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Management Guide for Annosus Root Disease (Pine-Type)

Heterobasidium irregulare (Fr.) Bref.. (= Fomes annosus (Fr.) Cke.)
See explanatory note regarding naming conventions for this fungus.

P-type Host:
Primarily Ponderosa pine

S-type Hosts:
- Douglas-fir
- Engelmann spruce
- western redcedar
- western hemlock

In northern and central Rocky Mountain forests, butt rot develops with infection in spruce, true firs, and western hemlock. Mortality is common in pines and Douglas-fir.

Introduction

Annosus root disease is a white root and butt rot of many conifer species throughout the western United States and many other temperate forest ecosystems (Hodges 1969). It is caused by the fungus Heterobasidion annosum (Fr.) Bref.. Annosus root disease occurs in both old growth and regeneration, and has long been recognized in many forest types in the northern and central Rockies.

In Intermountain forests, butt rot is associated with infection in spruce, true firs, and western hemlock and outright tree mortality is more common in pines and Douglas-fir (Hagle 1985, Byler and Hagle 1985). Bark beetles often attack infected trees (Byler 1989, Ferrell and Parmeter 1989, Hadfield et al. 1986).

Key Points
- P-type annosus is a threat to ponderosa pine, S type is not.
- Fresh stump surfaces can lead to new infections and increase inoculum.
- Chemical stump protectants are the only practical method available for P type annosus control in managed forests.

Overview of Annosus Root Disease Management in Pines

1. Assess the need. In many areas, pine-type annosus appears not to be present or not to cause significant damage. In areas with the threat of p-type annosus, preventing spread and intensification of the disease at the time of harvest or commercial thinning is the only practical measure.

2. Chemical. Protect fresh stump surfaces that are 14 inches diameter or greater from surface infection by spores.
**About Types of Annosus**

**Similar but Genetically-Distinct Types of Annosus**

*Heterobasidion annosum* in western North America consists of two intersterility groups or biological species. These two types, 's' and 'p', have very different host specificities.

**Ponderosa pine is the main host for the p-type.**

The hosts for the s-type include true firs, Douglas-fir, Engelmann spruce, western red cedar, and western hemlock.

This host specificity is not apparent in stump infections; both groups have been isolated from "non-host" stumps without causing disease in neighboring "host" trees (Lockman 1993, Otrosina and Cobb 1989, Kliejunas 1986).

**Click here for a discussion of S-Type annosus root disease management.**

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### Life history

Annosus root disease can spread in several ways. *H. annosum* in a diseased tree can infect a healthy neighboring tree by ectomycelium growing across root contacts, if the neighboring tree is a susceptible species. *H. annosum* can also spread by airborne spores (Hodges 1969, Hsiang et al. 1989). When spores land on a newly cut stump or fresh basal wound they may germinate and colonize the wood if conditions are favorable.

Spore infections are usually limited to the tops of freshly cut stumps in pine species (Otrosina and Cobb 1989), while freshly cut stumps and fresh basal wounds are susceptible to infection in other species (Schmitt et al. 1984). The newly infected stump or tree may then initiate a new disease center by root-to-root contact.

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### Stump Diameter and Infection

In a Forest Health Protection (FHP) survey in California, only ponderosa pine stumps greater than 14” in diameter were found to be infected with *H. annosum* (DeNitto 1988). Another FHP survey in California looked at the lower limit of stump diameter on which *H. annosum* was an effective pathogen in eastside pine type stands. In this survey, 75 of 83 disease centers had stumps >18” as an apparent source of infection (DeNitto 1985). Although various studies show infection occurring in stumps as small as 6.0”, field observations and mortality surveys in California indicate that only stumps greater than 16.0” routinely cause disease in neighboring trees (Kliejunas 1989).

A survey done in southern Idaho indicated stump size did not affect infection center initiation in ponderosa pine. The average diameter of stumps initiating annosus root disease centers was 22.3” and ranged from 11” to 31”. Smaller stumps were not observed in the survey, likely due to stump deterioration and/or the lack of smaller trees at the time of cutting (Marshall and Hoffman 1983).

In western Montana, the size of ponderosa pine stumps infected after a commercial thinning averaged 14.5”, and ranged from 9.0” to 32.0” (Hagle unpublished). It remains to be seen what size of stumps lead to disease and mortality in surrounding trees.
Incidence of P-type annosus

P-type annosus root disease is quite common on the Flathead Indian Reservation in western Montana, and is becoming common on several national forests in western Montana. A survey was completed in Region One on the Lolo NF in 2002 and the Bitterroot NF in 2003 to determine the incidence of p-type *Heterobasidion annosum* (Meyer comp. 2003). Surveyed stands were in the ponderosa pine forest type, with mature harvesting 20+ years ago and 30+ acres in size. Stumps in ten percent or more of these stands were surveyed to determine the incidence of *H. annosum* fruiting bodies.

