Identification of Five New Hosts of *Phytophthora ramorum* in an Infested Forest in California[1]

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Abstract

Phytophthora ramorum causes stem and bole cankers (sudden oak death) and foliar and twig dieback (ramorum blight) of susceptible plants. To date, more than 100 tree, shrub and herbaceous hosts of *P. ramorum* have been identified. In March 2015, plant samples were submitted to the CDFA Plant Pest Diagnostics Lab from the Marin Municipal Water District for disease analysis. The samples were collected near Bolinas Ridge in Marin County, CA in a maritime chaparral-live oak woodland forest with a history of *P. ramorum* and *P. cinnamomi*. The collectors noticed a large amount of unusual die-back in many plant species earlier in the drought year and were concerned that the plants were infected with *P. cinnamomi* or other *Phytophthora* root pathogens. Manzanita species (*Arctostaphylos canescens*, *A. sensitiva*, *A. virgata*), chinquapin (*Chrysolepis chrysophylla*) and chaparral pea (*Pickeringia montana*) were submitted for diagnosis. Isolation from the roots onto PARP media from samples was attempted even though the roots appeared healthy. No *Phytophthora* sp. grew on isolation plates and no *Phytophthora* spp. were detected from the roots using the Agdia *Phytophthora* spp. specific immunoassay. The *Arctostaphylos* and *Pickeringia montana* samples contained foliar tissue with leaf spot, vein necrosis and stem canker symptoms which were tested separately for *Phytophthora*. *Phytophthora* spp. was detected from the leaf spots and stem cankers from the *Pickeringia montana* and some of the *Arctostaphylos* spp. by immunoassay. In addition, *P. ramorum* was detected in culture and confirmed by sequence analysis from the symptomatic foliage of these hosts.

In April 2015, a second visit was made to the site to obtain official samples for regulatory purposes. In addition to the hosts collected initially, *Arctostaphylos glandulosa* and *Rubus ursinus* (California blackberry) were collected for testing for *P. ramorum*. On some *Arctostaphylos* plants, the leaves on entire branches were completely brown while the cambium was still green. Both mature and young foliage were affected. On some manzanita plants, the older foliage seemed more broadly affected, while on others the newest foliage on the growing tips was the most symptomatic. Chaparral pea plants exhibited small leaves that were necrotic with some partially defoliated. Cankers on the plants were located near the nodes with numerous necrotic areas on the short thorny stems. *Phytophthora ramorum* grew from isolated foliar and stem blight symptoms of *Pickeringia montana, A. virgata* and *A. glandulosa. Phytophthora ramorum* DNA was also detected from foliar leaf spot symptoms of blackberry using a species specific qPCR. Isolations from blackberry were unsuccessful on PARP media. Declining chinquapin trees appeared drought stressed with dry, chlorotic, and off-colored leaves. Affected branches and root suckers were collected and dark vascular streaks were seen in the xylem tissue when the bark was removed. These symptoms were seen in fully grown trees and young seedlings. *Phytophthora*

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ramorum DNA was isolated in culture onto PARP medium from the vascular streaking in a single tree but tested positive by PCR for *P. ramorum* from multiple trees.

Although the Bolinas Ridge area in Marin County, CA is known to be infested with *P. ramorum*, five new associated hosts of *P. ramorum* were identified at this site. *Arctostaphylos virgata* is endemic to Marin County and is listed on the California Native Plant Society Inventory of Rare and Endangered Plants. The severe leaf and stem blight symptoms seen on *A. virgata* and *A. glandulosa* differ from those previously described on *A. manzanita*, but are similar to those on other ericaceous hosts. Chaparral pea (Fabaceae) is an endemic shrub to California that occurs along the coast and in the foothills of the Sierra Nevada Mountains. Difficulty in sampling its thorny stems may have contributed to it being overlooked as a host of *P. ramorum* in the past. Chinquapin has been suspected as a host of *P. ramorum*; log inoculations indicated it was susceptible. This is the first report of *P. ramorum* being isolated from symptomatic chinquapins in the wildlands. The dark vascular streaking associated with infection by *P. ramorum* suggests that *P. ramorum* may also be a wilt pathogen on some members of the *Fagaceae*. Pathogenicity experiments are ongoing and are dependent on obtaining the proper species for testing.