DISEASES OF EASTSIDE PINE TYPES

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ABSTRACT

Dwarf mistletoes and Fomes annosus are the most damaging pathogens to ponderosa and Jeffrey pines and white fir in the eastside pine type. These diseases are affected by the silvicultural systems employed and in turn can influence the success of some silvicultural systems. Dwarf mistletoes are best dealt with through even-aged management and can be made worse when uneven-aged management is used. The impact of annosus root disease of pine and white fir is usually lessened in even-aged management systems, use of early thinnings, and the borax-treatment of pine stumps. The growing of white fir on marginal fir sites is a major contributing factor in promoting white fir mortality caused by annosus root disease.

PRINCIPAL DISEASES OF EASTSIDE PINE TYPE ARE

The most prevelant diseases of ponderosa and Jeffrey pines and white fir, the three most common conifers in the eastside pine type, are listed below in order of importance.

A. Diseases of Ponderosa and Jeffrey Pines

Dwarf Mistletoe
Annosus Root Disease
Elytroderma Needle Disease
Blackstain Root Disease
Medusa Needle Blight
Limb Rusts

B. Diseases of White Fir

Annosus Root Disease
Dwarf Mistletoe
Cytospora Canker
Decays Following Wounding

Dwarf mistletoes and annosus root disease are responsible for most of the disease-caused mortality.

MAJOR DISEASES AS THEY AFFECT AND ARE AFFECTED BY SILVICULTURAL SYSTEMS.

Dwarf Mistletoe in Pine and White Fir

Western dwarf mistletoe (Arceuthobium campylopodum) attacks ponderosa and Jeffrey pines and is the single most damaging disease of these species in the eastside pine type. Losses from this pest are due to reduced growth of moderately to heavily infected trees, and the death of heavily infected trees. This tree mortality is most often caused by the combined effects of dwarf mistletoe and cambium feeding insects (bark beetles, pine engravers, and flatheaded borers). Heavy dwarf mistletoe infections (Hawksworth 5 and 6) stress trees and increase their susceptibility to successful insect attacks. Other stresses, such as those caused by overstocking and/or drought, are additive to the dwarf mistletoe-caused stress and further increase trees' bark beetle susceptibility.

During the recent drought we saw examples of these drought-dwarf mistletoe-insect interactions. According to Miller's Forest Disease Survey, 1958 to 1966, about 9% of the ponderosa and Jeffrey pines are infected with dwarf mistletoe. Yet, during the first year of the drought, 75% of the ponderosa and Jeffrey pines killed in the one year, June 1976 to June 1977, were killed by the dwarf mistletoe, bark beetle and/or flathead pest complex. The proportion of trees killed by this complex decreased from 1977 to 1979 as the drought peaked and ended; but in 1978-79 the percentage of dwarf mistletoe-induced mortality of 42% was still significantly higher than the 9% level of dwarf mistletoe occurrence in the population as a whole.

The dwarf mistletoe which attacks white fir (A. abritinum f. sp. concoloris) is specific to white fir. This disease ranks second in importance to annosus root disease as the most damaging disease to white fir. Although a higher percentage of white fir (25%) are infected by dwarf mistletoe than are pine, this pest is

not as important as it is in pine, because it appears to stress fir less and results in a lower percent of tree mortality. The damage caused by dwarf mistletoe in white fir is the result of tree mortality due to the combined effects of this pest and cambial feeding insects (fir engravers and borers) and stem rot and windthrow of older trees when old bole cankers are invaded by wood decay organisms.

Dwarf mistletoes are long-lived obligate parasites which cannot live and reproduce off of the living host rree. This pest can spread horizontally only short distances at a rather slow rate (average 1 to 2 feet per year). Because of these characteristics, dwarf mistletoes are best adapted to survive and flourish in an uneven-aged stand with a high proportion of susceptible hosts in both the overstory and understory.

Thus, in a dwarf mistletoe infested eastside pine or fir stand any silvicultural system such as single tree selection, shelterwood, seed tree, group selection, or no management, which intermixes generations of the susceptible host, will favor the dwarf mistletoe infestation. Under these conditions, where the future stand is exposed to the currently dwarf mistletoe-infested stand, infection of the new stand is assured and future growth loss and tree mortality will result. At the worst, the new stand may be prevented from ever reaching merchantable size and years later will have to be destroyed if the site is to be made productive.

If uneven-aged management is the desired silvicultural system for a site currently occupied by a dwarf mistletoe infested stand, it may be best to implement this direction in a series of steps. The first step being the complete removal of the infested stand; followed by the establishment of an even-aged stand. The now dwarf mistletoe-free stand, through a series of intermediate cuts, could be converted gradually to an uneven-aged stand.

