

Ethanol Attracts Scolytid Beetles to *Phytophthora ramorum* Cankers on Coast Live Oak¹

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Abstract

Successful infection of coast live oak (*Quercus agrifolia* Née) stems by *Phytophthora ramorum* results in the formation of a canker visible initially at the bark surface by the release of a dark red to black colored exudate referred to as “bleeding.” Bark and ambrosia beetles are often attracted to diseased trees within the first year after bleeding cankers appear, and bore their gallery entrance holes almost exclusively within the canker boundaries, suggesting the presence of a primary attractant. These attacks accelerate tree mortality. Ethanol concentrations were analyzed in sapwood samples collected from paired diseased and healthy trees at three study sites in California. Samples from diseased trees were taken inside and outside of the boundaries of small spot cankers and larger cankers at the stem base. Trees with large basal cankers contained 4.3 times more sapwood ethanol than trees with spot cankers. Sapwood from within cankers had the highest concentrations, with 4.3 and 15.5 times more ethanol than sapwood from 1 cm or 15 to 30 cm outside the canker boundary, respectively. Paired healthy trees had the lowest sapwood ethanol levels.

Insect traps were installed at all three sites and baited with ethanol, ethanol+ (-)- α -pinene, or ethanol+ 4-allylanisole (4AA) lures. The three most abundant scolytids captured were *Xyleborinus saxesenii*, *Pseudopityophthorus pubipennis*, and *Monarthrum scutellare*, with considerable variation among sites. These species have all been trapped previously on *Q. agrifolia* trees inoculated with *P. ramorum*. Traps baited with ethanol only captured significantly more total scolytid beetles, *X. saxesenii*, and *P. pubipennis* than the traps where ethanol was combined with (-)- α -pinene or 4AA, except for *P. pubipennis* captured in traps with ethanol+4AA.

In another experiment, a 50 percent aqueous ethanol solution was sealed in the sapwood of *Q. agrifolia* logs. The bark surface immediately above the ethanol infused sapwood then received one of six treatments: 1) sprayed with an antitranspirant (Moisturin) solution to block ethanol release, 2) sprayed with (-)- α -pinene, 3) attached an ultrahigh release pouch of (-)- α -pinene, 4) sprayed with both antitranspirant and (-)- α -pinene, 5) sprayed with antitranspirant plus attached an ultrahigh release pouch of (-)- α -pinene, and 6) no bark treatment control. The bolts were placed at two of the study sites for 8 weeks (26 May to 21 July, 2011), and the number of combined bark and ambrosia beetle attacks were counted within the area of treated bark. In control logs, the number of beetles attacking the bark above the ethanol infused sapwood was 4.4 times greater than on the opposite side of the log where ethanol was absent in the sapwood. The attachment of an ultrahigh release pouch of (-)- α -pinene was the only treatment on the bark surface that impacted the beetles, reducing their densities to 19.1 percent of the attacks on logs without these pouches.

Elevated ethanol concentrations in *P. ramorum* cankers on *Q. agrifolia*, and the attraction of bark and ambrosia beetles commonly associated with these cankers to traps or logs baited with ethanol, provides strong evidence that ethanol is the primary attractant for these insects.

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