California Avocado Society 2011 Yearbook 94:120-126

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A new beetle-fungus disease complex threatening avocado

Recently a new beetle/disease complex was detected that causes a Fusarium dieback on avocado and other host plants in and near Los Angeles County. The disease is caused by a new, yet unnamed *Fusarium* sp. that forms a symbiotic relationship with a recently discovered *Euwallacea* sp. beetle, which serves as the vector. This beetle is morphologically indistinguishable from the tea shot hole borer, *Euwallacea fornicatus* (an exotic Asian ambrosia beetle). We suspect that this is a new species (for which we propose the common name: Polyphagous Shot Hole Borer) based on the large differences in DNA sequence between the beetle invading California, and beetles from tea plantations in Sri Lanka and other Asian collection sites. The beetle discovered in California is smaller than a sesame seed (about 0.1 inch in length). The

Figure 1: An avocado tree in Israel exhibiting symptoms of beetle/disease (Mendel et al. 2012)

identical new beetle species was found in Israel in 2009 in commercial avocado orchards where it has been causing damage to avocado (Fig. 1,2).

Figure. 2: A failed main branch of avocado in Israel caused by the Fusarium dieback (Mendel et al. 2012)

Unlike the Redbay Ambrosia beetle, the vector of the Laurel wilt disease which has been infesting avocado and other members of the avocado family (Laureceae) in the Southeastern United States, the new beetle has been observed on more than 100 different plant species in California including many species common in the urban landscape and on such agriculturally important species as: avocado, olive, peach, guava, lychee, mango, persimmon, and pomegranate.

The beetle and fungus have a symbiotic relationship. When the beetle burrows into the tree, it inoculates the host plant with the fungus, which is carried in its mouthparts in a structure called a mycangia. The fungus attacks the vascular tissue of the tree which brings water and nutrients from the roots to the rest of the tree eventually causing branch dieback. The beetle larvae live in galleries within the tree and feed on the fungus.

The California Avocado Commission provided emergency funding to launch a research project since the beetle/fungus complex could cause serious economic damage to the California avocado industry if introduced into commercial plantings. A team of University of California, Riverside (UCR) researchers are collaborating as they study this problem.

Dr. Akif Eskalen and field specialist Alex Gonzalez from the Department of Plant Pathology and Microbiology are conducting a survey in Southern California to determine the extent of the beetle infestation and the likely extent of *Fusarium sp*. infection in avocado trees and other host plants. They are also investigating Fusarium dieback incidence within the commercial avocado groves and landscape trees. Dr. Richard Stouthamer, Paul Rugman-Jones and Tim Paine from the Department of Entomology are studying the biology and genetics of the beetle and are exploring insecticides that may be used to kill the beetle on the plant

surface before they enter the tree. Reuben Hofshi, of the Hofshi Foundation, is also gathering information about the beetle/disease internationally, and has been instrumental in obtaining beetle specimens from international cooperators.

According to survey data through July 2012, the easternmost limit appears to be the 57 Freeway with everywhere west of it in LA County infested. East of the 57 Freeway appears to be free of detections, thus far. South of the 57 Freeway is also infested, particularly areas in the Orange County areas of Fullerton, Anaheim, and down to Laguna Beach. In between those cites, the Irvine area appears to be free of the beetle. (Fig. 3).

