FOREST MANAGEMENT NOTE

Note 52 *Northwest Region*

THE TRAP-LOG METHOD OF DETECTING ARMILLARIA ROOT ROT PATHOGENS IN FOREST SOILS

Armillaria root rot, a serious disease of forest trees in Canada, is caused by several species of the wood decay fungi, *Armillaria*, which afflict both conifer and hardwood trees of all age classes. The disease causes root and butt rots that can lead to mortality, growth losses, understocking, susceptibility to blowdown, and pest problems. The purpose of this note is to describe the trap-log method (Mallett and Hiratsuka 1985) of detecting Armillaria root rot pathogens in forest soils.

Disease Source

Armillaria root rot was at one time thought to have been caused by a single fungus, *Armillaria mellea* (Vahl ex Fr.) Kummer. It is now known that there are many different species of *Armillaria* capable of causing the disease, but in the prairie provinces only two species are commonly present, *A. ostoyae* and *A. sinapina* (Mallett 1990). *Armillaria ostoyae* is probably the most common and destructive species in western Canada, but it is difficult to distinguish between the two species.

Disease Symptoms

Trees affected by the disease may or may not show foliar symptoms: a diseased tree's foliage may yellow and then turn red as the tree dies, and the needles may or may not be retained. Young infected conifers often have shortened internodes, and they may develop a stress crop of cones. The fungus causes a yellow, stringy wood rot in the butt and roots. A white mycelial fan beneath the bark in the root collar is diagnostic for the disease.

Affected trees often die in patches, known as disease or root rot centers, which may be distinguished from areas of blowdown by the orientation of the fallen tree stems. Trees that have died from root rot in disease centers often lie crisscrossed on the ground; trees that have been blown over by high winds lie parallel to one another.

Disease Location

The fungus can live for many years in roots or pieces of wood in the soil. It produces rhizomorphs: shoestringlike structures that grow (sometimes for several meters) from infested woody debris—stumps or roots—through the soil, in search of tree roots to infect. The fungus can also spread through root-to-root contact.

It is often difficult to know the exact distribution of the fungus: dead and dying trees can indicate the presence of disease in the stand, but this does not fully delimit the extent of fungus growth in the soil. Knowledge of fungus location in a stand, a recent cutover, or a high-value plantation such as a seed orchard is very important in making the decisions that affect disease management.

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TRAP-LOG METHOD

Preparation

Trap-logs are small sharpened stakes that are placed in the soil to bait *Armillaria* species. They are made from healthy saplings that have been selected, cut, and delimbed. Many different species of trees may be used, but, in western Canada, experience has shown that trap-logs of trembling aspen or balsam poplar are most effective. Trap-logs made from poplar species retain the necessary intact bark for long periods of time in moist soils, whereas the bark of those made from pine or spruce dries out quickly and splits. The trap-logs should be approximately 35–50 cm long, 5–8 cm in diameter, be sharpened on one end, and have bark that is neither rough nor furrowed. A cool, shaded place is required for storing trap-logs, which must be used within a few days of cutting.

Placement

Trap-logs are usually driven into the soil to a depth of about 20–30 cm: it is important that the portion of trap-log beneath the soil have bark on it, and the duff around it must not be removed. Trap-logs can be set any time before the soil freezes. If an *Armillaria* species is present in the soil near trap-logs, its rhizomorphs will grow toward the trap-logs and attempt to colonize them (Fig. 1). In western Canada, trap-logs should not be left in the ground for more than one year because they will be colonized by other fungi.

Removal

Between 4 and 12 months after installation, the trap-logs should be dug up carefully to avoid damaging any attached rhizomorphs. The trap-logs can be examined, either in the field or when brought back to the laboratory, for evidence of rhizomorphs (Fig. 2) attached to the bark, anywhere from soil line to sharpened end. Rhizomorphs look similar to tree roots but are often brownish red in color; when broken open, their interiors have the appearance of white cotton wool. Also evident may be mycelial fans of the fungus that have developed underneath the bark of trap-logs (Fig. 3) left in the ground for 12 months before being dug up.

Following the examination of trap-logs, maps can be constructed to show areas of infestation (Fig. 4).

Reliability

This method has been used to detect with reliability *Armillaria* species in soils where the disease was already present in trees (Mallett and Hiratsuka 1985): trap-logs located on different sites were colonized by *Armillaria* species only on those sites where the disease was known to be present.

No information is currently available on the exact number of trap-logs needed to assess a site for root rot potential. However, if more than 10% of the trap-logs on a site are colonized, managers should consider assessing the site for further evaluation or control measures: in a high-value stand or plantation, for example, remedial action should be taken.

A positive trap-log (one colonized by *Armillaria* species) indicates that an *Armillaria* species is in the soil at the trap-log's location and that infested woody material must be nearby. It is important to recognize that different species of *Armillaria* vary in their ability to cause disease. At present these different species cannot be easily recognized in the field and must be identified by laboratory procedures.

