PSHB Research Update

By Tim Spann
Research Program Director

Currently, the California Avocado Commission (CAC) is funding six research projects related to the polyphagous shot hole borer (PSHB) and its fungal symbionts. The projects have been designed to develop critical knowledge about the basic biology of the beetle and fungi, and evaluate potential control methods, which will be summarized in this article. Additional research is being conducted to monitor the infestation in commercial avocado groves, which is covered in another article on page 8 in this issue of *From the Grove*.

In late 2014, an effective lure was found for attracting PSHB. The lure contains a mixture of four different compounds from a group known as para-menthenols, one of which is a compound called quercivorol. These compounds are not pheromones, but rather are known as kairomones – chemicals produced by the host tree or maybe the symbiotic fungi. Regardless, being able to effectively attract and trap PSHB has opened many new research doors.

Dr. Richard Stouthamer, University of California, Riverside (UCR) entomologist, is focusing his efforts on trap optimization with two primary goals: 1) developing attract and kill technology, and 2) understanding daily and seasonal flight and dispersal habits. To optimize the traps, his group is looking at factors such as trap height, placement relative to trees or open space, trap color, trap type and lure placement on the trap. At the same time, they are testing the effective distance at which the traps attract beetles.

Following trap optimization, Dr. Stouthamer's lab will work on developing effective trap and kill strategies. This could be as simple as deploying sufficient numbers of traps throughout a given area to catch most of the beetles flying in that area. However, even if what are perceived to be very large numbers of beetles are trapped, this may not be sufficient to reduce the population. To make the trap and kill strategy more effective, they will be exploring the possibility of inoculating the traps with entomopathogenic fungi or bacteria. The trapped beetles would become infected with the entomopathogens and could be released to spread these pathogens throughout the beetle colonies. This attract and kill by epidemic strategy may reduce beetle populations to a larger extent than traditional trap and kill.

Being able to trap the beetles effectively will also allow for studies of the beetles' flight activity on both a daily and seasonal basis. By collecting data on environmental conditions – air and bark temperature, humidity, and wind speed – we can begin to understand emergence patterns, flight distances, dispersal habits and other factors that will greatly improve any beetle management strategy developed.

The application of pesticide trunk infusion treatments for polyphagous shot hole borer control being applied to a tree at the Commission's Pine Tree Ranch demonstration grove. (Photo courtesy of Dr. Akif Eskalen, UC Riverside)

Since the lure was discovered late in 2014, these trials have just been established this spring. However, the team working on these trials is top notch and we are optimistic they will result in valuable information by later this year.

Drs. Joe Morse, Frank Byrne (UCR entomologists) and Akif Eskalen (UCR plant pathologist), are actively working to find a chemical solution – pesticide and/or fungicide – for PSHB and its fungal symbionts. Their group initiated field trials of registered and unregistered materials last October. These trials have been conducted in commercial groves (registered materials) and on the UCR campus and CAC's Pine Tree Ranch demonstration grove (unregistered materials). In the first trials initiated last October, materials were applied as trunk sprays. Although trunk sprays are not necessarily a viable method for many growers to use, and they have short periods of residual activity, they do provide data quickly about which chemicals have efficacy against this pest.

A second round of trials was applied in early January using trunk injection and infusion technologies. Again, this is a technique that is not easy for many growers to execute; however, it provides the potential for long-term (up to 18 months) efficacy. And this is a critical situation for

our industry so no technology can be overlooked. The first samples were collected from the trunk injections in mid-February for bioassays. Core samples are removed from the trees at different heights above the injection site. The cores are then exposed to the fungi and beetle to determine if the material is effective, and how quickly it is moving throughout the tree. The team is hopeful they can obtain sufficient efficacy data by late spring for CAC to submit a Section 18 Emergency Exemption application in the hopes of having at least one product available to growers by later in 2015.

The researchers and CAC also realize the importance of not just pursuing chemical control strategies for this pest-disease complex. To that end, Drs. Eskalen and Stouthamer will be returning to Southeast Asia (Taiwan, Vietnam and China) at the end of April to continue the work they began last spring to look for biocontrol agents. Last year's trip resulted in the discovery of a fly species that may be a natural enemy of PSHB. Trials are being conducted by cooperators in Vietnam to assess the fly's efficacy and determine if it is a candidate to be brought to the United States. On this year's trip, the researchers will have the advantage of the new lure. This will allow them to trap a much larger sample of PSHB and, consequently, increase their chances of finding more candidate biocontrol agents.

Harvesting a trunk core sample one month after trunk infusion treatments for laboratory bioassays to test chemical efficacy. (Photo courtesy of Dr. Akif Eskalen, UC Riverside)

In addition to the work in Southeast Asia, Dr. Eskalen has been investigating the population of endemic fungi and bacteria on avocado and other host tree species here in California. He has identified a couple of species of *Bacillus* bacteria that naturally live on the bark of avocado trees and, in lab tests, show some antagonism toward PSHB. If these findings prove out, these bacterium could be deployed by the trap and kill by epidemic or other methods, and would be a tool for organic growers since the bacteria are endemic to avocado trees.