Use of chemical plant growth regulators: potential benefits for psyllid management

By Timothy M. Spann, Antonios Tsagkarakis and Michael E. Rogers

There is considerable debate about the best way to manage Huanglongbing (HLB, citrus greening) in Florida. However, no one will argue against the importance of psyllid control. As the vector of the bacteria that causes HLB, effective control of the Asian citrus psyllid is paramount to the successful management of this disease. Until now psyllid management has relied on routine pesticide use, but new research is revealing some potentially promising new control strategies.

In 2009, a research project was undertaken to look at the possibility of using plant growth regulators (PGRs) to control excess summer flush with an eye toward reducing psyllid populations by eliminating the new flush the psyllid requires for egg-laying and nymph development. PGRs are chemicals that mimic or block the production of plant hormones — usually those involved in vegetative growth — but they may also be used to promote or inhibit flowering and fruit set. They are commonly used on ornamental flowering plants, but in the United States their use on food crops and fruit tree crops specifically is quite limited.

Our initial greenhouse and field trials used the compound prohexadione calcium (Apogee®, BASF Corp.), a gibberellic acid (GA) biosynthesis inhibitor. That is, it blocks one or more steps in the chemical pathway within the plant that results in the production of GA. Gibberellic acid promotes the growth and elongation of plant cells, so inhibiting its production reduces vegetative growth.

Since Apogee is not labeled for citrus, we used 0.5x and 1x (200 and 400 ppm), the maximum label rate. At these rates, we found Apogee to be virtually ineffective at reducing vegetative growth of citrus. In fact, on some plants it actually promoted growth, a phenomenon also observed by South African researchers. However, quite fortuitously, we observed fewer psyllids on the new flush of Apogee-treated trees in the field compared to the untreated trees.

Based on this observation, we conducted a set of followup greenhouse studies using Volkamer lemon seedlings and Valencia trees. In these trials, we used six different PGRs, including Apogee, all of which are GA biosynthesis inhibitors, but with slightly different modes of action. In these trials we treated container-grown trees with foliar applications of the different PGRs using recommended rates for woody perennial plants (none of these products are labeled for citrus). Ten days after the applications, a mated pair of psyllids was caged on each tree. We counted the number of eggs laid per tree, the number of nymphs and the number of adults that emerged over a 21-day period.

One of the PGRs tested was phytotoxic and severely burned the new flush in both trials; thus only the five non-toxic PGRs will be discussed. In the study with Volk, there were no differences in tree growth among any of the PGR-treated trees compared with the control trees. Despite not reducing growth, two of the PGRs reduced egg-laying over 21 days by 85 percent and two others reduced egg-laying by 65 percent. The fifth PGR increased egg-laying by nearly 40 percent. One of the PGRs that reduced egg-laying by 65 percent also reduced nymph survival to adult to about 10 percent, compared to > 50 percent on untreated trees.

In the study with Valencia, we found very similar results. None of the PGRs reduced tree growth relative to the untreated trees, but Apogee increased tree growth. Again, despite not reducing growing, there were significant effects on psyllid egg-laying. Three of the PGRs reduced egg-laying by about 95 percent, and two reduced egg-laying by about 65 percent. In this case, the PGR which had increased egg-laying in the Volk study reduced egg-laying (65 percent). Survival of nymphs to adults was affected by two of the PGRs in the Valencia study, reducing survival to about 25 percent, compared to 75 percent on untreated trees.

Because tree growth was not affected by the PGRs tested in these trials, but psyllid behavior was, we believe that the PGRs are affecting the biochemistry of the citrus tree, which reduces its suitability as a psyllid host. Most likely, this change is related to the GA biosynthesis pathway since that is the point of action of the chemicals. However, since these chemicals are not registered for use on citrus, their effects on citrus biochemistry have not been studied in detail.

This coming season, we plan to conduct field studies to determine if the efficacy of these PGRs tested so far transfers from the greenhouse to field-grown trees. In addition, we are planning to begin detailed biochemical analyses of the changes that occur in citrus when treated with these different PGRs in order to understand the reason for their effect on the psyllid.

With the exception of Apogee, it is unlikely that any of these chemicals will be registered for use on citrus. However, all is not lost. The understanding of citrus biochemistry and psyllid preferences that we can gain from these studies is very promising. We may find specific biochemical pathways within the tree that can be targeted by conventional or molecular breeding approaches that will reduce the suitability of citrus as a host for the psyllid. Or it may give us insight into a compound that can be developed as a psyllid repellent. Should Apogee one day receive a registration for use on citrus, it may prove to be a useful tool, in combination with pesticide use, to combat the psyllid and HLB.

Timothy M. Spann is an assistant professor, Antonios Tsagkarakis is a post-doctoral researcher and Michael E. Rogers is an associate professor, all at the University of Florida's Citrus Research and Education Center, Lake Alfred.