

NATURAL PARASITISM OF *PHYLLOCNISTIS CITRELLA*  
(LEPIDOPTERA:GRACILLARIIDAE) AT CUITLAHUAC,  
VERACRUZ, MEXICO

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ABSTRACT

The Citrus Leafminer *Phyllocnistis citrella* (CLM) was reported from Mexico for first time in September 1994. This insect spread rapidly over the main citrus-growing areas and it became a serious threat to the citrus industry in Mexico. The options for controlling this pest include chemical control and natural biological control. The objective of this investigation is to identify the parasitoids associated with the CLM and the variation in their populations in Persian lime, *Citrus aurantifolia* cv. 'Tahiti', at Cuitlahuac, Veracruz, Mexico. The species found are: *Cirrospilus* sp. n.1, *Cirrospilus* sp. n.2, *Horismenus* sp., *Galeopsomyia* sp. and *Elasmus tischeriae*. From November to March of 1995-96, parasitism of the CLM was more than 70% and the most abundant parasitic species were *Galeopsomyia* sp. and *Cirrospilus* sp. n.1 and sp. n. 2.

Key Words: *Phyllocnistis citrella*, *Citrus aurantifolia*, parasitoids, citrus

RESUMEN

El minador de la hoja de los cítricos *Phyllocnistis citrella* (MHC) se registró por primera vez en México en septiembre de 1994. El insecto se extendió rápidamente por las principales áreas citricolas y se ha convertido en una seria amenaza para la citricultura mexicana. Las tendencias para el control de la plaga señalan el uso del control químico y el control biológico natural. A este respecto, el objetivo del presente trabajo es conocer los parasitoides asociados con el MHC y su fluctuación poblacional en limón Persa, *Citrus aurantifolia* cv. 'Tahiti', en Cuitláhuac, Veracruz. Las especies encontradas son: *Cirrospilus* sp. n.1, *Cirrospilus* sp. n. 2, *Horismenus* sp., *Galeopsomyia* sp. y *Elasmus tischeriae*. Durante los meses de noviembre a marzo de 1995-96 se observó

un parasitismo de MHC mayor del 70%, y las especies más abundantes fueron: *Galeopsomyia* sp. y *Cirrospilus* sp. n.1 y sp. n.2.

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The Citrus Leafminer (CLM) *Phyllocnistis citrella* Stainton (Lepidoptera:Gracillariidae) was found first in 1993 in Florida USA, (Heppner 1993) and in September 1994 in Tamaulipas and Veracruz, Mexico (Ruíz and Coronado 1994) from these points of introduction, it spread rapidly through the main citrus-producing areas of Mexico. At the present time it is difficult to locate an area free of this pest, which now threatens citrus production in Mexico. In the southern part of Veracruz State, where Cuitlahuac is located, the problem is especially serious because Persian lime, *Citrus aurantifolia* (Christm.) Sweet cv 'Tahiti', is severely damaged by this insect. Other insect species such as the mealybug *Planococcus citri* and snow scale *Unaspis citri* also contribute to the pest problems in the area.

The CLM has its origin in South Asia, where it was observed in Calcuta, India, for the first time in 1865 (Sponagel and Diaz 1994). In this century the pest has spread to many countries through shipments of plant materials and by migration. This insect damages the young tender leaves of all species of the genus *Citrus*. In addition, Clausen (1931) reported that the pest also damages *Aeple marmelos*, *Murruga koenigii* and *Jasminium sombae*, and Quayle (1941) mentioned that CLM feeds on species of *Loranthus*. CLM reduces possibly the photosynthetically active leaf area of its host both by destroying mesophyll cells and by rolling the leaves during pupation. The pest is most destructive in young plantations, where it may cause total defoliation if it is not controlled. Furthermore, as Guerout (1994) pointed out, the mine built by insect favors the development of citrus canker, *Xanthomonas citri*, and other fungus pathogens such as *Alternaria*.

At present, CLM control practices consist of the application of chemical products as well as natural biological control. Classical biological control is another option, using the non-native parasitoid *Ageniaspis citricola* (Hymenoptera:Encyrtidae), which has reduced significantly damage by the CLM in Australia (Knapp et al. 1995).

