



Citrus Leafminer¹

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The small leafmining moth, *Phyllocnistis citrella* Stainton, family Gracillariidae (subfamily Phyllocnistinae), or the citrus leafminer (CLM), was found in late May 1993 in several citrus nurseries in Homestead, Florida, other parts of Dade County, Broward County, and Collier County. CLM is a new world, continental United States, and Florida resident. It is potentially a serious pest of citrus and related Rutaceae, and some related ornamental plants (Beattie 1989; Clausen 1993; Kalshoven 1981). CLM has previously been intercepted in the United States in 1914 (ports not noted) on citrus and *Atalantia* sp. horticulture stock imports from the Philippines (Sasser 1915). CLM is considered a potentially serious threat to Florida citrus and native Rutaceae. It has not previously been reported mining fruit rinds, but several possible cases have been observed in Florida.



leafmining moth.

PHYSICAL DESCRIPTION

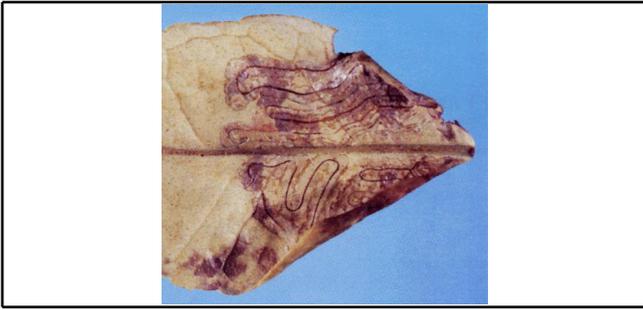
Adults of the citrus leafminer are minute moths (4 mm wingspread) with white and silvery iridescent scales on the forewings, with several black and tan markings, plus a black spot on each wingtip. The hind wings and body are white, with long fringe scales extending from the hindwing margins. In resting pose with wings folded, the moth is much smaller in appearance (about 2mm). The head is very smooth-scaled and white and the haustellum has no basal scales. Citrus leafminer is most easily detected by its meandering serpentine larval mine, usually on the ventral side of the leaf. Larvae are minute (to 3 mm), translucent greenish yellow, and located inside the leaf mine. The pupa characteristically is in a pupal cell at the leaf margin. Adults generally are too minute to be easily noticed, and are active diurnally and evenings.

DISTRIBUTION

A widespread Asian species (Clausen 1931, 1993; CAB 1970), described from Calcutta, India (Stainton 1856), CLM now is known from East Africa - Sudan to Yemen (Badway 1967), through southern Asia - Saudi Arabia to India (Fletcher 1920) and Indonesia (Kalshoven 1981), North to Hong

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meandering serpentine larval mine.

Kong and China, Philippines (Sasscer 1915), Taiwan (Chiu 1985; Lo and Chiu 1988) and southern Japan (Clausen 1927). It is also found in New Guinea and nearby Pacific Islands (CAB 1970), and Australia (Beattie 1989; Hill 1918; Wilson 1991). CLM also occurs in South Africa and more recently in parts of West Africa (CAB pers. comm.). The Australian introduction occurred before 1940, and has since 1969 been reported from northern Queensland. For the period from May to November 1993, CLM has spread to all Florida citrus counties south of Tampa and Orlando, with isolated sites as far north as Alachua and Wakulla Counties. The potential exists for CLM spreading to Louisiana and Texas.

