

# The Effect of *Phytophthora ramorum* on the Physiology and Xylem Function of Young Tanoak Trees<sup>1</sup>

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## Abstract

Tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, C.H. Cannon & S. H. Oh) is highly susceptible to *Phytophthora ramorum*. Symptoms include stem cankers, shoot dieback, and foliar blight. The mechanism by which *P. ramorum* kills the trees is not known, however. In this study we aimed to determine what physiological factors contribute to tanoak mortality when trees are infected with *P. ramorum*, and to investigate the relationship between elicitin secretion and disease symptoms. In growth chamber experiments, we investigated how photosynthesis, stomatal conductance, water usage, and stem-specific hydraulic conductivity were affected following inoculation of young tanoak trees with *P. ramorum* isolates that differed in elicitin secretion.

In experiments with 2-year-old tanoak saplings, stems of 60 trees were wound inoculated with one of three treatments, including a high-elicitin expressing *P. ramorum* isolate (PR-07-058[NA2]), a low-elicitin expressing *P. ramorum* isolate (4353[NA1]), or a noninoculated wounded control. Physiological parameters including photosynthesis and water usage were measured weekly for 5 weeks. Sets of trees from each treatment were sampled destructively twice monthly to measure the conductive properties of stem xylem tissue and to examine for the presence of tyloses. There was a large difference between the high- and low-elicitin treatments in stem hydraulic conductivity as early as week 2 of the experiment. Significant treatment differences were also observed in tree mortality. Trees inoculated with the high-elicitin expressing isolate died sooner and at a higher rate than trees inoculated with the low-elicitin expressing isolate. Photosynthesis and stomatal conductance began to decline 3 weeks after inoculation. This experiment was potentially compromised by differences in growth rate of the two isolates, so the experiment was repeated with high- and low-expressing NA2 isolates with similar growth rates.

Tanoak seedlings (2- or 3-months-old) were inoculated with one of three treatments: PR-05-002 (high-elicitin producing isolate), PR-05-166 (low-elicitin producing isolate), or a sterile V8 agar plug. Photosynthesis, stomatal conductance, water usage, and stem-specific hydraulic conductivity were measured twice weekly for 2 weeks when inoculated trees began to die. Net photosynthetic rate and stomatal conductance were significantly reduced in both sets of inoculated trees as compared to the wounded control trees by day 12 after inoculation. Stem-specific hydraulic conductivity was significantly reduced as early as 7 days after inoculation. There were few significant differences between the low-elicitin expressing and the high-elicitin expressing treatments.

The rapid decline in stem hydraulic conductivity in *P. ramorum*-inoculated trees, with a concomitant reduction in net photosynthetic rate and stomatal conductance, is consistent with the hypothesis that *P. ramorum* interferes with stem water transport. No clear role for elicitin secretion in pathogenesis was observed.

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