White Pine Blister Rust in Juvenile Western White Pine on State Lands in Washington

Daniel Omdal and Melanie Kallas Ricklefs

Introduction

Western white pine (*Pinus monticola* Dougl.) was once an integral part of the forest ecosystems of Washington. Due to its ability to tolerate extremes in site conditions, it was historically found interspersed throughout most vegetation zones. Around 1910, *Cronartium ribicola* J.C. Fisch., the causal organism of white pine blister rust (WPBR), was introduced into western North America on infected nursery stock grown in Europe and shipped to British Columbia. From British Columbia, the disease spread to Washington causing widespread mortality throughout the range of five needle (white) pines. White pine blister rust has become the most destructive disease of white pines in North America.

Over the last two decades, the USDA Forest Service and University of Idaho have established breeding programs to genetically enhance western white pine for resistance to white pine blister rust. During this time, the Washington Department of Natural Resources (DNR) has been steadily increasing the outplanting of western white pine seedlings on state lands. In 2001, more than 200,000 genetically enhanced western white pine seedlings were planted on state lands in Washington. Nevertheless, white pine blister rust remains a component of the forest ecosystems throughout the Pacific Northwest. A 2002 survey of western white pine saplings and mature trees in Washington revealed infection levels of up to 100% in some geographic regions. It is unknown what percentage of the white pine surveyed in this study was genetically enhanced, however, it is unlikely that western white pine planted on state lands west of the Cascade Mountains prior to 2001 was genetically enhanced. Due to high white pine blister rust infection levels, much, if not all of the western white pine planted on state lands since 2001 is genetically enhanced stock.

High levels of white pine blister rust in western white pine saplings suggest that mortality due to white pine blister rust may be underestimated by excluding juvenile white pine from these studies. It is likely that some of the planted western white pine succumb to blister rust prior to reaching the sapling stage. In fact, recent investigations of juvenile western white pine stands (less than five years old) revealed high levels of infection in some geographical regions of Washington. However, the majority of sites assessed had been planted with stock that was not genetically enhanced for white pine blister rust resistance.

High infection levels in unimproved juvenile western white pine indicate that, in some regions, juvenile western white pine may suffer significant infection and mortality prior to reaching the sapling stage. It is believed that the genetically enhanced stock would experience less infection and mortality than unimproved stock. The focus of this study is to monitor the incidence and severity of WPBR infection, and thus determine the success of the resistance mechanisms, in genetically enhanced juvenile western white pine.

The Pathogen

Cronartium ribicola is a fungus that infects all 5-needle pines and requires *Ribes* spp. (gooseberries and currants) as alternate hosts to complete its life cycle. The fungus infects pine through the needles and grows down the twigs into the branches and ultimately into the main stem. In the spring, aecial blisters (fig. 1) break through the bark of infected tissue giving cankers a blistered appearance. The aecial blisters produce spores that infect only *Ribes* spp. Once on a *Ribes* plant, the fungus initially produces spores that re-infect only *Ribes* spp. (fig. 2) and may amplify available inoculum. In the fall, spores that infect pine are produced on *Ribes* spp.

Figure 1. Aecial blisters on juvenile western white pine.

Figure 2. Infected *Ribes* spp. leaf.

Symptoms

Branch flagging is the most obvious symptom of WPBR (fig. 3). When the fungus encircles the branch, it girdles and kills the branch rapidly, resulting in flagging. Girdling of the main stem results in topkill (fig. 4). Retention of red needles is most common in recently killed branches and treetops. Cankers on young, smooth-barked trees start out as an orange discoloration in the bark with or without swelling. As the canker expands in size, it will often have a rough center surrounded by a diamond-shaped orange lesion of infected bark (fig. 5). The rough center is the portion of the canker that has sporulated, while the orange discoloration of the bark represents the leading edge of the fungus.

Figure 3. Branch flagging on western white pine sapling.

Figure 4. Topkill of western white pine sapling.

Figure 5. Lesion on smooth bark of western white pine sapling.

Methods

- Two recently planted (2001 or later) management units containing a significant amount of genetically enhanced juvenile western white pine will be selected from each geographic region of Washington state using the Washington DNR Forest Resource Inventory System.
- Permanent plots consisting of 100 western white pine seedlings will be established in each of these management units.
- The seedlings will be visually assessed for WPBR cankers.
- The number and location of WPBR cankers, along with any other information regarding seedling health, will be recorded.
- Mortality will be recorded during plot establishment, but only live seedlings will be tagged for use in the permanent plot.
- Plots will be assessed for WPBR each year, for a total of three years.

Objectives

There are no current surveys that assess the incidence and severity of white pine blister rust on genetically enhanced western white pine in Washington. Therefore, we have no data indicating whether or not the genetic enhancement improves the chances of survival in the field. Survival of juvenile western white pine is critical to restoring the species in forest ecosystems of Washington. While western white pine is not listed as a species of concern, five-needle pines are a key species in many Pacific Northwest ecosystems and they have been significantly impacted over the last century. Restoration of western white pine is consistent with the goals of the Northwest Forest Plan to maintain and restore the natural diversity and health of the northwest forest ecosystem. This study will help us to quantitatively describe the relative success, over time, of genetically enhanced western white pine in resisting infection and mortality caused by white pine blister rust.

Contact Information:
Daniel Omdal dan.omdal@wadnr.gov (360) 902-1692
Melanie Kallas Ricklefs melanie.kallas@wadnr.gov (360) 902-1395
Washington Department of Natural Resources
P.O. Box 47037
Olympia, WA 98504-7037

Acknowledgements:
This project is being funded by an Evaluation Monitoring grant from the USDA Forest Service's Forest Health Monitoring program.