Path Of Least Resistance

Smart use of today's chemistries is key to a successful psyllid control program.

By Lukasz Stelinski and Michael Rogers

Among the tools available for current management of the Asian citrus psyllid, insecticides play a large role. Sound integrated pest management (IPM) calls for use of many tactics simultaneously, including insecticides. Although a considerable amount of current research is focusing on the development of possible pesticide-alternative tools for psyllid management, insecticides will undoubtedly play an important role in controlling this disease vector into the distant future. Thus, protecting the effectiveness of these important tools by minimizing the development of resistance is a critical aspect of a sound and forward-looking psyllid management program.

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Mind Your MOA

Repeated, frequent use of the same insecticide mode of action (MOA) can lead to the development of resistance. Resistance does not develop in an individual insect following multiple exposures. Instead, it is the composition of the insect population that changes over time. Essentially, repeated use of the same MOA kills off all of the insects that were susceptible to the treatment and leaves all of the mutants that cannot be killed by the labeled dose to further reproduce. If this is done repeatedly, those naturally resistant mutants keep breeding with one another and their numbers keep rising in the population until they dominate the population, which may lead to eventual product failures. If one rotates multiple MOAs, this selection pressure to develop a resistant population is broken up by preventing the development of a "Frankenstein" population resistant to a single MOA.

Over the past several years, we have been investigating the development of resistance in Florida psyllid populations, and more recently, the mechanisms causing resistance in the Asian citrus psyllid. Our philosophy has been to collect data proactively before problems arise in order to understand how current insecticide use is affecting the existing levels of resistance among psyllid populations in Florida. Also, we have been investigating the mechanisms of resistance development in Florida psyllid populations.

By gaining a full understanding of the fundamental underlying reasons for how resistance is developing, we plan to develop sound rotation schedules of available MOAs that specifically prevent development of cross-resistance between different MOAs. Hypothetically, depending on the underlying mechanism(s) causing resistance, it may be unwise to follow a neonicotinoid application with a pyrethoid spray, but rather an organophospate spray might be a better choice after the neonicotinoid. In order to develop effective rotation schedules that minimize resistance development, a sound understanding of the underlying mechanisms is essential.

Citing Psyllids

To date, we have characterized the baseline susceptibility of several psyllid populations throughout the major citrus growing regions of Florida to 14 of the most commonly used insecticides for psyllid control. This has been determined by comparing the susceptibility of field-collected psyllids to that of our known susceptible laboratory cultures, which do not receive exposure to insecticides. In general, each psyllid population tested to date from five counties in total has exhibited decreased susceptibility to many of the tested compounds compared with the susceptible laboratory strain. The decrease in susceptibility to the various

In the fight against greening, it is critical to avoid the development of insecticide resistance in the Asian citrus psyllid.

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insecticides tested has ranged between 2- and 34-fold. We also have observed evidence of cross-resistance between two different insecticides (imidacloprid and thiamethoxam) that have the same MOA. Imidacloprid is formulated as Provado 1.6 F and Admire Pro (both Bayer CropScience) and is an important systemic insecticide that has been used in psyllid management for several years, particularly as a soil-applied systemic for protection of young trees. Thiamethoxam, formulated as Actara 25 WG or Platinum 75 SG (both Syngenta Crop Protection), is another neonicotinoid that was registered for use in citrus against psyllid only recently; however, evidence of cross-resistance to this MOA has already been observed in our early investigations.

Focused In

Our work on the mechanisms of pesticide resistance is revealing why these field populations are showing decreased susceptibility to certain insecticides. For instance, we are finding the target site of organophosphate and carbamate insecticides, which is the acetocholinesterase enzyme in the insect nervous system, is 2- to 4-fold less sensitive to insecticides such as Lorsban (Dow AgroSciences), Dimethoate, Malathion, and Sevin (Bayer CropScience) for several field populations in Florida. Furthermore, we are finding certain populations of psyllids that are less susceptible to insecticides have elevated levels of pesticide-degrading enzymes in their bodies, which occur at lower levels in our susceptible laboratory colony. Collectively, these results indicate multiple mechanisms are developing simultaneously and have an additive effect on the development of resistance by psyllid populations.

It is important to understand the levels of resistance we are seeing at this point are not disastrous and things are not out of control yet — either for whole psyllids exposed to an insecticide or at the nitty gritty target site. The amounts of active ingredient of the various insecticides that are labeled for field application are still much higher than the minimum dose needed to kill those psyllids in our controlled laboratory evaluations. Thus, the levels of resistance documented to date should not lead to any product failures yet. However, our laboratory experiments also have shown that through constant exposure, we can artificially create a population of psyllids that is 100-fold resistant to imidacloprid after only five generations.

Rotation Recommendation

These results clearly indicate we need to be vigilant in our stewardship of available products — always rotate MOAs. For now, we suggest any rotation is better than none. Our current efforts are focusing on optimizing rotation based on a clear understanding of the mechanisms of insecticide resistance. The rotation schedules we will develop will simultaneously optimize efficacy, while minimizing the potential for resistance. Furthermore, we will continue monitoring psyllid populations to understand fluctuations of susceptibility to available pesticides over time. We believe this proactive approach will help maintain the utility of these important psyllid management tools into the distant future. FG

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