

Common and Uncommon Diseases of Oak, Tanoak and Bay - New Diagnostic Tools Have Led to Important New Discoveries

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Although sudden oak death has been the primary concern for California oak woodlands over the last 20 years, other fungal pathogens of oak (*Quercus* spp.), California bay (*Umbellularia californica*), and tanoak (*Notholithocarpus densiflorus*) also occur in California. Many cosmopolitan Botryosphaeriaceae species with wide host ranges can invade oak and tanoak under stress conditions through wounds, causing perennial cankers in twigs and shoots and large bole cankers. Oak root rot caused by *Armillaria mellea* is widespread in native California soils and infected trees often exhibit cambium death and canopy dieback due to root colonization. White mycelial fans are often seen under the bark and cambium and the distinctive mushrooms may be present during the fall and winter months on the bases of infected trees. Species of *Ganoderma* can also cause root and butt rots of oak and other hardwoods. The large characteristic conks are generally found at or near the base of the tree and usually indicate advanced wood decay (Swiecki and Bernhardt 2006). Although macromorphological characters of some of these fungal pathogens make generic identification possible in the field, species-level identification for many fungi, including those in the Botryosphaeriaceae usually requires culturing onto media followed by DNA sequence analysis.

Our increased awareness of other pathogens associated with hosts of *Phytophthora ramorum* has coincided with the increased use of DNA-based techniques for fungal species identification. More than 2,000 new fungal species were described in 2017, and it is estimated that there are millions yet to be discovered (Niskanen et al. 2018). In 2018, a new *Tubakia* species (*Tubakia californica*) causing a foliar disease and twig dieback of Fagaceae species was described in California (Braun et al. 2018). Leaves of infected trees do not undergo typical defoliation in the fall. Instead, they remain attached, allowing the fungus to overwinter and release inoculum in close proximity to the new season's spring growth. Confirmed hosts of *T. californica* include California black oak (*Quercus kelloggii*), interior live oak (*Q. wislizeni*), coast live oak (*Q. agrifolia*), chinquapin (*Chrysolepis chrysophylla*), and tanoak. In 2010, a new leafspot disease of bay resembling Ramorum blight was documented in a Sonoma County area known to be infested with *P. ramorum*. Subtle differences in symptomology between this disease and those caused by *P. ramorum* led the collector to send the sample to the California Department of Food and Agriculture (CDFA) for identification. Culturing and PCR analysis revealed it to be a novel species of *Cylindrocladium* that has yet to be officially described. New DNA-based diagnostic tools have also detected the presence of many more Botryosphaeriaceae canker pathogens than previously known from oak, tanoak, and bay (Lynch and Eskalen 2014). *Dothiorella iberica*, *Botryosphaeria dothidea*, and multiple species of *Diplodia* and *Neofusicoccum* have all been confirmed on these hosts. Nearly all these species occur on agricultural and other hardwood hosts and cross infection is likely occurring. As the Plant Pest Diagnostics Lab continues to receive more samples, we are placing greater emphasis on using molecular, sequence-based

diagnostic approaches to detect existing and new pathogens. These techniques have not only improved the accuracy and reliability of the Plant Pest Diagnostics Lab's determinations but have also increased our knowledge of the diversity of fungal pathogens in California.

References

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