In Mexico, various species of native parasitoids, principally members of the family Eulophidae, have been reported (Table 1). Most of these are ectoparasites and attack not only lepidopteran leafminers, but also those belonging to other orders.

The main objective of this work is to identify the species of parasitoids associated with the CLM at Cuitlahuac and to learn about their effectiveness in controlling the pest at this location.

#### MATERIALS AND METHODS

Field work was conducted from August, 1995, to September, 1996, at Cuitlahuac, Veracruz (Fig. 1). This area is located at 18°50' North latitude, 96°55' West longitude and is 420 meters above sea level. Total precipitation in 1995 was 2, 200 mm, with a temperature that varied from 12°C to 36°C. The rainy season is from June to November (Fig. 2) (Bautista et al. 1996).

The collections were made mainly from Persian lime but some were made from sweet orange (*Citrus sinensis* (L.) Osbeck) and tangerine (*C. reticulata* Blanco). Every week 10 flushes less than eight centimeters long, in five different trees (50 flushes in total) were examined to determine the level of infestation by CLM. Parasitism of the CLM was detected by collecting a total of 1609 infested leaves located at or below the

TABLE 1. PARASITOID SPECIES ASSOCIATED WITH THE CLM IN MEXICO (RUIZ &amp; MATEOS 1996, MARTÍNEZ &amp; RUIZ 1996, PERALES ET AL. 1996).

Taxon	Locality
<i>Cirrospilus quadristriatus</i>	Tecoman, Colima.
<i>Cirrospilus</i> sp	Tecoman, Colima. northern Veracruz central Tamaulipas
<i>Closterocerus</i> sp	Tecoman, Colima. Tecoman, Colima. northern Veracruz central Tamaulipas
<i>Horismenus</i> sp	Tecoman, Colima. northern Veracruz central Tamaulipas
<i>Pnigalio</i> sp	central Tamaulipas
<i>Tetrastichus</i> sp	Tecoman, Colima. northern Veracruz
<i>Zagrammosoma</i> sp	Tecoman, Colima. central Tamaulipas

middle of flushes 20 cm length. These leaves were placed in paper bags and taken immediately to the laboratory where the relative humidity was between 65 to 75% and the temperature varied between 18 and 25°C. The leaves were placed in Petri dishes, three per dish, with their petioles wrapped in moist cotton, and observed daily until emergence of the adult CLM or its parasitoids. It was necessary to control the humid-

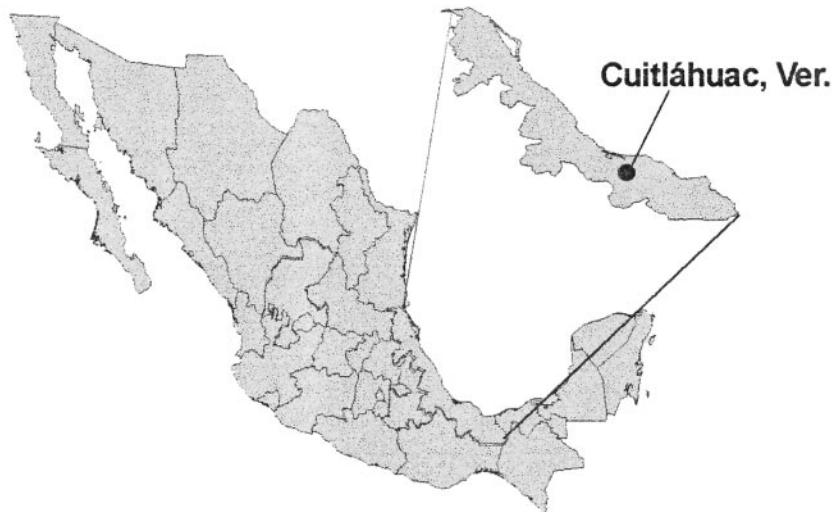


Fig. 1. Location of the area of study of the CLM.

