Compartmentalization of Decay Associated with Fomes annosus in Trunks of Pinus resinosa

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The author gratefully acknowledges the assistance of Cynthia Cocks, Jonathan Carter, H. William Pottle, Paul Berry, Chad Pilling, Robert Blanchette, and Denis Grimard, and of Northeast Electronics, Concord, N.H., for support that made the study possible.

ABSTRACT

Decay associated with *Fomes annosus* in 26 *Pinus resinosa* trees was compartmentalized in the trunks. The decay was confined to the wood present in the trunk at the time the fungus grew from the root into the root collar. The new wood that continued to form in the trunk was not infected. The healthy wood was associated with vigorous lateral roots.

Phytopathology 65:1038-1039

Additional key words: decay in living trees, tree root rots.

Decay associated with wounds on tree trunks is compartmentalized or confined to the wood present at the time of wounding (1, 2, 3). Additional compartments of discolored and decayed wood may develop later if additional wounds are inflicted. Compartmentalization of wound-initiated infections is a major defense mechanism in trees. An understanding of compartmentalization is essential to the understanding of the decay process in living trees.

An aspect of the decay process that is not well understood is the tree's response to decay advancing upward into trunks from roots. This condition is common with most root rots. To help clarify this portion of the decay process, dissections and examinations were made of roots and trunks of *Pinus resinosa* Sol. infected with *Fomes annosus* (Fr.) Karst.

MATERIALS AND METHODS.—Ten living, but declining, *P. resinosa* trees with sporophores of *F. annosus* at their root collars were dug on the Massabesic Experimental Forest in Alfred, Maine, in 1974. The trees were 28 years old and 20-30 cm in diameter at 1.4 m aboveground. The plantation had been thinned twice, and infections by *F. annosus* were first observed 8 years ago. Large sporophores were common on many stumps.

After the trees were dug, the roots were washed thoroughly to remove all soil; and the trunks were cut at the root collar and 2 m above. The bark was removed from the 2-m trunk bolt, and it was cut into smaller bolts each 20 cm long. Each 20-cm bolt was split longitudinally to map the configuration of the infected wood. From each small bolt, six wood chips 3 × 3 × 10 mm were taken from the decay; and six chips were taken from the discolored and resin-soaked wood contiguous to the decay. The chips were placed in a medium consisting of 10 g malt extract, 2 g yeast extract, and 20 g agar in 1 liter of distilled water. After 10 days incubation at 25 C, the microorganisms growing from the chips were identified.

After the root sections were washed, the bark was removed. Disks 5 cm thick were cut consecutively from the root collar downward. The configuration of the infected wood in each disk was diagrammed.

To examine entire columns of discoloration and decay, six additional trees were dug out, and longitudinal dissections were made with a chainsaw from 2 m above the root collar downward through the roots. All sections were smoothed by sanding to allow better examination of the configuration of the columns.

Longitudinal and transverse dissections were made with a chainsaw on 10 additional trees dug from the same area and from the Bear Brook State Park, Allentown, New Hampshire. The procedures described were used to examine the pattern of decay in the trunks and in the roots.

RESULTS.—The wood chips from the 10 trunks yielded almost exclusively *F. annosus* from the decayed wood and the contiguous resin-soaked wood.

In all 26 trunks examined, the infected wood was confined to the wood present at the time the fungus killed the root collar (Fig. 1). In most trees, *F. annosus* advanced only a few centimeters in the cambial zone above the root collar. The fungus advanced to 2 m above the root collar in only two trees.

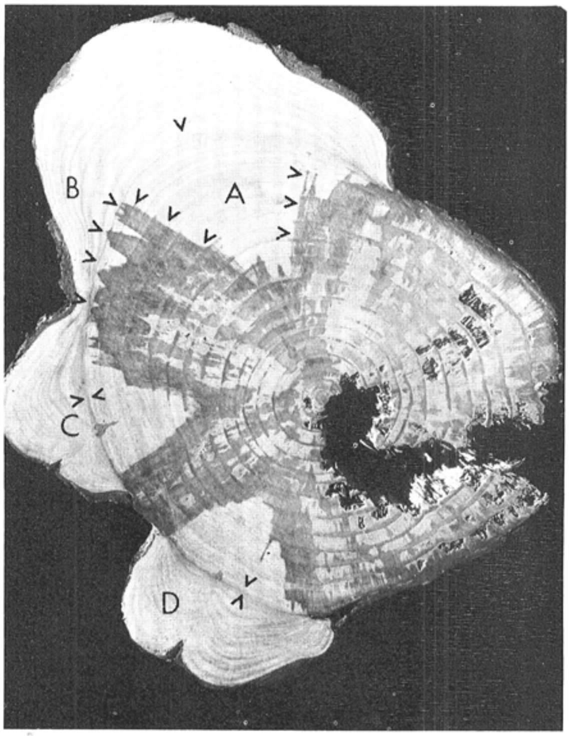

Fig. 1. Compartmentalization of decay associated with *Fusarium annosus* at root collar of *Pinus resinosa*. A, C, and D are vigorus lateral roots. Each root maintained a wedge of healthy wood into the tissues present when the root collar was infected. Each wedge is bordered by resin-soaked wood as shown by the arrows in the A root area. The arrows in the B, C, and D areas indicate diameter of the trunk when portions of the root collar were killed. The wood that formed after this was not infected. The resin-soaked wood in the B area stopped at the arrows.

When the fungus killed a portion of the circumference of the root collar, the tree responded in the same way as it would when wounded. The amount of circumference at the root collar that was killed depended on the size and number of the infected roots. The large taproot had the most advanced decay in all trees. The most advanced trunk decay was on the side of the tree that had no lateral roots (Fig. 1). The bases of these trees were slightly flattened. In some large trees, large vigorous lateral roots were present (Fig. 1).

The roots were associated with noninfected wood, even within the cylinder of wood that was present when the portion of the root collar was killed (Fig. 1). These roots had compartmentalized the infection, not only by forming healthy tissues in the wood that formed after root-collar kill, but by forming another compartment wall along the rays inward (Fig. 1). The healthy radial tissues along the rays were heavily resin-soaked. They were wedge-shaped. This type of compartmentalization accounted for the jagged configuration of the resin-soaked wood and decayed wood in the trunk where columns of decayed wood and resin-soaked wood were separated by wedges of clear healthy wood (Fig. 1).

DISCUSSION.—The resin-soaked wood yielded *F. annosus,* which indicates that the fungus can remain alive in these tissues. It seems that in *P. resinosa, F. annosus* grew from rootwood to trunkwood in 1 year. In two trees, the fungus grew so rapidly that cambium to several meters above the root collar was killed. When *F. annosus* grew into the cambium of the root collar, the trees responded by walling off the infection. If trees did not respond this way, then every root-rotting fungus would have an easy access to all the trunk tissues and would quickly kill the tree.

The vigorous noninfected lateral roots sustained the life of the trees. Each vigorous lateral root compartmentalized its tissues. Compartmentalization of infected tissues is a major survival system in trees.

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