HOST PLANTS

CLM is common on species of citrus and related Rutaceae within its range (Kalshoven 1981). CLM is most commonly found on leaves of grapefruit (*Citrus X paradisi* Macfad.) and pummelo (pomelo) (*Citrus maxima* (Burm.) Merr. (Badawy 1967). Recorded Rutaceae include *Aegle marmelos* (L.) Corr. Serr. in India (Fletcher 1920), *Atalania* sp. in the Philippines (Sasscer 1915), *Murraya paniculata* (L.) Jack. in India (Pruthi and Mani 1945), *Poncirus trifoliata* (L.) Raf. in India (Clausen 1933), and various native Rutaceae in Indonesia (Kalshoven 1981). Other reported hosts include *Jasminum sambac* (L.) Aiton (Oleaceae) in India (Fletcher 1920), mistletoes on citrus (*Loranthus* spp., Loranthaceae) in the Philippines (Reinking and Groff 1921), *Pongamia pinnata* (Leguminosae) in India (Margabandhu 1933), and *Alseodaphne semecarpifolia* Nees (Lauraceae) in India (Latif and Yunus 1951). Florida records include various *Citrus* sp., Kumquat (*Fortunella crassifolia* Swingle), and calamondin (*X Citrofortunella microcarpa* (Bunge) D.O. Winjnands).

Several other hosts have been reported for CLM but larvae do not complete their life cycle on these incompatible hosts: *Murraya koenigii* L. Sprengel (Rutaceae) in India (Fletcher 1920), *Jasminum* sp. and *Jasminum cinnamomum* Kobuski (Oleaceae) in India (Pruthi and Mani 1945), *Dalbergia sissoo* Roxb. ex DC (Leguminosae) in India (Latif and Yunus 1951), *Salix* sp. (Salicaceae) in India (Pruthi and Mani 1945), and *Grewia asiatica* L. (Tiliaceae) in India (Latif and Yunus 1951).

BIOLOGY

The biology of Citrus Leafminer has been reported on by a number of researchers, including Badawy (1967), Beattie (1989), Clausen (1927, 1931, 1933), Fletcher (1920), Kalshoven (1981), Latif and Yunus (1951). Eggs of CLM are laid singly on the underside of host leaves. Egg eclosion occurs within 2-10 days, whereupon larvae immediately enter the leaf and begin feeding. Larvae make serpentine mines on young leaves (sometimes also young shoots), resulting in leaf curling and serious injury. Leaf mines are usually on the ventral leaf surface, except in heavy infestations when both leaf surfaces are used. Usually only one leaf mine is present per leaf, but heavy infestations can have 2 or 3 mines per leaf; up to 9 mines on large leaves have been found in Florida. As with similar leafminers, larvae are protected within the leaf during their feeding cycle. Larvae have 4 instars and development takes from 5-20 days. Pupation is within the mine in a special pupal cell at the leaf margin, under a slight curl of the leaf. Pupal development takes 6-22 days. Adults emerge about dawn and are active in the morning; other activity is at dusk or night. Females lay eggs evenings and at night (Badawy 1967; Beattie 1989). CLM may help spread citrus canker (Hill 1918; Ando et al. 1985) because of leaf damage from the mine.

Generations per year appear to be continuous: 6 in southern Japan (Clausen 1931), 9-13 in northcentral India (Lal 1950); 10 in southern India (Pandey and Pandey 1964). Development time totals about 13-52 days (Pandey and Pandey 1964), depending on weather and temperate conditions. Adults live for only a few days. Florida generations are produced about every 3 weeks.



Adults.

SURVEY

Symptoms of infestation include: 1) leaves with serpentine mines, usually on ventral surfaces; 2) curling of leaves (may harbor mealybugs); 3) epidermis appearing as a silvery film over leaf mines; 4) pupation chamber near leaf margin, the edge of which is rolled over, and exposed portion of chamber with a distinct orange color; and 5) succulent branches of green shoots may also be attacked (Beattie 1989; Pandey and Pandey 1964).

CONTROL

Parasites reported for CLM include 39 species from Southeastern Asia, Japan, and Australia, mostly Chalcidoidea (Heppner 1993; Kalshoven 1981; Lo and Chiu 1988). A pheromone to attract males of CLM has been developed in Japan by Ando et al. (1985), called (7Z, 11Z)-7,11-hexadecadienal. Most work has been done using chemical control, especially in India. Various spray regimes, timing of growth flushes, and promotion of biological control are recommended in Australia (Beattie 1989). In Florida, chemical control recommendations are still being evaluated, but biological control and semiochemical trapping may be the most likely methods to help reduce populations of CLM in the long run.

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