

In Vitro Foliage Susceptibility of Canary Islands Laurel Forests: A Model for Better Understanding the Ecology of *Phytophthora ramorum*¹

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Abstract

The tree species that dominate the cloud-zone forests of Macaronesia, the coastal redwoods of California, the Valdivian forests of Chile, the Atlantic forests of Brazil and the podocarp forests of New Zealand are all examples of paleoendemic species that once had a much wider distribution. They appear to owe their survival to the particular environmental conditions provided by coastal sites or oceanic islands. Some of these coastal areas unfortunately have proved unique scenarios for the establishment and spread of exotic aerial *Phytophthoras* such as *P. ramorum* and *P. kernoviae*. The most reasonable explanation to these invasions is that these ecosystems share climatic and taxonomic affinities with the pathogen's original localities and hosts, but not the defence strategies evolved during the long arms race between the host(s) and pathogen in their original centre. In other words, they have not coevolved into tolerance relationships. Then it would be expected that forest ecosystems showing higher taxonomic affinities to those of the original centre would show more tolerance to the pathogen than those less related. This explanation assumes, however, that (i) there is a common basal defence system in plants (Heath 1991) to which multiple host pathogens, such as *P. ramorum*, are trained to overcome and (ii) a relative ancestral origin of these *Phytophthoras*. We provide the results of *in vitro* foliage inoculations of plant members of the Canary Islands laurel forest as a model for a better understanding of the ecology of *P. ramorum*, as well as a biogeographic link between sudden oak death (SOD) and the possible center of origin of *P. ramorum* in southeast Asia or the Indomalayan archipelago.

In order to differentiate between nonhost resistances due to preformed defence barriers (constitutive defence) and nonhost resistance due to induction of basal defence system (inducible defence), we carried out both wounded and unwounded inoculations. In the first experiment completed in the spring of 2005, leaves were wound inoculated with mycelial plugs. In the second experiments done in the spring of 2006, healthy leaves were inoculated with zoospores. Five isolates, three belonging to the EU1 lineage and two to the NA1 lineage, were used in these assays.

Thirteen tree species belonging to the Lauraceae, Ericaceae, Caprifoliaceae, Aquifoliaceae, Theaceae families showed different responses to *P. ramorum* infection when detached leaves were inoculated with zoospores (unwounded) and mycelium plugs (wounded). They also

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showed diverse capabilities to sustain *P. ramorum* sporulation. Only two species, *Apollonia burbujana* and *Visnea mocanera*, did not form any lesion both in the wound and zoospore inoculations and neither showed hypersensitive response when leaves were examined by dissecting microscope. *Picconia excelsa* and *Heberdenia excelsa* developed necrotic lesions only in the wound treatment; therefore, resistance being due to preformed barriers. All the other species formed necrotic lesions in both experiments. Surprisingly, all species inoculated, even those that did not developed necrosis, sustained to some degree *P. ramorum* sporulation. Interestingly, symptoms on species of the laurel family somewhat reminded those observed on leaves of bay laurel in California. Although most foliage did not show dramatic symptoms when inoculated (tending to tolerance), there seems to be a high risk of establishment if *P. ramorum* is introduced into the laurel forests, considering the plant community composition, structure and prevalent climatic conditions in these ecosystems. Our results suggest that a high host diversity would not decrease the risk of disease transmission.

Based on these and other experiments, two main driving forces are proposed which may determine *P. ramorum* lifestyle: the constraint on short-distance dispersal in a high species diversity forest (e.g. laurel forests), and the fitness costs caused by the need for a multiple-host strategy, which seems to be associated with reduced sporulation (Moralejo and others 2006). Casual observations of asymptomatic infection and sporulation from asymptomatic inoculated foliage are in accordance with the infection and dispersal strategies hypothesized for *P. ramorum*.

Key words: Alien species, nonhost resistance, *Phytophthora* sporulation, disease transmission, fitness cost.

Literature Cited

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