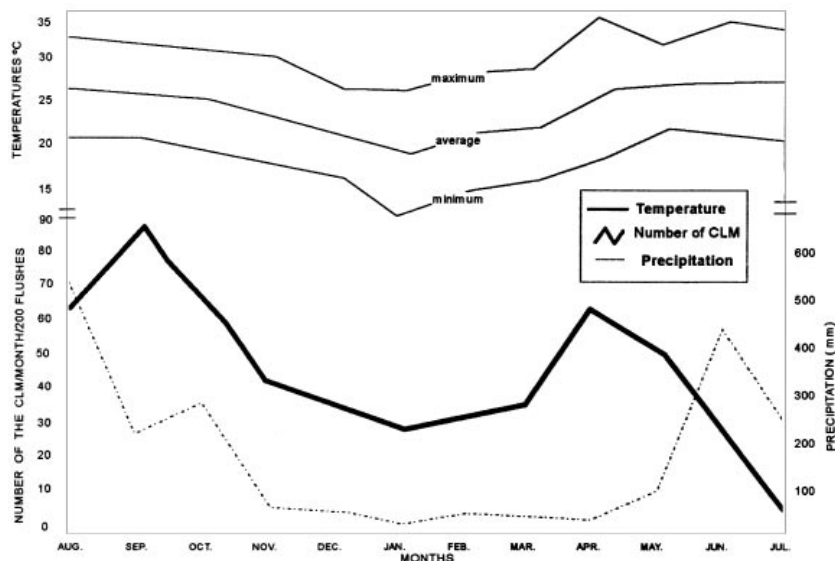


Fig. 2. Variation in temperature, precipitation and the number of citrus leafminers between August, 1995, and July, 1996, at Cuitlahuac, Veracruz.

ity because dehydration of the leaves or contamination by saprophytic fungi due to excess humidity can affect the emergence of the insects. Some of the wasps that emerged were placed in 70% alcohol and others were dehydrated with a critical point drier and pinned for identification. Another procedure that was used to collect parasitoids consisted of selecting infested leaves and enclosing them in small bags of organdy, without removing them from the tree. They were examined every day until emergence of the adult insects. A total of 312 leaves from 39 flushes were treated this way.

The parasitoids were identified using the keys of Schauff and LaSalle (1996). In addition, the eulophids were sent to the Centro Nacional de Referencia de Control Biológico in Tecmán, Colima, Mexico and to Dr. John LaSalle, at the International Institute of Entomology, in London, England, for confirmation. To confirm the determinations of the elasmids, specimens were sent to Dr. Lonny D. Coote, at the Royal Ontario Museum, in Canada.

#### RESULTS AND DISCUSSION

The highest population levels of the CLM were observed in September, October, April and May while the lowest incidence occurred in the months of January and July (Fig. 2). Incidence of the CLM was not closely related to the development of new flushes. In January and July most of these flushes were free from the pest (Table 2). In addition a high level of parasitism, above 70%, was observed from November to March. In June and July a high percentage of parasitism was observed on the few leafminers collected (Fig. 2).

Five species of parasitoids in the superfamily Chalcidoidea (Table 3) were reared from the 1609 infested leaves that were taken to the laboratory for this purpose. The first four species belong to the family Eulophidae (Hymenoptera). *Cirrospilus* 1 and 2

TABLE 2. VARIATION IN THE INCIDENCE OF THE CLM AND ITS PARASITIDS AT CUITLAHUAC, VERACRUZ IN 1995-96.

Month	Leaves examined	CLM larvae and/or pupae found	CLM larvae and/or pupae parasitized	Percent parasitized
Aug.	225	207	68	32.8
Sep.	291	301	148	49.1
Oct.	229	158	92	58.2
Nov.	191	148	107	72.2
Dec.	95	18	15	83.3
Jan.	63	7	6	85.7
Feb.	94	11	9	81.8
Mar.	111	31	22	70.9
Apr.	201	104	71	68.2
May.	109	62	29	46.7
Jun.	67	12	9	75
Jul.	45	4	4	100

and *Galeopsomyia* sp yet have not been described. The neotropical genus *Horismenus* is very difficult taxonomically, so it is not possible to be sure if the species collected is undescribed or not (LaSalle 1997, personal communication). *Elasmus tischeriae* is in the family Elasmidae, species of which generally attack species in the orders Diptera and Coleoptera.

In the months of August and September the parasitoids population on the CLM were reduced considerably, possibly because they were attacking other species of leaf-miners.

#### *Cirrospilus*

LaSalle (1996) reported fifteen species of *Cirrospilus* associated with the CLM, including the undescribed species collected in this study. The same author states that

TABLE 3. PARASITIDS OF THE CLM AND THEIR RELATIVE IMPORTANCE AT CUITLAHUAC, VERACRUZ.

