Latent Infection by *Fusarium circinatum* Influences Susceptibility of Monterey Pine Seedlings to Pitch Canker

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Pitch canker, caused by *Fusarium circinatum*, is a serious disease affecting *Pinus radiata* D. Don (Monterey pine) in nurseries, landscapes, and native forests. A typical symptom of pitch canker is canopy dieback resulting from girdling lesions on terminal branches (Gordon et al. 2001). More extensive dieback can result from coalescing lesions on large branches or on the main stem of the tree. The severity of disease depends, in part, on susceptibility of the individual tree. Some will suffer no more than a few infected branch tips, whereas others sustain extensive damage and may ultimately die from the disease, often in conjunction with other forms of stress. However, some trees that become severely diseased eventually recover, with the absence of new infections attributed to systemic induced resistance (Gordon et al. 2011). To date, induced resistance in Monterey pine has been examined only in mature trees, but the disease can also affect seedlings, with potentially significant impacts on regeneration. Although the pitch canker pathogen can be a cause of mortality in seedlings, those that are not killed may remain infected without showing symptoms (Gordon et al. 2001, Storer et al. 2001). The present study was undertaken to determine if seedlings with symptomless infections manifest systemic-induced resistance to pitch canker.

To establish symptomless infected seedlings, seed was sown in sand infested with either 100 or 1,000 propagules per gram, referred to as the low and high inoculum treatments, respectively. Control seedlings were grown in non-infested sand. Six months after sowing, symptomless seedlings representative of each treatment were challenge inoculated by depositing a suspension of 1.25×10^4 spores per ml into a 1.0 mm diameter wound on the main stem. Susceptibility to pitch canker was quantified as the length of the lesion developing at the site of inoculation.

The results showed that resistance was significantly increased in seedlings previously exposed to the pathogen ($P < 0.001$). Stem lesions were 32 to 54 percent shorter than controls in the low inoculum induction treatment and 63 percent shorter in the high inoculum treatment (fig. 1). In addition, a greater proportion of plants appeared healthy in the high inoculum treatment, compared to untreated plants ($P = 0.033$) (fig. 2).

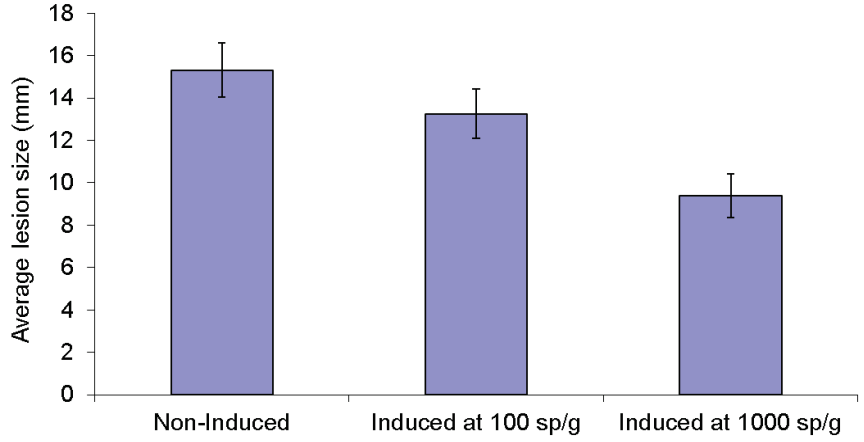

Figure 1—Lesion sizes on inoculated trees (n=60) 19 days after inoculations.

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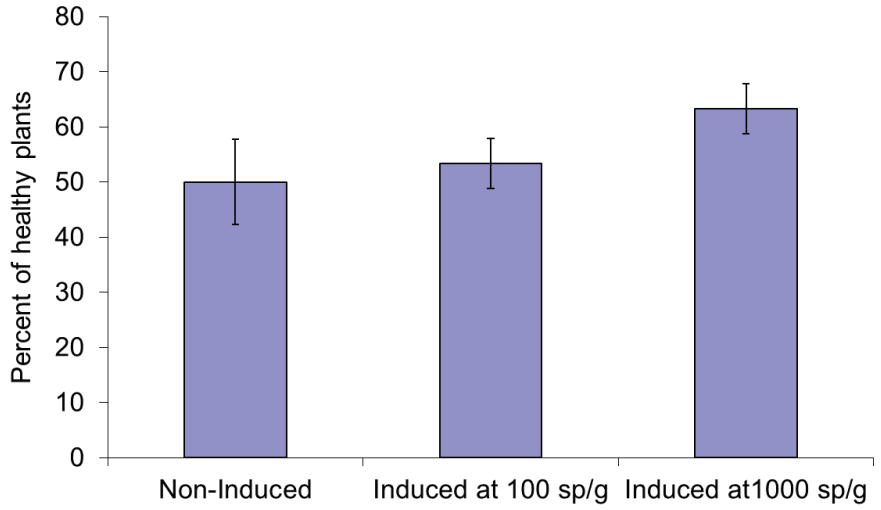

Figure 2—Percent of plants (n = 60) appearing healthy 19 days after inoculation.

Similar results were obtained in experiments using 18-month-old seedlings, suggesting that systemic-induced resistance can persist as seedlings mature. Together, these results indicate that symptomless root infections can induce systemic resistance in seedlings, potentially enhancing survival rates.

The growth-defense balance hypothesis predicts that increased expression of secondary metabolic pathways associated with disease resistance will decrease allocation of resources to growth. Contrary to this prediction, plant growth was not reduced in induced plants (fig. 3).

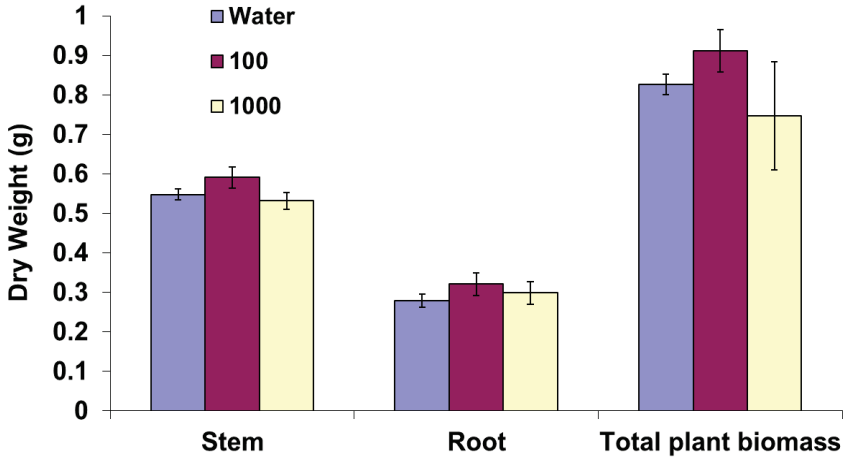

Figure 3—Effect of induced resistance on plant growth.

This is the first study to describe systemic-induced resistance in tree seedlings, and offers insight into the ecological role of *Fusarium circinatum* as an endophyte. If subsequent studies confirm these findings, we aim to determine if similar effects can be documented to occur under natural conditions. If so, it will be of interest to know what factors determine whether infections at the seedling stage result in death or a longer lasting association that may enhance resistance to subsequent challenge by the pitch canker pathogen.

Literature Cited

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