RECOMMENDATIONS

The trap-log method can be used to detect *Armillaria* in the soil for a variety of purposes:

1) The technique can be used in recent cutovers to determine if *Armillaria* species are present in areas that were suspected of having root rot in the previous stand. To determine if a stump or a standing tree in the cutover is infested, four trap-logs should be placed around it, approximately 1 m apart and about 1 m from the stump or tree.

2) The technique can be used in a similar manner in mature forests to determine the presence of the fungus in the soil and its location in the stand. In this case, the number of trap-logs used will depend on the desired sampling intensity (Fig. 4).

3) Stands that are scheduled to be harvested should be examined for disease centers before harvesting takes place, and the centers marked. Trap-logs can be used at the edges of the disease centers to determine the distribution of the fungus in the soil of otherwise-healthy stands

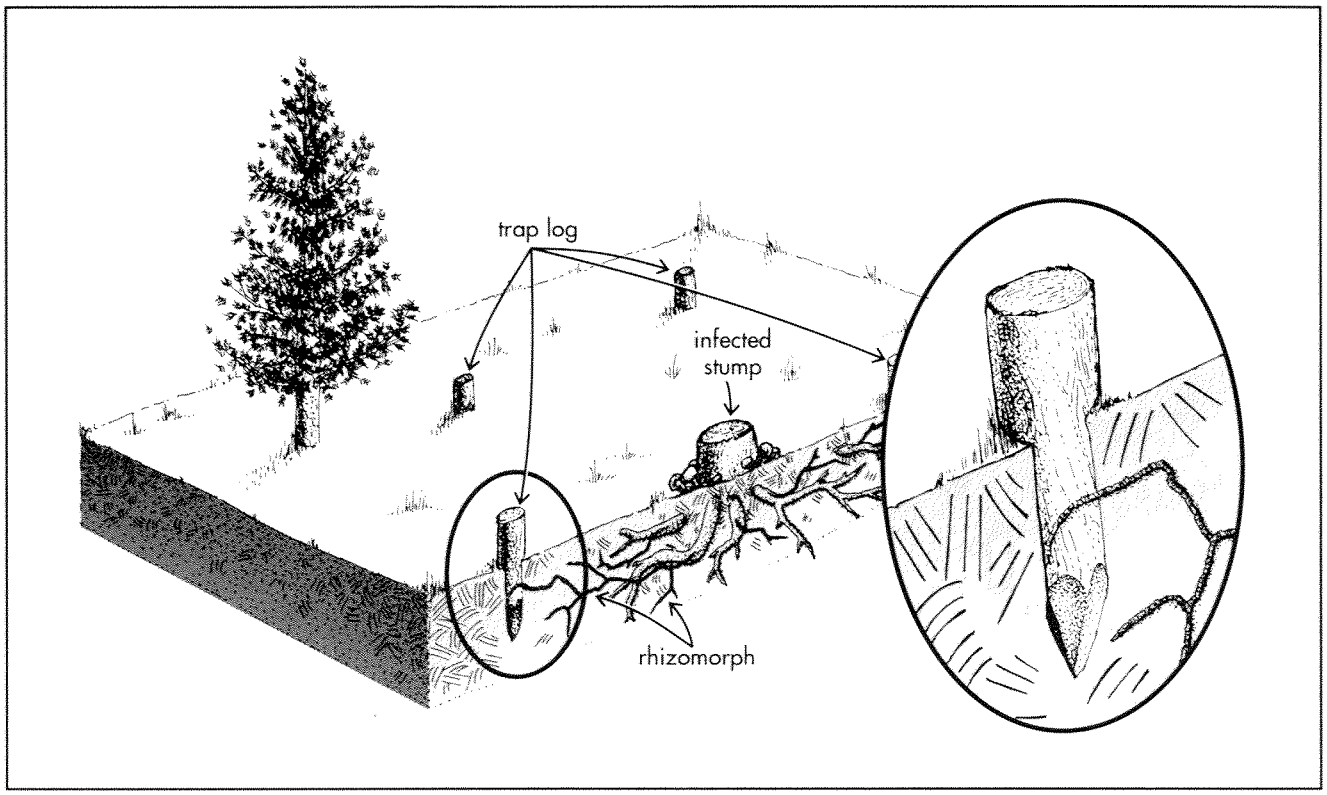

Figure 1. Rhizomorphs from an Armillaria-infested stump attempting to colonize trap-logs.

