BIOCHEMICAL MECHANISMS OF DISCOLOURATION, DECAY, AND
COMPARTMENTALISATION OF DECAY IN TREES

by

W. C. Shortle
USDA Forest Service, P.O. Box 640, Durham, New Hampshire 03824, U.S.A.

Summary
Research on discoloration and decay (pathogenesis), and on compartmentalisation of decay (protection) in living trees has been conducted by Shigo, Shortle, and associates for more than 20 years. As they enter their third decade of pioneering research, it seemed appropriate to list, in chronological order, 100 papers that show a progressive understanding of the highly complex systems involved in tree decay. Thirteen review papers are listed from 1965 to 1984. These papers recognise the contributions of many scientists and attempt to expand our thinking about how trees decay and how trees respond to limit the internal spread of decay. The 87 research papers cited were published from 1962 to 1983, and constitute the major contributions which form the foundation for ongoing research into biochemical mechanisms for discoloration, decay, and compartmentalisation of decay in trees.

Decayed wood in living trees arises from discoloured wood which is formed after the wood, vascular cambium, and phloem are exposed by wounding. The discoloured wood is a transition state between sound wood, which may be in one of several forms: sapwood (the immediate product of cambial derivatives), heartwood (a dry transformation product of sapwood), or wetwood (a wet transformation product of heartwood, or a form of discoloured sapwood). Being in a state of transition from wood that is essential sound (properties of cell walls substantially unaltered) to wood that is becoming decayed (cell wall substances decomposing), discoloured wood will have physical, chemical, and biological properties that are highly variable. The causes of variation are complex and involve the wood protoplasts (ray and axial parenchyma), decay fungi, and microorganisms that develop in discoloured wood along with decay fungi. Shifts in the oxidative metabolism of wood protoplasts cause the concentration of secondary metabolites, which help to plug and preserve wood, to rise relative to the concentration of primary metabolites useful as food to tree, decay fungus, and microorganisms alike.

Ionisation of wood by the decay fungi and their associates counters the protective transformations of the host and reverses the nutritional balance of soluble wood substances. This accelerates the physiological activity of decay fungi, which begin to decompose cell wall substances. Shifts in metabolism triggered by injury and infection attain a maximum efficacy in layers at the boundary of discoloured wood by transformation of extant sapwood, or by transformation of anomalous wood formed from cambial derivatives in response to injury and infection. These layers wall off, or compartmentalise, decay in trees, thus limiting its spread. Variations in the compartmentalisation response may be caused by genetic variation or external stresses.

Review Papers, 1965 to 1984


Research Papers, 1962 to 1983


