Frontline EXPRESS
Canadian Forest Service, Great Lakes Forestry Centre

Bulletin No. 6

EPIDEMIOLOGY OF ARMILLARIA ROOT DISEASE IN PLANTATIONS

INTRODUCTION:

The fungus *Armillaria ostoyae* causes the most common and damaging root disease in coniferous forests across Canada. In British Columbia the disease is especially damaging in the southern interior where many stands contain diseased trees. When a mature stand is clearcut, the stump and root system of trees that were infected by *A. ostoyae* are colonized and become inoculum. Planted trees can be infected by the fungus when their roots grow into contact with colonized stump roots or when fungal rhizomorphs produced from the stump contact tree roots.

Research at the Pacific Forestry Centre on development of Armillaria root disease in plantations includes (1) recording the incidence and distribution of the disease in two Douglas-fir plantations from establishment to age 50; (2) determining disease incidence using aboveground symptoms compared with the actual belowground incidence; and,

Trees killed by *Armillaria ostoyae* in a Douglas-fir plantation.

(3) recording the incidence and distribution of root disease in a multi-species plantation established following removal of root disease inoculum (destumping).

LOCATION/SITES:

The research, most of which is ongoing, is conducted throughout the range of *A. ostoyae* in the southern interior of British Columbia. The sites are located in the Interior Cedar-Hemlock and Interior Douglas-fir biogeoclimatic zones.

RESULTS:

Disease development in Douglas-fir plantations:

The temporal and spatial distributions of mortality caused by *A. ostoyae* have been monitored in 2-ha plots in two Douglas-fir plantations for 30 years. Mortality began about 6 years after planting near colonized stumps of the previous stand and has continued to the present, averaging 1% and 0.4% per year at the Sugar Lake and Nakusp sites, respectively. The difference in the amount of mortality can be attributed to the larger number of stumps colonized by the fungus at the Sugar Lake site. The disease has created unstocked or understocked openings of up to 0.02 ha in area in both stands. About 40% of trees that show disease symptoms halt spread of the fungus in their roots and survive. However, these trees grow more slowly than healthy ones and are predisposed to windthrow.

Visible versus actual disease incidence:

In five juvenile coniferous stands in each of the dry, moist and wet climatic regions in the southern interior of British Columbia, trees in 0.01 ha plots were examined for aboveground symptoms of disease and then were pulled from the soil and the roots were examined for *A. ostoyae* infection. The incidence of below ground infection was 37% in stands on moist region sites, 33% in the wet region and 10% in the dry region. The probability of a tree being diseased increased with tree diameter. Only one quarter to one half of infected trees show aboveground symptoms of the root disease.

Disease incidence following destumping:

In 1968, one half of a 2.56 ha tract in a mature Douglas-fir lodgepole pine stand was whole-tree logged and root raked while the other half was conventionally logged. Seedlings of Douglas-fir, lodgepole pine, western red cedar, paper birch, western larch and Engelmann spruce were planted

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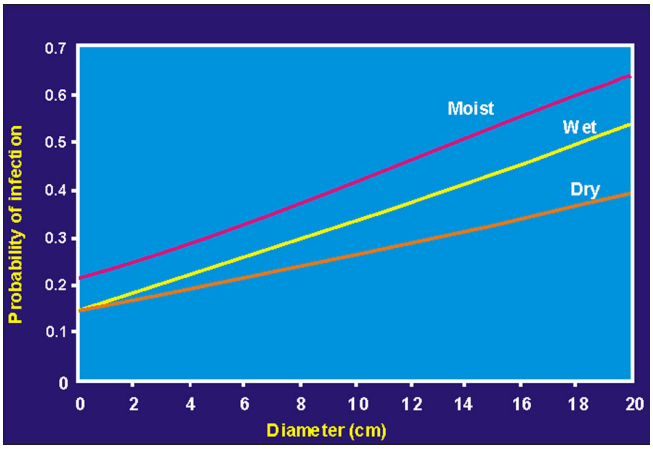
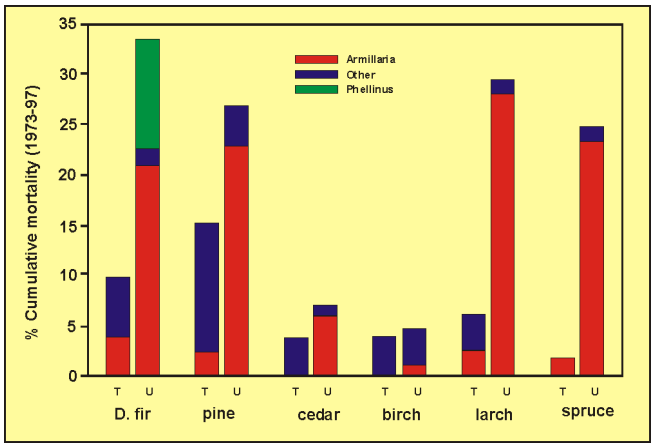
alone and in mixtures of two species in 0.04-ha plots on the two blocks. Incidence of tree mortality has been recorded periodically for 30 years. The principal causes of mortality have been the root diseases caused by *Phellinus weirii* and *A. ostoyae*. *Armillaria ostoyae* has been recorded on all conifer species while *P. weirii* has been recorded only on Douglas-fir. Cumulative mortality from root disease for tree species in stumped plots is less than 4%; whereas, in the untreated plots it is more than 20% for most species.



In juvenile coniferous stands, the probability of a tree being infected with *A. ostoyae* increases with dbh and it is higher in stands on sites in the moist climatic region.

depending on the site's climatic region. The difference between visible and actual disease incidence must be considered when interpreting the results of surveys and predicting the future impact of the disease on timber production. Incidence of infection and mortality caused by *A. ostoyae* in plantations can be reduced by removing stumps colonized by the fungus after harvest or by planting the least susceptible species for the site or a mixture of species, including hardwoods.



Percent cumulative mortality over 30 years of six tree species by root disease, in whole tree (T) and conventionally harvested (U) plots.

IMPLICATIONS FOR PLANTATION MANAGEMENT:

In the southern interior of British Columbia, Armillaria root disease has a negative effect on plantation development and productivity by killing trees in patches and reducing the growth of those with non-lethal infection. Its impacts begin soon after plantation establishment and will likely continue throughout the rotation. Surveys to determine disease incidence in plantations using above ground symptoms can only detect one-quarter to one-half of the diseased trees,

SOURCES OF RELEVANT INFORMATION:

Morrison, D.J.; Pellow, K.W.; Norris, D.J.; Nemec, A.F.L. 2000. Visible versus actual incidence of Armillaria root disease in juvenile coniferous stands in the southern interior of British Columbia. Can. J. For. Res. 30: 405-414.

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