

Citrus Leafminer in California Citrus

Kris Godfrey¹ and Beth Grafton-Cardwell²

¹Biological Control Program, CDFA, Sacramento

²Dept. of Entomology, UC Riverside, stationed at Kearney Agricultural Center, Parlier

Where is Citrus Leafminer a pest?

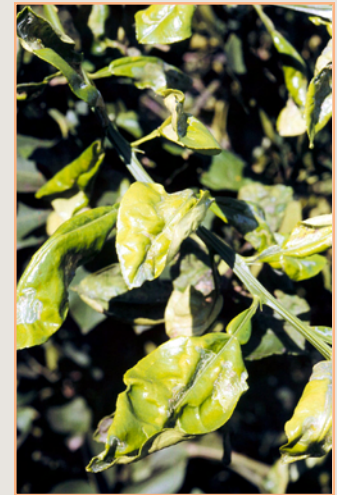
The citrus leafminer, *Phyllocnistis citrella* Stainton, is a small moth that belongs to the family Gracillariidae. This species is native to Asia and can be found throughout Asia, Taiwan, southern Japan, the Philippines, Indonesia, New Guinea, Australia, South Africa, parts of west and east Africa, the Mediterranean region of Europe, and from Saudi Arabia to India. It can also be found throughout the Caribbean Islands, Central America, Mexico, and South America.

In the United States, the citrus leafminer (CLM) was first found in a few citrus nurseries in southern Florida in May 1993. Since that time, it has spread throughout the citrus growing areas of Florida into Louisiana and Texas.

In California, CLM was found in backyard citrus in a few locations in January 2000 in Imperial County adjacent to the Mexican border. By the fall of 2001, CLM had spread to other areas of Imperial County and is now found from Winterhaven to Niland, attacking nursery stock; commercial groves of lemons, grapefruit, and oranges, and backyard citrus. We expect it to move northward from Imperial County and eventually infest citrus in all areas of the state.



What is the damage caused by Citrus Leafminer?



CLM larvae infest the flush growth (new growth at the tips of branches) of citrus by mining the lower surface of newly emerging leaves. This feeding causes the leaves to curl and look distorted. In addition, CLM mines provide an opening for the entry of pathogens. In Florida, CLM mining increases the incidence of citrus canker which is presently absent from California, at least in part, because of our quite dry climate.

Research in Florida has shown that most mature trees (greater than 4 years of age) are not significantly affected by CLM, provided that large densities of CLM larvae do not occur during the spring flush, the flush that produces the current year's crop. However, lime trees may need greater protection. Young trees tend to produce copious amounts of flush growth throughout the year allowing CLM to increase in number. For young trees, such as those in nurseries, replants within mature groves, and newly established groves, CLM can cause tree death if the tree experiences continual defoliation. In California, we have not observed continual defoliation because the summer heat seems to suppress populations, and so we are not likely to see tree death.

What host plants will Citrus Leafminer feed upon?

CLM is most commonly found on citrus and related plants in the family Rutaceae. All types of citrus leaves (e.g., grapefruit, pummelo, lime, lemon, and orange) are fed upon. In addition, CLM may feed upon kumquat and calamondin leaves. A few other species of plants in other plant families have been reported to have CLM feeding damage. However, upon further testing, CLM larvae would not complete development on these plants.

What is the life cycle of Citrus Leafminer?

Adult CLM moths are active in the morning and the evening. During the evening hours, female moths lay their eggs singly on the lower side of an expanding citrus leaf. Each female moth may lay between 18 - 76 eggs (mean of 48 eggs) during her life (2 - 7 days). The eggs hatch in 2 - 10 days, and the young larvae begin mining the leaf surface. Typically, the mining occurs only on the lower side of the leaf, and there is only 1 mine per leaf. However, when large densities of CLM are present, both sides of the leaf may be mined, and 2 or more mines may be found on each leaf. CLM larvae complete 4 instars within the mines in 10 - 20 days. Pupation occurs within the mine in a special pupal cell at the leaf margin. Pupation lasts from 5 - 22 days. The adult moths emerge from the pupae at dawn. The entire life cycle of CLM takes 1.5 - 8 weeks to complete depending upon temperature conditions. In the desert valleys of southern California, there are multiple, overlapping generations per year.

How can Citrus Leafminer be detected within a grove?

In areas where CLM is present or suspected of being present, scouting for CLM can begin when 50% of the trees are producing flush growth. To determine if CLM is present, new flush growth should be examined. On the apical terminals (10 leaves at the top of the branch), the smallest leaves may harbor CLM eggs and small larvae that are very difficult to see. The next leaves on the branch are several days older and may harbor larvae and pupae. These are the leaves to examine carefully with a hand lens for CLM life stages.

