Message from the President

Tom Bellamore

PSHB - Leave No Stone Unturned

The polyphagous shot hole borer (PSHB) continues to be at the forefront of the numerous issues commanding the Commission's attention. It is first on a formidable list long enough to make any grower question the future of avocado production in California—competition, water pricing and availability, labor, regulation, and more—and it is not our problem alone. In Israel, the invasive pest has been attacking avocado groves since at least 2005. And a close relative, the red bay ambrosia beetle, *Xyleborus glabratus*, has been threatening Florida avocado groves for the past decade as well.

These are not your typical, garden-variety pests; rather, they have followed a convergent evolutionary path that has prepared them to be survivors. Ambrosia beetles belong to the weevil subfamilies Scolytinae and Platypodinae (Coleoptera, Curculionidae) and live in nutritional symbiosis with ambrosia fungus. Carried by female beetles in their mouthparts, the fungus is used to infest host plants and is used as a food source by the adult and larval stages of the beetles.

Shot hole borers are a group of ambrosia beetles that make tiny entry holes in trees. Specimens collected in California and Israel are morphologically similar to *Euwallacea fornicatus*, but DNA evidence suggests they are another species. Confused?....it gets worse: shot hole borers collected from Los Angeles County appear to be different from those first found in San Diego County, near El Cajon. This could be significant if the two forms of the beetle exhibit differences in behavior, for example, but this remains to be seen.

Clearly, there is nothing simple about this problem, not even the name. In California, "polyphagous shot hole borer" has been suggested as a common name for the beetles and it will be used here, generally, in reference to the enemy before us, despite what genetic diversity might dictate. Scientific debate over nomenclature aside, the one thing ambrosia beetles in Florida, California, Israel, Sri Lanka, and Vietnam have in common is that they are difficult, if not impossible, to control. The longevity of the infestations in Israel and Florida attest to that fact.

The reason stems, in part, from the reproductive biology of many of these insects. Mated female shot hole borers tunnel into trees and create galleries, where they cultivate fungal gardens and lay eggs. The sex ratio among offspring is heavily biased toward females and brothers mate with sisters within the gallery. Only females fly, and mated females leave the gallery to create their own galleries for offspring production. Time spent outside the gallery is limited and beetles do not rely on sex pheromones for reproduction, making chemical control and trapping challenging.

A single mated female can initiate a new beetle population. Heavily infested trees appear to suffer from the sheer number of tunnels that may be bored into the xylem tissue as well as the growth of fungus introduced by the beetles. Hundreds of entry holes can be found on heavily infested branches. Branch dieback, fruit shriveling, and tree death have all been observed where infestations are severe. Like a combination knockout punch, the biology of the beetle and the beetle-fungus interaction make PSHB the most daunting pest-disease complex ever encountered by the California avocado industry.

The Commission began funding PSHB research soon after the pest was discovered in a backyard avocado grove in Los Angeles County in 2012. Since that time, more than $1 million has been committed toward monitoring the spread of the pest, understanding its biology and origins, searching for biocontrol agents, and examining various means of suppressing populations. Researchers at the University of California-Riverside have also looked to federal

sources, such as the U.S. Department of Agriculture (USDA), for funding, and several have been successful at receiving grants. The Commission advocated strongly before USDA's Animal and Plant Health Inspection Service in early 2014 on PSHB funding, and at CAC's appeal, California Secretary of Agriculture Karen Ross made PSHB the focus of a multi-agency Summit in May 2014 to broaden awareness of this latest invasive species and build upon the task force model used in similar situations.

Once PSHB appeared in commercial avocado groves in mid-2014, the Commission was able to commence field chemical trials based on previously conducted laboratory work. Much of the recent focus has shifted to the very difficult task of searching for chemical treatments that offer some promise of being either prophylactic or curative. With the assistance of researchers and industry members in Israel and Florida, a short list of chemicals was developed for testing here in California. Ultimately, however, materials will only be made available to California avocado growers following emergency use or full registration with the California Department of Pesticide Regulation, and efficacy must be proven under California conditions.

Work is also in progress on lure development and trapping. The idea is to use traps to detect the presence of PSHB before infestations become severe. Optimization of the lure may ultimately make traps more attractive to beetles, and although this, by itself, is not likely to become an effective means of control, as one scientist put it, "Every dead female beetle is one less chance of starting a new population."

At this juncture, the Commission's approach to the PSHB issue may be summed up as follows: 1) understand what is known about the pest-disease complex and what has been done worldwide, thus far, to control its spread; 2) bring experts together to provide the best independent and collective thinking about next steps; 3) identify any knowledge gaps and areas of research that either show promise or need to be done in order to advance toward our goal; 4) address the knowledge gaps by finding experts to do the necessary work and pooling resources with all parties interested in having that work performed; and 5) continue to raise awareness about PSHB across a broad cross-section of interests and advocate strongly for federal and state support for the exploration of potential solutions.

Tom Bellamore meets with Dr. Tom Atkinson, Dr. Dustin Meador and Jim Bethke to discuss PSHB strategies.

The situation warrants that the Commission remain engaged with key scientists working on PSHB so that informed and reasoned decisions can be made in the quest to find practical solutions for the grower. Toward that end, CAC Issues Management Director Ken Melban recently attended a technical workshop at the Instituto de Ecologica in Xalapa, Mexico, dedicated to *Xyleborus glabratus* and *Euwallacea* species. At that meeting, Ken made vital connections with researchers from Florida, Israel, Mexico, South Africa and Canada who had gathered to share the latest knowledge about these pests and control efforts to date. These direct contacts have already yielded dividends by guiding the consideration of chemicals being tested in field trials in California avocado groves.

Over the next several months, the Commission plans to tap the expertise of many of the experts Ken met in Xalapa, and invitations have been extended to several scientists to come to California to view the PSHB infestations in avocado groves first-hand. The motivation behind the invitations is simple: the more conversations that occur between the California researchers working on PSHB and their counterparts in other parts of the world, the more likely a new idea will emerge that warrants exploration. Collaborative problem-solving, heightened awareness, vigilance with respect to monitoring and early detection, and coalition-building to share resources are all part of the Commission's leave-no-stone-unturned strategy when it comes to addressing the most difficult invasive species ever encountered by California avocado growers.