Species	Percent parasitized	Biological phase attacked <sup>1</sup>
<i>Cirrospilus</i> sp 1	22.6	Larvae III (2) and prepupae(7)
<i>Cirrospilus</i> sp 2	25.1	Larvae III(2), prepupae(1) and pupae(9)
<i>Horismenus</i> sp	19.3	Prepupae(1) and pupae(13)
<i>Galeopsomyia</i> sp	27.6	Larvae II(1), III(1), prepupae(4) and pupae(7)
<i>Elasmus tischeriae</i>	5.4	Larvae II(2), III(1) and pupae(2)

<sup>1</sup>) number of individuals observed.

this is a cosmopolitan and polyphagous genus although it prefers to parasitize insects in the family Gracillaridae. Sometimes the members of *Cirrospilus* act as hyperparasitoids (LaSalle 1996), even though this the species collected at Cuitlahuac, Veracruz were not observed doing this. The two *Cirrospilus* species found at Cuitlahuac are ectoparasitic, the pupae remaining in the mines of the host.

#### *Galeopsomyia*

The collection at Cuitlahuac is the first record of the genus for Mexico (Bautista et al. 1996). This species, which is being described by LaSalle, is ectoparasitic on the CLM in the larval phases II and III and prepupae. In one case it was observed as a facultative solitary hyperparasitoid. The highest incidence of this species was observed in October and November. According to LaSalle (1994), the species of this genus generally attack Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera).

#### *Horismenus*

This ectoparasitoid of the CLM, can be confused with *Galeopsomyia*. LaSalle (1996) reported two species of *Horismenus* associated with the CLM which have not yet been described. It is very common to find species of this genus acting as hyperparasitoids (Coffelt and Schultz 1993).

#### *Elasmus*

Of the five species of parasitoids associated with the CLM, *E. tischeriae* Howard was the least abundant at Cuitlahuac; only about 5% of the parasitoid individuals were of this species. LaSalle (1994) reports three species attacking the CLM, *E. tischeriae*, *E. zenhtneri* and an undescribed species. To date, *E. tischeriae* is the only one that has been found in Mexico. Some authors place this species in the family Eulophidae instead of the monotypic Elasmidae. It is the capable of parasitizing lepidopteran borers, but it also has been frequently found parasitizing species of *Polistes* (Hymenoptera: Vespidae) (Borror et al. 1989). In the study area this species was observed in the months of August and September.

#### Other predators

Several other predatory arthropods associated with the CLM were observed at Cuitlahuac. These include syrphid flies, common lacewings, spiders (Table 4) and the ant species, *Crematogaster aff-brevispinosa* and *Conomyrma bicolor* (Hymenoptera:Formicidae).

TABLE 4. SPIDER SPECIES ASSOCIATED WITH CLM, AT CUITLAHUAC, VERACRUZ.

Family	Species
Araneidae	<i>Araneus</i> sp
	<i>Leucauge argyra</i> Walckanaer
	<i>Argiope argentata</i> Fabricius
Salticidae	<i>Habronatus</i> sp
Theridiidae	<i>Thymoites unimaculatum</i>

## CONCLUSIONS

The highest population levels of the citrus leafminer occurred in September and October, then in April and at the beginning of May. The lowest incidence of the pest was observed in January and July. The parasitoid species with the highest percentage; of parasitism were *Cirrospilus* and the *Galeopsomyia*. In the period from November to March, the level of parasitism was very high, about 70%.

## ACKNOWLEDGMENTS

This study was supported by Consejo Nacional de Ciencia y Tecnología (CONACYT), through Project 0503 PB "Bioecología del minador de la hoja de los cítricos *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae). Una nueva plaga para la citricultura mexicana". The authors thank Dr. J. LaSalle and Dr. D. Lonny Coote, of the International Institute of Entomology, London, England, and Department of Entomology, Royal Ontario Museum, Toronto, Canada, respectively, for their assistance in the identification of the parasitoids. Identification of the ants was made by M. C. Luis Quiroz Robledo, Institute de Ecología, A. C., Jalapa, Veracruz, Mexico. Identification of the spiders was made by Dr. Carlos Solis Rojas, Universidad Autonoma de Nuevo Leon, Linares, Mexico.

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