One monitoring plan that has been suggested for detection of CLM in a mature grove involves selecting 10 trees at random in each acre of a grove during a period when 50% of the trees are producing flush growth. For each tree, 2 apical terminals with flush growth are collected. The goal is to collect 20 terminals and approximately 200 leaves per acre. These apical terminals are then examined with a hand lens for active mines with live larvae or pupae. A live CLM larva will move within the mine, is a pale color, and leaves a trail of clear liquid one to two body lengths behind it. **If any larvae or pupae are found, a sample should be submitted to your local County Agricultural Commissioner or UCCE Farm Advisor for positive identification.**

How do you manage Citrus Leafminer on mature trees?

Research conducted in Florida has shown that CLM will not harm mature trees (older than 4 years of age) provided the trees have adequate fertilizer and water at the appropriate times of the year. Typically, CLM densities are low in the spring when mature trees are producing leaf growth that will make the current season's crop, and so, the damage is not heavy enough to reduce yield. In Florida, the CLM populations continue to increase on flush growth throughout the year, reaching the highest densities in the fall and winter. In California, the populations are low in the spring, seem to be suppressed by summer heat and decline until September - November when they increase to their highest levels. Most citrus, except for limes, can tolerate this damage without economic loss of the crop provided general tree health is maintained.

In Florida, biological control in the form of parasitic wasps plays a significant role in the management of CLM. Native natural enemies may cause more than 50% mortality of CLM larvae and pupae. In addition, an introduced parasite, *Ageniaspis citricola*, has provided more than 90% mortality on CLM populations in some areas of Florida. Close relatives of the native natural enemies found in Florida exist in California, and with time, they will likely attack California CLM populations. A program

has been initiated to encourage these natural enemies to attack CLM. One promising candidate is *Cirrospilus coachellae*, a parasite of citrus peelminer (*Marmara gulosa*) native to the Coachella Valley. In addition, plans have been made to import *A. citricola* for release in the coastal areas of California once CLM arrives in these citrus growing areas. This parasite requires habitats with high humidity to survive and so, it will not be effective in inland areas.

Populations observed in mature citrus in California thus far have not been heavy enough to warrant insecticidal control. Avoiding insecticides for CLM will help conserve native natural enemies for CLM as well as other insect pests within the grove. Chemical control of CLM in mature trees is extremely difficult – treatments are rarely effective and can lead to upsets of CLM and other pests due to reductions in natural enemy populations. This insect can complete its life cycle in as short as 14 days and attacks only new flush growth. During a flush period, new growth is continually being produced, so insecticide applications made at a particular time will not protect new growth that appears after the application.

To slow the northward spread of CLM in California, good sanitation at harvest should be practiced. Because CLM inhabits the leaves as larvae and pupae and may be at its heaviest densities at harvest time, care should be taken to eliminate leaves from the harvest bin. Late instar larvae and pupae within the leaves may have time to complete development while the fruit is being transported and stored in the bins, and emerge as moths in a new, uninfested area of California.

How do you manage Citrus Leafminer on young trees and replants?

Young citrus trees (those less than 4 years of age) will have their growth slowed and in some cases may be killed if defoliation caused by CLM feeding is continuous. In Florida, young trees will flush continuously and allow CLM to increase to very high densities. In California, we have not had CLM present in young trees long enough to know if they can maintain their populations during the summer. We observed that CLM did not survive the summer Imperial Valley heat in mature trees, and it may respond the same way in young trees. In Florida, it is recommended that insecticidal applications begin when 30% of the new, emerging leaves have active CLM mines. For recommendations on timing, rates, and insecticides, please see the companion document, or contact your local UCCE Farm Advisor.

How do you protect nursery trees from Citrus Leafminer?

Trees in citrus nurseries must be protected from CLM. Feeding by CLM on nursery trees can result in a reduction in growth and vigor, and in extreme cases, may kill the young tree. Insecticide recommendations that will assist in managing CLM populations and maintaining tree health within the nursery are given in the companion document.

Acknowledgements

The photos used in this publication were provided by Dr. J. Peña (Tropical Research Center, University of Florida, Homestead, Florida), Dr. B. Grafton-Cardwell, Mr. S. A. Kinnee (Plant Pest Diagnostics Lab, CDFA, Sacramento, California), and Ms. D. A. Mayhew (Biological Control Program CDFA, Sacramento, California). The layout was designed by Ms. D. A. Mayhew. The information in this publication was derived from the following sources:

Browning, H.W., P. A. Stansley, and J. Peña. 2001. 2002 Florida Citrus Pest Management Guide: Citrus Leafminer. IFAS, University of Florida. ENY - 623.

