

# Effectiveness Of Stump Removal In Reducing Annosus Root Rot Losses In Christmas Tree Plantations

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Annosus root rot, which is caused by *Heterobasidion annosum*, has become a serious problem in a number of Christmas tree plantations in the PNW. Thirty to forty percent of Fraser and noble fir trees have been killed prior to harvest in some plantations. Unlike Phytophthora root rot, Annosus root rot can occur on highly productive, well-drained sites.

The fungal pathogen that causes Annosus root rot spreads via two methods. Initial infection in Christmas tree plantations probably occurs when fruiting bodies on diseased trees and stumps in nearby forests release airborne spores that spread the disease to the plantations. Once the disease becomes established, fruiting structures can be produced on stumps within a plantation and spread the disease to nearby freshly-cut stumps during harvest. After the spores land on freshly-cut stumps, which are susceptible to infection for only a short period of time, they germinate and begin to colonize it. Preliminary studies in plantations show that spore dispersal can occur throughout late fall when trees are harvested and the treatment of freshly cut stumps with materials like Sporax is aimed at protecting healthy stumps from infection by these spores.

Once infected, stump treatments are not effective in preventing the spread of the fungus into the stump's roots and then into the roots of adjacent healthy trees that are in contact with the colonized roots. In addition, seedlings can also become infected when their roots come in contact with the diseased roots and stumps left over from the previous crop. The buildup of Annosus in a plantation takes place over a period of years.

Stump removal prior to planting is commonly recommended as one approach to minimize development of this disease in forest settings. The fungus that causes Annosus root rot does not compete well against other microorganisms that are present in the soil. Thus its potential to cause disease in a new planting is largely dependent on the size of the pieces of infected roots and stumps that are left in the field, the susceptibility of the newly planted trees, and the time it takes for the seedling's roots to come in contact with infected roots and stumps.

How effective is stump removal in reducing the development of this disease in Christmas tree plantations? During the past three years, we have been monitoring the development of Annosus root rot in 21 Christmas tree fields in Oregon and Washington. Each of these fields had previously produced one or more crops of true fir Christmas trees and was replanted between 1997-2000. These fields contained about 34,000 trees. In 2001, we determined how many trees were missing or had been replanted in each field. Then during 2001, 2002, and 2003, we monitored how many trees were killed by Annosus root rot.

In a portion of the fields at three sites, growers had removed the stumps prior to replanting and thus provided us an opportunity to determine the effectiveness of this treatment in reducing losses caused by this disease. One field had been planted with Fraser fir, one with noble fir and the other was planted with grand fir.

Although the highest level of mortality during the 3-year period we monitored the 21 fields was almost 40%, the highest mortality in the three fields was about 14%. Removal of stumps in all three fields caused a significant reduction in the number of missing/replanted trees and the number of trees that died during the past 3 years (Table 1). Based on the data from these trials, stump removal would have reduced losses during the past three years by 87 to 146 trees per acre (Table 2). If estimated losses are based on the total losses since planting, stump removal would have been expected to reduce losses by 103 to 228 trees per acre.

Losses associated with Annosus root rot are not just limited to the number of trees killed prior to harvest. In fields with high levels of disease, many growers harvest trees earlier in the rotation in an effort to reduce the number of trees killed prior to harvest. By doing this, the trees are smaller and thus have a lower market value. Postharvest studies have also shown that diseased trees that are harvested prior to being killed do not have as good a keepability as healthy trees.

While stump removal did not eliminate Annosus root rot from the sites in these studies, it did significantly reduce the extent of losses from this disease. In the portions of the fields where the stumps were removed, they were removed right after harvest and then replanted. At this point it is unknown what effect planting a cover crop and delaying replanting until the next year might have on disease development. It is also unclear how effective other approaches of stumps removal, such as grinding, would be in reducing losses.

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Table 1. Effect of stump removal prior to replanting on the extent of losses associated with Annosus root rot.

Species	Stumps removed prior to planting	% of trees missing/replanted prior to 2001	% of trees killed 2001-2003	Total losses(%)
Noble fir	No	6.8	13.9	20.7
	Yes	0.5	2.7	3.2
Fraser fir	No	11.2	7.0	18.2
	Yes	0.4	0.3	0.7
Grand fir	No	1.1	9.5	10.6
	Yes	0.7	2.0	2.7

Table 2. Estimated increases in the numbers of healthy trees per acre associated with stump removal

Species	2001-2003 period	Total losses(%)
Noble fir	146 <sup>1</sup>	228
Fraser fir	87	227
Grand fir	98	103

<sup>1</sup>Assumes planting density of 1,300 trees per acre