) of *Phyllocnistis citrella* (Lep.: Gracillariidae) in Jaguariúna, São Paulo State, Brazil: preliminary results. *Journal of Applied Entomology*, 123: 237-240.
- FEICHTENBERGER, E. & RAGA, A. First report of Citrus Leafminer *Phyllocnistis citrella* (Lep.: Gracillariidae) in Brazil. In: Reunión Interamericana de Horticultura Tropical, 42., Curitiba, Anais. p. 445. 1996.
- FRIAS, E.; DIEZ, P. 1996: Parasitoides (Eulophidae, Elasmidae) nativos del "minador de las hojas de los cítricos" (*Phyllocnistis citrella* Stainton) (Lep.: Gracillariidae) encontrados en la provincia de Tucumán. Centro de Investigaciones para la Regulación de Poblaciones de Organismos Nocivos (CIRPON), *Revista de Investigación*, 10(1-4): 59-60.
- GRAVENA, S. 1996: Bicho mineiro dos cítricos. *Laranja & Cia.*, Brasil, 44: 3-5.
- HOY, M. A.; NGUYEN R.; POMERINKE M. A.; BULLOCK R. C.; HALL D. G.; KNAPP J. L.; PEÑA J. E.; BROWING H. W.; AND STANSLY P. A. 1997a. Classical biological control of the citrus leafminer. pp 21-25. In: J. Ferguson, G. J. Hochmuth, and D. N. Maynard [eds.], *Florida Agricultural Conference and Trade Show (FACTS), Citrus and Vegetable Proceedings*, PRO 109. 30 September – 1 October 1997, Fort Myers, Florida.

- HOY, M. A.; NGUYEN, R.; POMERINKE, M.; BULLOCK, R.; HALL, D.; KNAPP, J.; PEÑA, J.; BROWNING, H.; AND STANSLY, P. 1997b. Distribution of *A. citricola* – a parasite of the citrus leafminer. *Citrus Industry*, May: 51– 52.
- MARTÍNEZ-B., C., 1996., Insectos parasitoides del minador de la hoja de los cítricos, *Phyllocnistis citrella* Stainton, en tres localidades de la zona centro del estado de Tamaulipas, Mexico, Universidad Autónoma de Tamaulipas, Cd. Victoria, Tamaulipas, Mexico. 47 p. MSc Thesis.
- NEALE, C.; SMITH, D.; BEATTIE, G. A. C.; MILES, M. 1995. Importation, Host Specificity Testing, Rearing and Release of Three Parasitoids of *Phyllocnistis citrella* Station (Lepidoptera: Gracillariidae) in Eastern Australia. *J. Aust. ent. Soc.*, 34: 343 – 348.
- PENTEADO-DIAS, A.M.; SANTIN, G.; PAIVA, P.E.B.; PINTO, R.A. 1997: Parasitoides de *Phyllocnistis citrella* (Stainton) (Lepidoptera: Gracillariidae: Phyllocnistinae) no Estado de São Paulo. *Laranja, Cordeirópolis, Brasil*, 18 (1): 79-84.
- PERIOTO, N.W. Primeira ocorrência do gênero *Galeopsomyia* Girault (Hymenoptera: Chalcidoidea: Eulophidae) para o Brasil. *O Biológico*, 59 (1): 97-98, 1997.
- PRATES, H.S.; NAKANO, O.; GRAVENA, S., 1996: A minadora das folhas de citros “*Phyllocnistis citrella*” - Stainton, 1856. Campinas: CATI. 3p. (CATI. Comunicado Técnico, 129).
- RUÍZ-C., E.; MATEOS-C., J.R.; CORONADO-B., J.M., 1997 [1996]: *Galeopsomyia* (Hymenoptera: Eulophidae), parasitoide del minador de la hoja de los cítricos, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) en Tamaulipas, Mexico. *Folia Entomológica Mexicana*, 96: 107-108.
- SCHAUFF, M.E.; LASALLE, J.; WIJESEKARA, G.A. The genera of chalcid parasitoids (Hymenoptera: Chalcidoidea) of citrus leafminer *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae). *Journal of Natural History*, 32: 1001-1056, 1998.

SÁ, L.A.N. de, COSTA, V.A. 1997: Ocorrência de parasitóides de *Phyllocnistis citrella* no município de Jaguariúna, SP: Resultados preliminares. In: Congresso Brasileiro de Entomologia, 16., Salvador, Brasil. Resumos. p. 145.

Silveira Neto, S.; Nakano, O.; Barbin, D.; Villa-Nova, N.A. 1976. Manual de Ecologia dos Insetos. São Paulo, Ed. Agronômica Ceres, 419p.