Guillén, M., D. R. Davis, and J. M. Heraty. 2001. Systematics and biology of a new polyphagous species of *Marmara* (Lepidoptera: Gracillariidae) infesting grapefruit in the southwestern United States. Proc. Entomol. Soc. Wash. 103(3): 636-654.

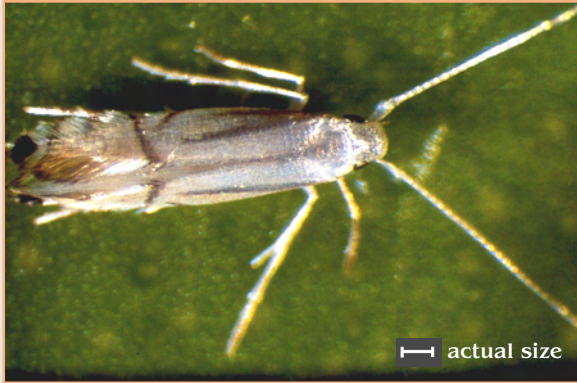
Heppner, J. B. 1993. Citrus leafminer. Florida Dept. of Agriculture and Consumer Services. DPI. Entomology Circular No. 359.

Knapp, J.L. 1995. Citrus leafminer, *Phyllocnistis citrella* Stainton: Current Status in Florida - 1994. Citrus Leafminer Workshop. IFAS. University of Florida, Orlando, Florida.

What does Citrus Leafminer look like?

CLM is closely related to another California citrus pest, the citrus peelminer (CPM). CPM is native to the southwestern United States and northern Mexico. CLM and CPM can be differentiated using the following characteristics:

Citrus Leafminer

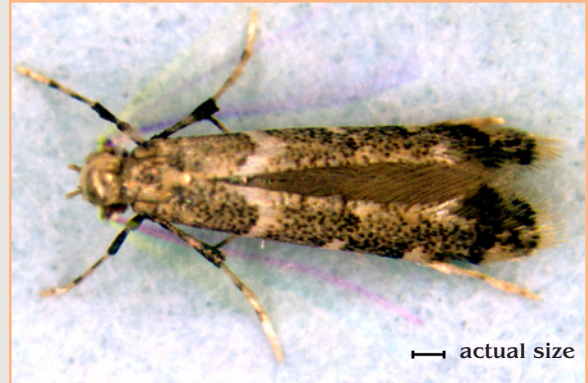


Small, light colored moth about 4 mm in length. The front wings are white or silver with several black and tan markings. There is a black spot on the tip of each front wing.

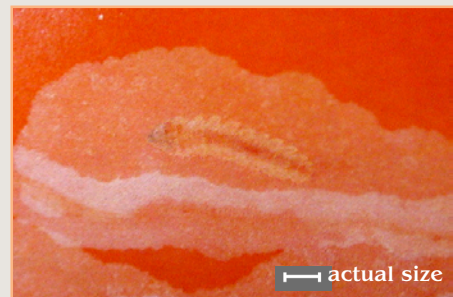


Minute larva (maximum length 3 mm), translucent, yellowish-green in color. Body segments with rounded edges. Last larval instar almost cylindrical in shape and pale in color.

Citrus Peelminer



Small, brown moth about 4 mm in length. The front wings are brown with tan markings.

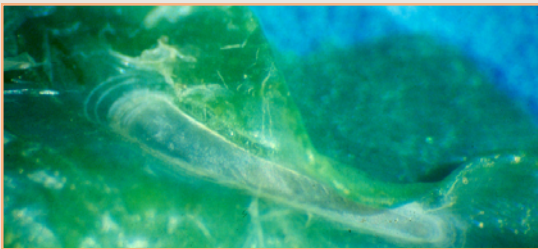


Minute larva (maximum length 4 - 4.5 mm), whitish in color. Body segments more triangular in shape (upper photo). Last larval instar reddish in color (lower photo).

Citrus Leafminer



CLM larvae usually feed on leaves creating a serpentine mine. There is usually only one mine per leaf, although in heavy infestations, there may be multiple mines per leaf and mining on both sides of the leaf. There may be minimal feeding on green shoots, and on very rare occasions, mining on fruit.



CLM pupate within the mine at the leaf margin in a special cell under a slight curl of the leaf (top photo).

Citrus Peelminer



CPM larvae will mine the surface of fruit and green stems. Much of this feeding is done on protected places on the fruit and stems.



The last larval instar of CPM leaves the mine and finds a suitable site for pupation (e.g., on the fruit, crevice under the bark, leaf litter, etc.). This larva spins a cocoon comprised of a sheet of white silk with a series of minute balls on the exterior surface.