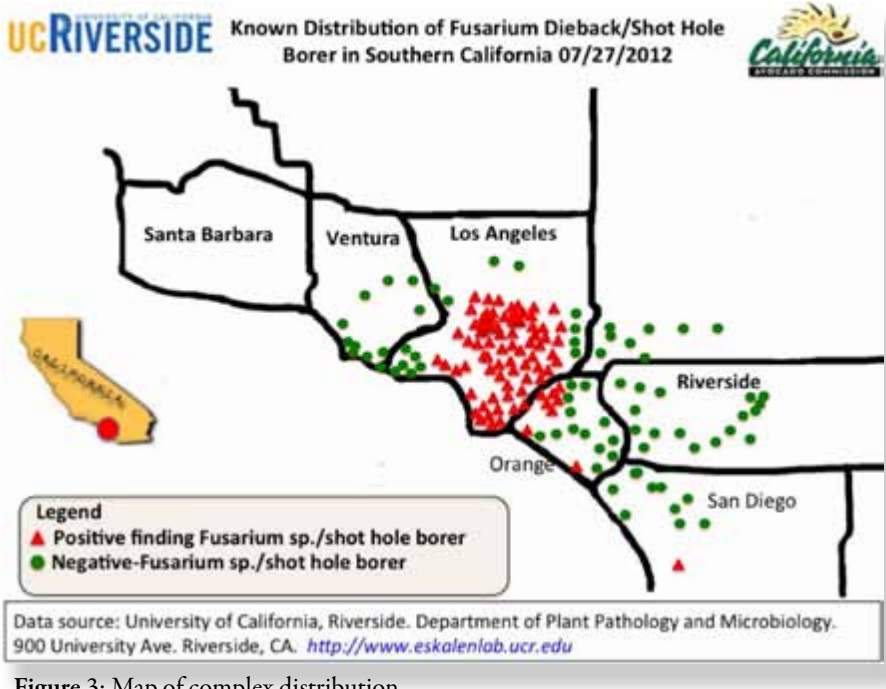

Figure 3: Map of complex distribution

Fusarium dieback symptoms

Symptoms of the disease on avocado include a white powdery sugar exudate that can be either dry, or surrounded by wet discoloration of the outer bark. (Fig. 4,5) This symptom can be in association with a single or multiple beetle entry/exit holes (Fig. 6,7). While there is no visible injury to the bark at this early stage of colonization, examination of the cortex and wood under the infested entry/exit hole bored by the beetle, reveals brown discolored necrosis caused by the fungus (Fig. 8,9).

Figure 4: White ring of sugar exudate surrounds the beetle entry/exit hole (A.Eskalen)

Figure 5: Limb damage showing sugar exudate (A.Eskalen)

Figure 6: A singe entry/exit hole covered by sugar exudate. (A.Eskalen)

Figure 7: Multiple entry/exit holes of beetle on an avocado branch (cv. Hass) (A.Eskalen)

Figure 8: An entry/exit hole of the beetle on Avocado bark (cv. Bacon) (A.Eskalen)

Figure 9: Typical Fusarium dieback symptoms, scraping the bark down to the wood behind the beetle entry/exit hole reveals brown necrotic tissue. (A.Eskalen).

The vector beetle

The beetle is a new *Euwallacea* species relative of the tea shot hole borer (an exotic Asian ambrosia beetle). It is very small and difficult to see (Fig. 10). The beetle holes penetrate approximately 0.4-1.57 inch into the wood and there are often many entry/exit holes on an infested tree. The exit hole on avocado is about 0.033 inch wide (Fig. 8). Females are black colored and about 0.07-0.1 inch long (Fig. 11), males are brown colored and about 0.05 inch long (Fig. 12).

Figure 10: Male (left) and female (right) beetles on a penny. (A. Eskalen).

Figure 11: Female beetle Euwallacea sp., 0.07 to 0.1 inch long and black. (G. Arakelian).

Figure 12: Male beetle Euwallacea sp., 0.05 inch long and brown. (G. Arakelian).

Known Hosts

Box elder *(Acer negundo)*, Castor bean *(Ricinus communis)*, Avocado *(Persea americana)*, Black locust *(Robinia pseudoacacia)*, English oak *(Quescus robur)*, Goldenrain *(Koelreuteriae elegans)*, Coast live oak *(Quercus agrifolia)*, Engelmann oak *(Quescus engelmannii)*, Sycamore

(Platanus racemosa), Big leaf maple *(Acer macrophyllum)*, California Bay Laurel *(Umbellularia californica)*, White alder *(Alnus rhombifolia)*, Olive *(Olea europaea)*, Peach *(Prunus persica)*, Persimmon *(Diospyros sp.)*, Mimosa *(Albizia julibrissin)*, Liquid amber *(Liquidambar styraciflua)*, Wisteria vine *(Wisteria sinensis)*.

What to do:

- Look for a single entry/exit holes with surrounding white powdery exudate on avocado. The symptoms may be different on different hosts such as different levels of staining and/or gumming.
- Scrape off the bark layer around the infected area to look for necrotic tissue.
- Follow the gallery to look for the discolored necrosis caused by the fungus.
- Certain plant species appear to be a preferred host for the beetle such as box elder, castor bean, English oak, sycamore, liquidambar, goldenrain tree and coast live oak. If such plants are present close to avocado groves, inspect them for evidence of the presence or damage by the beetles. The highest beetle exit/entry holes density is found at the base of the plant. If no beetle holes are present, it may be a good idea to remove the plants[1]. If beetle holes are found we do not yet have a proven way in which the plants can be destroyed without allowing the beetles to disperse.

Who to contact if you find the problem:

If you suspect that you have found this beetle or seen symptoms of the Fusarium dieback in your grove or surrounding areas in other host plants please contact either your local farm advisor, pest control advisor, county Ag Commissioner office, or the CAC office at 949-341-1955. You can also contact Dr. Akif Eskalen at the University of California, Riverside by either phone 951-827-3499, or email at akif.eskalen@ucr.edu for confirmation of the pathogen.

[1] Editor Note: Please check with local authorities prior to removing protected species.

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