INFLUENCE OF OLEORESIN CONSTITUENTS FROM Pinus ponderosa AND Pinus jeffreyi ON GROWTH OF MYCANGIAL FUNGI FROM Dendroctonus ponderosae AND Dendroctonus jeffreyi

T.D. PAINE* and C.C. HANLON

Department of Entomology
University of California
Riverside, California 92521

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Abstract—Dendroctonus jeffreyi and D. ponderosae are morphologically similar sympatric species of pine bark beetles over portions of their geographic ranges; however, D. jeffreyi is monophagous on P. jeffreyi while D. ponderosae is highly polyphagous. Both species carry a species of mycangial fungi that are also very similar in appearance. Growth of the two mycangial fungi and of the fungus Leptographium terebrantis (associated with the polyphagous and non-tree-killing Dendroctonus valens) in the presence of oleoresin constituents of host and nonhost conifers was tested by placing individual chemicals on agar growth medium and by growing the cultures in saturated atmospheres of the chemicals. The fungus associated with D. jeffreyi showed greater tolerance for chemical constituents placed on the growth medium than the other two fungi, and growth after three days was enhanced by heptane, the dominant constituent of P. jeffreyi oleoresin. Growth of all three species of fungi was reduced by the resin constituents when the chemicals were presented as saturated atmospheres. The results suggest that the influence of the tree on growth of the symbiotic fungi of the bark beetles during the initial attack process may be different than after colonization by the beetles is complete. The difference in the responses of the apparently related species of mycangial fungi may provide some new insight into the evolutionary history of these beetle/mycangial fungus/host tree systems.

Key Words—Dendroctonus, Pinus, Coleoptera, Scolytidae, bark beetles, mycangial fungi, inhibition, host resistance, monoterpenes, Ponderosa pine, Jeffrey pine.

*To whom correspondence should be addressed.
INTRODUCTION

*Dendroctonus ponderosae* Hopkins is a highly polyphagous primary bark beetle, colonizing 12 species of pines, including *Pinus ponderosa* Laws., in North America (Wood, 1982). *Dendroctonus jeffreyi* Hopkins, a species sympatric with *D. ponderosae*, is monophagous on *P. jeffreyi* Grev. & Balf, a host-plant species not utilized by *D. ponderosae*. The two beetle species were synonymized by Wood (1963), but were separated by Lanier and Wood (1968) on the basis of host range and subtle morphological difference. In addition, Smith (1965) described physiological differences between the two bark beetle species.

*Pinus jeffreyi* is considered to be an older species than *P. ponderosa* (Fowells, 1965), although the two species were in synonymy at one time (Munz and Keck, 1968). The current distribution of *P. jeffreyi* includes southern Oregon, California, and northern Baja California, while *P. ponderosa* is broadly distributed throughout western North America (Fowells, 1965). The geographic distributions the two pine species overlap in California. However, *P. jeffreyi* is often associated with slightly drier and colder sites than *P. ponderosa* (Fowells, 1965). Although not common, these two pines will occasionally form natural hybrids (Mirov, 1929).

Both *D. ponderosae* and *D. jeffreyi* are closely associated with specific fungi that are carried between host trees in maxillary mycangia of both sexes (Whitney and Farris, 1970; T.D. Paine, unpublished data). *D. ponderosae* is associated with *Ophiostoma clavigerum* (Robins.-Jeff. & Davids.) Harrington. A mycangial fungus with characteristics that are very similar to characteristics of *O. clavigerum* has been isolated from *D. jeffreyi* (T.D. Paine, unpublished data) but has not been described as a separate species or as a form of *O. clavigerum*. These fungi are inoculated into trees during colonization by the beetle. The pines have two principal defenses against invasion by insects or infection by microorganisms: the preformed resin contained within resin ducts immobilizes or intoxicates colonizers, and an induced reaction isolates invading organisms with resinous necrotic lesions. The primary resin of *P. ponderosa* is predominantly monoterpane and resin acids; the resin of *P. jeffreyi* is composed primarily of n-heptane (Mirov, 1929; Smith, 1967; Anderson et al., 1969; Smith, 1971). The primary resin of *P. ponderosa × P. jeffreyi* hybrids is intermediate in character between the two parent species (Smith, 1963, 1967, 1982) (Table 1).

*Dendroctonus ponderosae* and *D. jeffreyi* overlap in geographic distribution in California as do the distributions of *P. ponderosa* and *P. jeffreyi*. The beetles and their mycangial fungi appear to be closely related, but the host ranges of the insects do not overlap. Smith (1963, 1965) demonstrated that the resin volatiles from the proper host were nontoxic to adult beetles, but volatiles from nonhost pines caused mortality. However, it is not known how the resin con-