UC Riverside Scientists Working Towards A Solution To Invasive Ambrosia Beetles In California Avocados

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Two closely related Ambrosia beetles (*Euwallacea* sp.) have been identified in commercial avocado groves in California. The polyphagous shot hole borer (PSHB), detected in Los Angeles, Orange, Riverside, San Bernardino counties and recently in Ventura county, and the Kuroshio shot hole borer (KSHB), detected in San Diego county, are morphologically indistinguishable, but genetically distinct. Already widespread in a variety of reproductive host trees common in the urban landscape (including box elder, willow, several maple, oak and sycamore species), the beetles represent a significant threat to trees in both landscape and agricultural settings. Adult females construct galleries in the xylem system of host trees, where they cultivate symbiotic fungi (*Fusarium, Acremonium and Graphium* spp.) as a food source for their developing young. The fungi are taken up by progeny females in specialized organs within their mouthparts, and transported to other sites within the same tree, where new colonies are established, or to newly colonized hosts. The galleries compromise the structural integrity of infested trees, which can represent a serious safety hazard in urban environments, and disrupt the flow of water and essential nutrients within the xylem. In addition to the physical damage, the fungi extract nutrients from the xylem system, further depriving the tree of nutrients essential for healthy growth and fruit production.

The control of Ambrosia beetles and their associated fungi using chemical pesticides is complicated because of their location inside the host trees. The application of insecticides to the external surfaces of trees, where the beetles must first alight prior to boring, has the potential to kill beetles by contact activity. However, once the beetle burrows inside the tree, surface treatments are largely ineffective. One possible solution to this problem may be the use of systemic insecticides, whereby beetles are targeted within the xylem system. Scientists at UC Riverside are evaluating the use of systemic insecticides and fungicides in a 2-pronged attack against the symbiotic system. The fungicides would target the fungus and deprive the beetle larvae of a food source, thereby preventing them from developing into adults. The insecticides would prevent the beetle from establishing galleries within susceptible tree hosts, and prevent the survival of beetles and their offspring already present within trees.

There are currently no systemic fungicides registered for use on avocados in California that will control the fungal pathogens associated with the shot hole borers. However, a Section 18 Emergency Exemption was issued by the EPA to Florida for the use of propiconazole (formulated as Tilt®) to control laurel wilt of avocados, a fungal pathogen that is cultivated within trees by the redbay ambrosia beetle. In laboratory studies, propiconazole has been shown to inhibit the growth of *Fusarium* sp.; hence the interest of the California avocado industry in pursuing a

Section 18 for the use of Tilt to manage *Fusarium* dieback in avocados. However, before a Section 18 can be approved in California, studies must be completed within the state that show residues in fruit do not exceed established temporary tolerance levels following certain application strategies. One such study was recently completed on Hass avocados cultivated at the South Coast Research and Extension Center. An important objective of the study was to compare flair root infusion and trunk injection applications of Tilt at different application timings. The study was conducted over a 16-month period and provided fruit residue data necessary to support the Section 18 application.

At the completion of the IR-4 fruit residue study, scientists at UC Riverside took wood core samples from the vascular tissue of the trees at 1, 3 and 5 feet above the infusion/injection sites to quantify the levels of propiconazole and determine the extent to which the fungicide had moved within the trees. Different groups of trees had been treated at 3, 12 and 16 months prior to the sampling, with a second series of applications occurring 3 months after the first. Tilt is not formulated for injection, so the researchers availed of the opportunity to assess how effective the different treatments were at establishing the fungicide in the tree. ~~The results were promising.~~ Propiconazole was detected in all samples, confirming that the fungicide had moved within the xylem. Regardless of treatment timing and application method, the highest levels of propiconazole were detected near the site of injection, with concentrations declining as the distance from the injection point increased. Interestingly, the highest concentrations within samples taken at 5 feet, where trees would be most vulnerable to beetle attack, were present in the most recently treated trees (treated at 3 months), suggesting that propiconazole ~~does~~ can establish within the tree relatively quickly. And, b~~B~~ased on the levels of propiconazole measured in trees treated earlier (16 months prior to sampling), the fungicide appears to persist within the xylem for over 1 year. While this residue data was promising, a series of bioassays in which the pathogen was exposed to wood cores that were cut from the treated trees indicated that the concentrations were insufficient to provide effective control of *Fusarium.*

The IR-4 study being conducted at the South Coast Research and Extension Center ~~will~~ was designed to provide critical data in support of ~~the~~ a possible Tilt Section 18 application. While the avocado industry is unlikely to proceed with an application because of the poor efficacy of Tilt in wood core bioassays, the study nevertheless highlights the type of work that is needed in order to support such applications. In addition, the data generated from the wood core samples has provided important information to researchers seeking to understand how effective injection methods are at delivering pesticides into trees, and will assist them in formulating treatment strategies for growers to use in the management of ambrosia beetles. UC field stations such as the South Coast Research and Extension Center are important resources available to researchers where research studies can be done on pesticides prior to registration. Such studies are often difficult to achieve in a grower cooperator's field because of mandated crop destruct.~~.~~ We greatly appreciate this Center being available to support IR-4 projects leading to future pesticide

registrations for California crops, as well as our research developing methods to manage newly invasive Ambrosia beetles.