Metabolite Profiling to Predict Resistance to *Phytophthora ramorum* in Natural Populations of Coast Live Oak[1]

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Abstract

Sudden oak death, caused by the invasive oomycete pathogen *Phytophthora ramorum,* continues to shape the dynamics of coastal populations of oak (*Quercus* spp.) and tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh) in California and tanoak in southwestern Oregon. Over the last decade, high mortality rates have been reported in natural populations of coast live oak (CLO; *Quercus agrifolia* Née) in California, raising concerns for the integrity of important coastal ecosystems. However, it is now recognized that in spite of high infection and mortality rates, asymptomatic CLO have persisted.

Though the mechanisms of persistence are not known, putative phenolic biomarkers of oak resistance to the pathogen have been identified and include tyrosol hexoside pentoside, ellagic acid, and total phenolics. To test the accuracy of these biomarkers in predicting resistance within natural populations of CLO, we quantified biomarkers in 148 mature trees from two naïve stands in Briones Regional Park, East Bay Regional Park District, Contra Costa County, California. Those trees were then inoculated with *P. ramorum* to assess their resistance by measuring resulting cankers approximately 10 months after inoculation. We applied a predictive model to estimate survival based on canker lengths. This model predicted that 18 percent of inoculated trees have an 80 percent probability or greater of being resistant, with 85 percent of those trees containing one or more biomarkers at or above resistant threshold levels. Current efforts are focused on identifying novel biomarkers, which may better predict resistance in naïve populations of CLO. Additionally, to account for phenology as a potential source of variation in CLO phenolics, we measured biomarkers every season from December 2010 to November 2011 in 14 randomly selected control trees. We found no significant differences among seasons in the putative phenolic biomarkers tyrosol hexoside pentoside, ellagic acid, and total phenolics.

Mitigation of disease, via exploitation of host resistance, is one of the most effective and economically feasible management strategies for keystone tree species in forested ecosystems. The ability to identify resistant trees in natural populations of CLO, before they are attacked by the pathogen, through development of relatively easily measureable biomarkers, could be incorporated into disease management plans aimed at preserving resistant trees which could otherwise be lost to urban encroachment, fire, or other destructive disturbances.