



TOP LEFT: Citrus leafminer larva burrowing in leaf. **BOTTOM LEFT:** Canker infecting citrus leafminer mines. **RIGHT:** Citrus leafminer adult.

Leafminer control update

By Lukasz Stelinski, Philip Stansly and Stephen Lapointe

The citrus leafminer (CLM) is an important pest of citrus in Florida. Adults are tiny, white moths with dark wing spots and are difficult to see due to their diminutive size (just a few millimeters) and activity during late evening and early morning.

An important part of the biology of this insect is the release of a very specific, long-range pheromone by females that is used by the males to locate mates. Lures containing this female-produced sex-attractant capture only male moths. Commercially available sticky traps baited with this pheromone are used to evaluate population trends and effectiveness of control applications.

After mating, females deposit eggs on soft young flush, often on the underside near the midrib, after

landing on the unopened leaf. The emerging larva burrows directly into the leaf where it feeds and develops within galleries just beneath the leaf cuticle. At this stage, the larva and damage are clearly visible, but unfortunately, harm has already been done. Loss of photosynthetic area can stunt growth of young trees, and citrus canker may be exacerbated. This is because larval feeding disrupts the leaf cuticle, opening palisade tissues to invasion and colonization by the causal bacteria. The larva eventually stops feeding and forms a pupal cell of folded leaf margin secured with silk. New adults later emerge from the pupae to restart the cycle.

INSECTICIDAL CONTROL

Insecticides that kill larvae are currently the most important tools


for control of this pest. The early larval stage is the most susceptible and best target to avoid injury as larvae emerge from the egg and begin to feed on flush. Young trees are often the most susceptible to CLM damage. Soil applications of neonicotinoid insecticides (e.g., Admire Pro, Platinum 75SG or Belay 2.13 SC) can provide multi-week control of CLM in non-bearing trees, and should be applied up to two weeks prior to a leaf flush in order to allow lethal concentrations of insecticide to accumulate in the foliage and also control Asian citrus psyllid (ACP). However, it is important to remember that all neonicotinoid insecticides share the same mode of action, so back-to-back applications of these insecticides may hasten development of insecticide resistance in both pests, which must be avoided.

Foliar applications of neonicotinoids in these or neighboring trees will also select for resistance and are generally less effective than soil applications.

Insecticides recommended for leafminer control can be found in the 2015 Florida Citrus Pest Management Guide. Proper timing of foliar sprays to coincide with flushing cycles is critical to optimize CLM management. The goal is to kill larvae as soon as they begin mining. Although broad-spectrum insecticides targeting ACP adults may kill adult CLM, typically populations rebound in groves soon after foliar sprays of organophosphate or pyrethroid insecticides, and may even increase under intense ACP management due to suppression of natural enemies. Applications of foliar insecticides should be made during a window when CLM larvae hatch and begin feeding to maximize larval kill. In general, the earliest applications should occur between 13 and 30 days after budbreak. The duration of control may be shorter if a heavy flush occurs soon after the foliar application. It may be advantageous to target spring flush, even though CLM damage is not evident, to prevent buildup of populations that will cause damage later in the year.

There are opportunities for combining control of CLM with that of other pests. Most recommended products for CLM control are also effective against ACP, which also develops in young flush. Well-timed summer applications of Agri-Mek or Micromite can be useful to manage citrus rust mite. Cyazypyr from Dupont Crop Protection is a recently available product that is highly effective against CLM (as well as ACP). Several (eight+) weeks of protection against CLM have been documented following soil-applied treatments of this active ingredient. It is also highly effective as a foliar treatment against CLM.

Some newly registered insecticides for use in Florida citrus are mixtures of two modes of action that allow for simultaneous CLM and ACP



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Recently, some growers have tried the mating-disruption technique for managing CLM in Florida.

control. Agri-Flex combines the active ingredient of Agri-Mek with that of Actara (a neonicotinoid) in a single formulation to target CLM larvae and ACP nymphs and adults. However, any consecutive application of an insecticide employing the same mode of action, whether it is a single or dual mode of action, increases the probability of insecticide resistance developing in the target pests. Intrepid 2F (methoxyfenozide) + 2 percent v/v horticultural spray oil (435) is effective against CLM larvae by interfering with the molting hormone. Intrepid can be used alone or tank-mixed with another insecticide without selecting for resistance to ACP, upon which it has no effect.

MATING DISRUPTION

Recently, some growers have tried the mating-disruption technique for managing CLM in Florida. This is a method by which large quantities of the leafminer's pheromone are released

into the crop, which interferes with the males' ability to find females. The idea is to disrupt the males so they can't find females, leaving females unmated and thus protecting the crop from infestation by the larvae because no viable eggs are laid within the treated area. Triangular "delta" traps baited with pheromone are typically used to monitor effectiveness of mating disruption. If few or no male moths come to the traps, it is assumed that mating is being disrupted.

We have been investigating this technology for the past seven years. Since 2013, we have investigated the Dcept CLM™ product from ISCA. This dispenser of pheromone is hand-applied onto branches of citrus trees and is commercially available. This technology removes the need for a mechanical applicator, but the acreage that can be treated by hand is limited by the availability of labor.

In 2014, approximately 4,000 acres of citrus in Florida were treated

with this new mating-disruption product. There were cases of success and cases where protection required supplemental use of insecticides. Therefore, the product was not a consistent replacement for insecticides, despite 14 to 20 weeks of possible protection. We speculate that this was because of the high population densities of CLM in treated areas, possibly due to the lack of biological control under heavy insecticide regimes for ACP. This appears to have happened in the case of the parasitoid wasp, *Ageniaspis citricola*, that was imported and released to control the leafminer, but now is scarce in citrus groves intensively managed to control the psyllid. Also, it is possible that mated female CLM move in from untreated areas, compromising effectiveness. Previous research has shown that mating disruption always works best on an area-wide scale.

Despite the progress of treating 4,000 acres in Florida with mating disruption, it may be necessary for even greater contiguous treatment with this product to see the true benefits. Traditional insecticide treatments therefore remain as the main tools for managing this important pest. Many are highly effective. Systemic insecticides for young tree protection are especially effective and generally have a longer duration of efficacy than foliar-applied larvicides. Foliar applications must be made to flush in a timely manner to achieve adequate control. One may expect the possibility of two to four weeks of control with a foliar larvicide or up to six to eight weeks of control with a soil-applied neonicotinoid or Cyazypyr, depending on application timing, tree size and weather conditions. 🍊

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