Twenty-five percent of the surveyed stands on the Lolo NF contained *H. annosum* fruiting bodies (n=48), with an average infected stump diameter of 25.5". Over 70% of the surveyed stands on the Bitterroot NF contained *H. annosum* fruiting bodies (n=42), with an average infected stump diameter of 31.1".

S-type annosus root disease is quite common throughout true fir types in western Montana and north Idaho. Less is known about the incidence of s– and p-type in eastern Montana.

Management of P-type Annosus

Silvicultural Management

P-type annosus is routinely found acting as the only root disease agent in ponderosa pine stands. The sites where annosus root disease has been recognized as a problem are sites where ponderosa pine is the most suitable and desired tree species, so species conversion is not a viable management option.

The trend today in managing ponderosa pine is to use multiple entries to maintain old growth or to intensively manage second growth ponderosa pine. Presently, there are few known areas in northern and central Rockies with extensive mortality from p-type *H. annosum*, but with repeated entries into ponderosa pine stands, it appears to be only a matter of time before the fungus colonizes sufficient stumps and causes disease in residual trees. Once annosus root disease becomes established in a stand, there is no economically feasible procedure for directly suppressing the disease. Preventing introduction of the disease is the most efficient and economical method of reducing the impact from *H. annosum*.

When damage from *H. annosum* is already extensive, stump treatments will not be effective. At this point in stand development, favoring less affected species during stand entries is recommended.

Preventing Stump Infection

Control of p-type *H. annosum* has traditionally been accomplished by protecting freshly cut stump surfaces from infection. Chemicals such as borate compounds have a history of success (DeNitto 1993, Kliejunas 1989). The need for

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<table>
<thead>
<tr>
<th>National Forest</th>
<th>Positive <em>H. annosum</em></th>
<th>Ave. Stump Dia. (in.)</th>
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<tbody>
<tr>
<td>Lolo</td>
<td>12 (25%) (n=48 stands)</td>
<td>25.5 (n=11)</td>
</tr>
<tr>
<td>Bitterroot</td>
<td>30 (71%) (n=42 stands)</td>
<td>31.1 (n=35)</td>
</tr>
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</table>
Preventing Stump Infection (continued)

stump protection in the Northern Region has not been definitively demonstrated, but is highly recommended when managing ponderosa pine. Stump treatments in Region One are presently recommended in ponderosa pine stumps 14” and greater in diameter in ponderosa pine stands in western Montana.

Although there is no environmental reason preventing its occurrence in eastern Montana, P-type annosus root disease has not been identified in eastern Montana, and as such, stump treatments are presently not recommended.

Biocontrol using competing wood decay fungi

Biocontrol agents, such as *Phlebiopsis gigantea* (Fr.) Jul., have been used with success as stump treatments in other parts of the United States and in Europe, but have not been tested in the Northern Region. Biocontrol agents as stump treatments in the Northern Region warrant more investigation.

Recognizing Annosum Root Disease

Trees with annosus root rot may display typical root disease symptoms. Infected trees may have faded, chlorotic crowns, reduced needle retention, reduced growth, stress-induced cone crops, resin-soaked and discolored wood, and decay in the roots and butts.

Incipient decay appears as yellow-brown to red-brown stain. Advanced decay is characterized by a white stringy or spongy mass, which may contain small black flecks running parallel to the grain.

*H. annosum* fruiting bodies (i.e. sporophores or conks) can sometimes be found inside decayed hollowed stumps, just under the duff layer at the base of infected pines, and also as small "button conks" on the outside of infected roots and root collars on all susceptible species. Annosum fruiting bodies are perennial, woody to leathery, with dark brown upper surface and white to cream-colored lower surface with very small pores. "Button conks" are small, corky mounds of sterile tissue, and are generally cream-colored.

Culturing and/or incubating the decayed wood and observing the imperfect stage of the fungus, *Spiniger meineckellus* (A.J. Olson) Stalpers, may be necessary for positive identification of the decay.
Literature Cited


Explanatory note:

Scientific names for the two species of fungi that cause annosum root disease in North America are now firmly established. *Heterobasidion occidentale* (Otrosina & Garbel.) causes annosum root disease (fir-type) and *Heterobasidion irregulare* (Garbel. & Otrosina) causes annosum root disease (pine-type). The sections for annosus root disease in this management guide were written while these names were still somewhat tenuous or not yet proposed, and therefore the name of *H. annosum* was still being used for both. In addition, there is discussion presented in regards to the possible delineation between the two fungi, and the biology of two inter-sterility groups (S-type and P-type) of the fungus *H. annosum*.

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