Intermediate silvicultural treatments can be and are used to alleviate the damaging effects of dwarf mistletoe in infested pine or fir stands. Thinnings are used to: 1) remove the heavily infected high-risk trees (Hawksworth 5 and 6) from the stand (such trees are not only a high risk to themselves from bark and engraver beetles attack but also are a risk to adjacent trees as they may serve as foci for beetle group kills); 2) increase the growth rate of lightly to moderately infected trees so that the host grows faster than the mistletoe moves up through the crown; 3) reduce the stocking stress on the dwarf mistletoe-infected leave trees; 4) select non-host species which not only are immune to the dwarf mistletoe but serve as screens protecting nearby susceptible pines.

Fomes annosus in Pine

The eastside pine type is one of the forest types most severely impacted by Fomes annosus root disease. Most annosus root disease infections of pine stands occur through the fungus invasion of freshly cut pine stumps. These pine stumps are susceptible for 6 to 8 weeks after cutting. After the fungus infests and colonizes the pine stump it moves via root contacts into the root systems of adjacent live trees and kills them by girdling the tree at the root crown. These annosus root disease-stressed trees are often attacked and killed by cambial feeding insects. In the eastside pine type, where stumps decay slowly, stumps have remained infective for 50 years, passing the infection onto the young saplings and poles whose roots grow into contact with the infested stump's root system. All conifers are susceptible to F. annosus infection from pine stumps. Surveys conducted by the Lassen National Forest indicate that the number of stumps infected can range from 0 to over 50%, but usually runs from 5 to 15% in the pure pine areas of the forest. The rate of pine stump infection appears to drop markedly as one moves up into the mixed conifer eastside type. We have no accurate information on the levels of mortality caused by annosus root disease in the eastside pine type, but observations and individual stand data indicate that it may be in the neighborhood of 10% of the total pine mortality.

Once infection centers are established there is little we can do to control this root disease, so it is important that we consider reasonable steps to prevent its establishment in eastside pine stands. Prevention can be accomplished by treating the surface of freshly cut pine stumps with dry powdered borax on the day they are cut. This prevents the fungus from entering the stump and other nonpathogenic fungi will colonize the stump. In thinning operations, when cutting trees 8" d.b.h. or smaller,

they may be left untreated during the summer when exposed to the high temperatures resulting from solar radiation. The upper portions of these stumps reach 40° C and above, which will kill F. annosus spores and new infections on or close to the stump surface.

Most infection centers we see are found around stumps 12" in diameter and larger. Small stumps, even when colonized by the fungus, for some unknown reason do not seem to initiate many infection characteristics of the stand surrounding the stump. If it is in a stand of seedlings and saplings, the infection center as evidenced by dead pines not spread much beyond the expected root zone of the infested stump. On the other hand if the surrounding stand is comprised of sawtimber the infection center will spread from the stump through the pine stand at a rate of 1 to 2 feet per year as far as there is root contact between these pines. In such stands infection centers from single or multiple infested stumps can become several acres in size and continue to expand for over 50 years.

These characteristics lead to some suggestions as to how to prevent or lessen the chances of occurrence and the severity of annosus root disease in eastside pine.

1. Thin eastside pine stands once, early and heavy before the stumps reach 6" in diameter, in the summer. Small stumps tend not to carry the infection and solar radiation will kill F. annosus on or in stumps.

2. Manage on an even-aged basis and minimize the number of entries after reaching pole-size. F. annosus infection centers established in merchantable stands grow larger and kill merchantable valuable trees. Infection centers in clear cuts tend to stay within the infected stumps root zone and kill only young seedlings and saplings.

3. Where a survey of stumps from past cuttings indicate a stump infection rate of 5% - 10% or higher, consider treating all pine stumps larger than 8" in diameter with borax at the time of cutting.

Fomes Annosus in True Fir

Fomes annosus causes a different kind of disease in true firs than it does in pines. In true firs the fungus causes a decay of the smaller roots and the heartwood of larger roots and the butt, and does not, as in pine, quickly kill the tree by invading the cambium and inner bark at the root crown and girdling the tree. In fir the result of this disease is the gradual loss through decay of part of the root system. It is our current thought, that if the tree is vigorous and growing well that it can stay ahead of this root loss by growing new root tissue faster than it is lost. But, when tree growth slows as a result of overstocking and competition, other disease problems, or injury, and the tree's production of new roots no longer offsets those lost to F. annosus, the tree enters a period of slow decline. This period of decline characteristically continues for 10 to 20 years and in the last stages the tree is often attacked by the fir engraver.

Often in eastside pine we see an understory of true firs, and in the past when the pine overstory was harvested these true fir were sometimes released to form the next stand. We are now seeing serious problems in some of these eastside fir stands. Many of these stands are almost pure fir, overstocked, growing on a fairly low site. The trees are 18" to 24" in diameter and holes are beginning to appear in the stands where the fir are dying and falling over. Characteristically we find that the trees have not been growing well for years. F. annosus root disease is established throughout the stand and the mortality is the result of annosus root disease and the fir engraver. We also find that the white fir are growing on questionable fir sites and that the problem appears to be as much a result of off site trees as the action of forest pests. It is usually our recommendation that the site be returned to ponderosa and/or Jeffrey pine in the next rotation.