

# Citrus leafminer mating disruption

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The citrus leafminer, *Phyllocnistis citrella*, is a major pest of citrus production worldwide. Larval feeding within serpentine mines damages leaves, which can result in reduced growth rate of young trees. Furthermore, wounds caused by leafminer feeding predispose trees to infection by citrus canker. Leafminer damage heals slowly, thereby increasing the period of susceptibility to the bacterium and contributing to its spread and severity throughout the feeding galleries.

Larvae are difficult to control with foliar insecticides because they are protected within the leaf tissue. As a result, insecticides applied for leafminer often fail to control all of the life stages present; thus, damage can reappear two to three weeks after treatment.

In 2006, the sex pheromone of citrus leafminer was identified by researchers in California. The leafminer's sex-attractant pheromones are a blend of chemical signals emitted by female moths that guide males to females for mating. Pheromones are the sole means by which these tiny insects find each other over long distances. Calling females can attract males from distances of 40 yards or more. One successful mating of a female leafminer can yield 100 or more fertilized eggs.

Mating disruption is the insect control practice of deploying synthetic pheromones into the crop atmosphere to interfere with normal mate finding. This control technique exploits the male leafminer's natural response to follow the female's pheromone trail. The synthetic pheromone is a volatile chemical that mimics the authentic sex pheromone produced by the female leafminers. The effect of mating disruption is to confuse male leafminers by masking or interfering with the females' natural pheromone trails. Consequently, male leafminers experience reduced success in locating and mating with females. The end-result is a reduction in fertilized eggs and resultant damaging larvae. Mating disruption is non-toxic to beneficial organisms because pheromones are released at very small quantities and are highly species-specific.

Mating disruption has become an



Figure 1: Example of mechanized applicator for SPLAT-CLM

essential component of IPM programs for major moth pests worldwide in temperate tree fruit, small fruit, forage crops, forestry and stored-product warehouses. Mating disruption reduces the need for application of broad spectrum insecticides and in some cases, it is practiced as a stand-alone tactic.

Is mating disruption a possible option for citrus leafminer control? The answer appears to be, "Yes!" In a 2007 spring and summer initial field trial of citrus leafminer control with the recently identified pheromone, very promising results were obtained. The male citrus leafminer's capability to locate a source of pheromone was disrupted by deploying pheromone dispensers, with the highest disruption (>99 %) achieved with 370 dispensers per acre. Furthermore, leafminer damage was reduced by more than half, even though insecticides were not applied throughout the season. Following this "proof of concept" investigation, we began developing citrus leafminer mating disruption into a practical tool that could be deployed economically on a large scale. To accomplish this goal, we partnered with a company in the pheromone industry, ISCA Technologies (Riverside, Calif.), which develops and markets pheromone release devices for pest control.

Recently, flowable wax-based dispensers were developed for releasing moth pheromones. These dispensers

are biodegradable, inexpensive and easy to produce. Also, they can be applied either by hand or with custom-made mechanical applicators mounted to tractors (Figure 1). Currently, ISCA holds patent rights to this technology, which is called SPLAT (Specialized Pheromone and Lure Application Technology). Because of its initial investment and patent of this delivery method, ISCA is positioned to quickly produce and market this product combined with the leafminer pheromone should our ongoing research trials prove that this would be a valuable tool for Florida citrus growers.

In 2008, we evaluated SPLAT containing citrus leafminer pheromone components and found it to be highly effective in both disrupting male leafminers' ability to find females and in reducing subsequent leafminer injury. Our major goal for 2009 is to develop and optimize effective mechanized applicators for this pheromone dispenser so that SPLAT-CLM, which is the name for ISCA's leafminer product, can be deployed to large acreages of citrus quickly and efficiently. We will also investigate how control of leafminer with mating disruption affects spread of citrus canker.

ISCA meanwhile is working to register the product for use in Florida citrus. Targeted deployment of SPLAT-CLM for leafminer management will have no negative impact on the wide

complex of natural enemies that are known to limit leafminer population growth in citrus. So, control of leafminer with SPLAT should work hand-in-hand with biocontrol. However, large scale commercial deployment of SPLAT-CLM for leafminer management will have no negative impact on the wide complex of natural enemies that are known to limit leafminer population growth in citrus. So, control of leafminer with SPLAT should work hand-in-hand with biocontrol. However, large scale commercial deployment of SPLAT-CLM will likely require use of specialized equipment that we are developing for rapid deployment of this product.

Mating disruption targets a specific pest and has no negative impact on natural enemies, the environment, or agricultural workers. However, the pest-specificity of pheromones for

insect control can be their Achilles' heel, with respect to economics and adoption. Since SPLAT-CLM is only effective on the citrus leafminer, application of this product will have no impact on populations of the Asian citrus psyllid. Broad spectrum pesticides have the advantage of targeting multiple pests with a single product. Unfortunately, this affects the complex of natural enemies that help regulate pest populations, if given a chance.

Predicting the potential impact of leafminer mating disruption on pest management in Florida citrus in the near future is difficult. The process may become another effective tool for leafminer management that has the unique benefit of conserving natural enemies. But, given the current priority of psyllid control for huanglongbing management, selective tools for the leafminer, like mating disruption,

may have less applicability right now given the existing high cost of annual psyllid management. As the cost of psyllid control is reduced by the adoption and further refinement of more economical application technologies, such as low volume spraying and coordinated large-scale psyllid management, integration of more selective tools like leafminer mating disruption may become more feasible. Furthermore, the goal of developing a combined pesticide alternative for leafminer and psyllid, which combines the leafminer pheromone and a psyllid repellent, is being investigated.

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