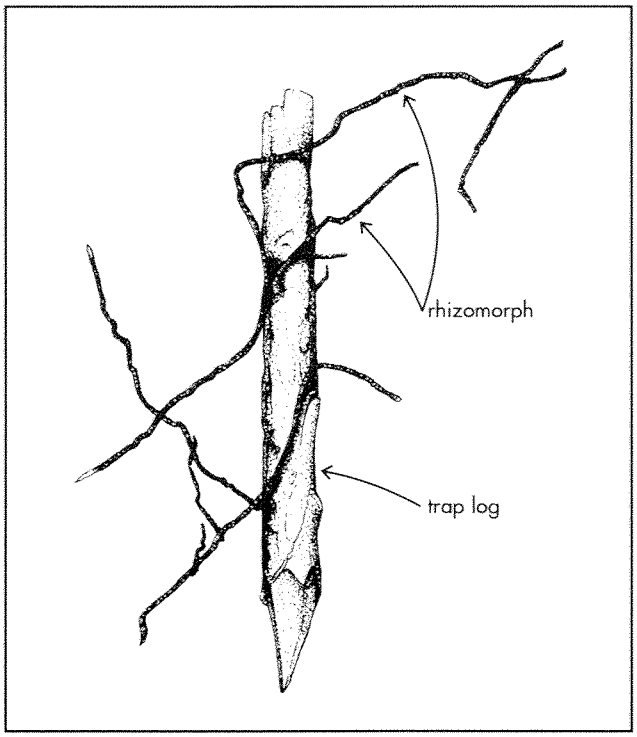

Figure 2. Rhizomorphs growing from an infested root.

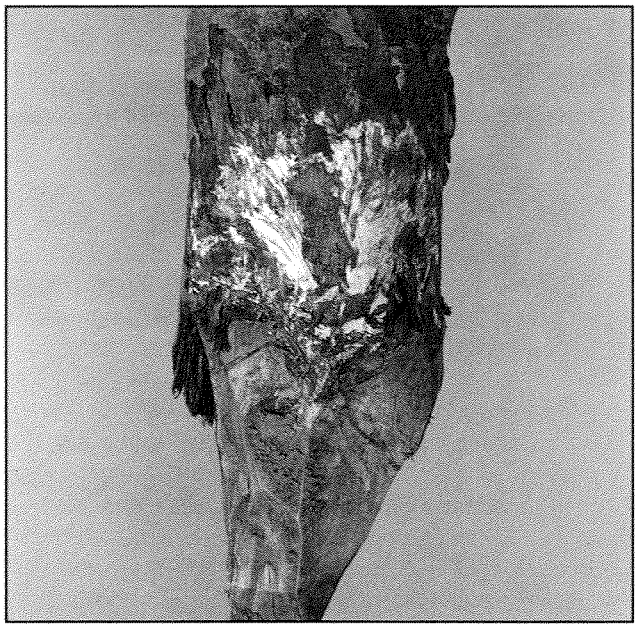

Figure 3. Trap-log with bark removed to show a white fan of mycelium. (Reproduced with permission from the National Research Council [Mallett and Hiratsuka 1985].)

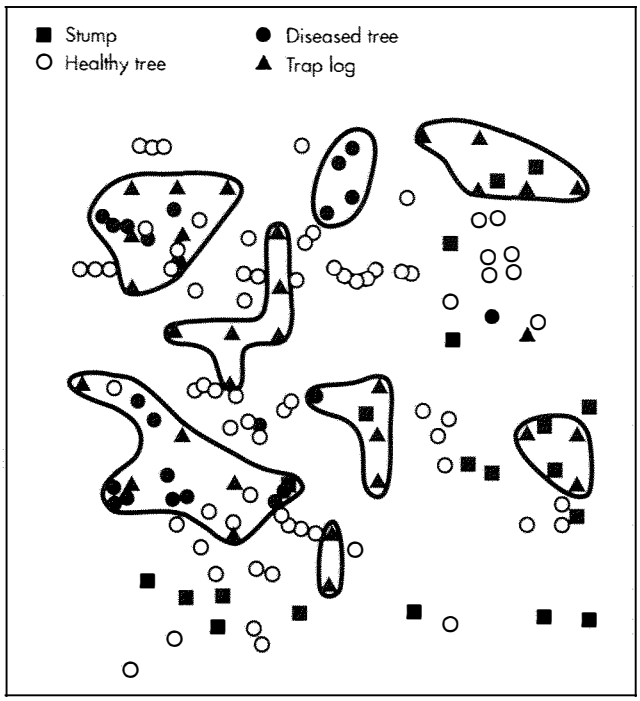

Figure 4. Schematic diagram of a trap-log plot, showing trap-logs that were positive for Armillaria (enclosed areas). (Reproduced with permission from the National Research Council [Mallett and Hiratsuka 1985].)

(Fig. 4). The trap-logs should be placed about 1 m apart, either around the periphery of a disease center or in grid patterns around suspected stumps or diseased trees, to determine the location of the fungus in the soil.

4) The method should be used before the trees are planted in high-value plantations to determine the location of any existing fungus in the site. The method can also be used in an existing plantation with diseased trees to determine the extent of the fungus in the soil.

In all cases, mapping the location of the fungus enables control measures such as stump removal or ditching to be carried out with a greater chance of success.

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