

Effects of Environmental Variables on the Survival of *Phytophthora ramorum* in Bay Laurel Leaves¹

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Abstract

Bay laurel (*Umbellularia californica* (Hook. & Arn.) Nutt.) is the primary reservoir host of *Phytophthora ramorum* Werres, De Cock & Man in't Veld in coastal California woodlands. Non-lethal foliar lesions on bay laurel trees support the majority of pathogen sporulation during the winter wet season and appear to provide the primary means of surviving through California's arid Mediterranean summers. Previous experiments have shown that the proportion of symptomatic bay leaves from which *P. ramorum* can be successfully isolated decreases during the summer. In addition, isolation of *P. ramorum* from bay laurel leaves was less at the end of the dry season within mixed evergreen forests when compared to redwood-tanoak forests. These experiments also suggested a positive correlation between bay laurel stem water potential and summer isolation frequency from leaves. A more thorough understanding of the environmental and physiological constraints on the summer survival of *P. ramorum* will assist in the development of SOD risk assessments.

A field study was conducted to investigate environmental and phenotypic correlates of isolation success from bay laurel leaves in the summers of 2005 and 2006. In 2005, 10 trees were monitored at both a mixed-evergreen forest (Fairfield Osborne Preserve) and a redwood-tanoak forest (Jack London State Historical Park). These two sites are approximately 5 km apart on opposite sides of Sonoma Mountain. An additional 31 trees were added in 2006 at 10 sites located in the Sonoma and Mayacmas mountain ranges. Temperature, relative humidity, and vapor pressure deficit data were obtained from weather stations and data loggers placed at each site. Midday stem and leaf water potential was measured with a portable pressure bomb. Both asymptomatic and symptomatic leaves were photographed and analyzed for leaf size and shape, lesion size, and for percent lesion coverage. Survival was measured by isolating from 10 symptomatic leaves from each tree at each timepoint. Isolates from each site were compared for aggressiveness on leaves taken from a single bay laurel tree. Susceptibility of bay trees found at each site were compared by inoculating asymptomatic leaves with either a cocktail of regional isolates, or a single commonly-used lab strain of *P. ramorum*.

The proportion of symptomatic bay laurel leaves from which *P. ramorum* could be successfully isolated fell during both summers. The final proportion of successful isolations varied significantly between sites and years, although the relative differences between sites appeared constant. Large amounts of variation were found within sites that could not be explained by environmental differences. This is likely due to heterogeneous resistance to *P. ramorum* within the bay laurel population. Leaves taken from different trees displayed different resistances to lab inoculations. Leaves removed from bay laurel trees in the late summer appeared to be more resistant to inoculation than those removed in other seasons. This may be due to a direct induced resistance to *P. ramorum* or to indirect resistance mediated by phenological responses to summer environmental conditions. Isolation success

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was associated with phenotypic traits such as leaf size in addition to canopy exposure and midday stem and leaf water potential. Overall it appears that the survival of *P. ramorum* in bay laurel leaves is affected by both a heterogeneously resistant bay laurel population and environmental variables. The survival of *P. ramorum* within bay leaves may be affected by the light interception of individual leaves. The apparent death of the mycelium could be due to direct physical stresses of irradiance such as low water potential, or to indirect physiological changes, which are being tested in lab, growth chamber, and future field experiments.

Key words: *Phytophthora ramorum*, *Umbellularia californica*, sudden oak death, survival, climate.