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

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Canker Class F: canker has girdled the stem and killed the portion of the tree above the canker

Introduction

Western white pine (*Pinus monticola* Dougl.) was once an integral part of the forest ecosystems of Washington. Around 1910, *Cronartium ribicola* J.C. Fisch., the causal organism of white pine blister rust (WPBR), was introduced into western North America from Europe, causing widespread mortality throughout the range of five-needle pines. Over the last five decades breeding programs have been working to genetically enhance western white pine for resistance to WPBR. During this time, the Washington Department of Natural Resources (DNR) has been steadily increasing the outplanting of western white pine seedlings on state lands, including those genetically enhanced (F2 progeny). Twenty-two total permanent plots have been established across Washington to assess the development of WPBR in young plantations of F2 western white pine (WWP) progeny.

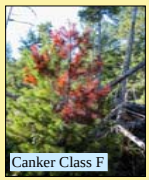
Canker Class E: canker present on main stem but not girdling

Objective

To quantitatively describe the relative success over time of genetically enhanced western white pine in resisting infection and mortality caused by WPBR.

Canker Class E

Canker Class D and E



Canker Class F

Methods

- 22 permanent plots established (Figure 1)
  - genetically enhanced (F2 progeny) juvenile WWP recently (2001 or later) planted
  - established in five DNR regions
- 100 live 4-5 year old WWP tagged at each plot
- WWP visually assessed for WPBR cankers
  - number of cankers on each tree
  - canker class (Table 1)
- Pre-existing WWP mortality recorded at time of plot establishment
- Plots assessed for WPBR each year

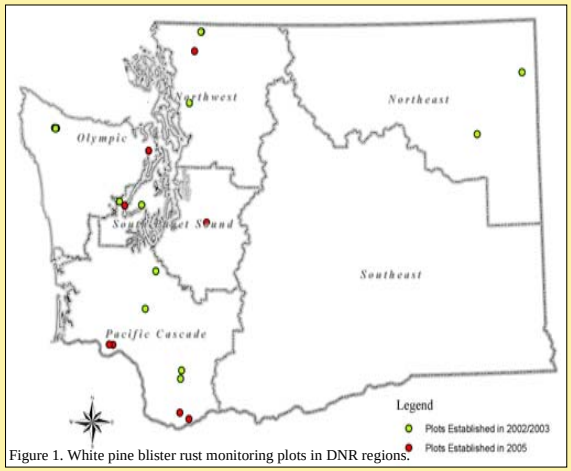


Figure 1. White pine blister rust monitoring plots in DNR regions.

Results

- 1.1% WWP killed by stem girdling cankers among all plots
- WPBR infection rates ranged from 0 – 95%
- 4 out of 12 plots established in 2002/2003 with WPBR infection rates of 0-1%
- 2 out of 10 plots established in 2005 with WPBR infections rates of 0-1%
- Regional WPBR infection rates (Table 2, Figures 2,3)
  - Northwest
    - highest regional infection rates (48%)
  - Northeast
    - lowest regional infection rates (0%)

Table 2. Regional WPBR infection rates, canker classes, and maximum number of cankers

Region	Greatest individual plot WPBR infection rate	Majority of cankers (in canker class:)	Maximum number of cankers on one tree
Northeast	0%	--	0
Northwest	95%	D	22
Olympic	32%	D	16
Pacific Cascade	76%	C	28
South Puget Sound	6%	C	2

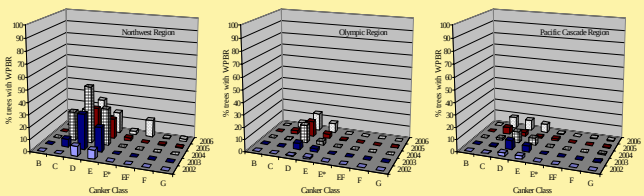


Figure 2. Northwest, Olympic, and Pacific Cascade Regions WPBR infection rates for each assessment year. 2002 – 2004 % rates are for only those sites established in 2002/2003, while the % rates for 2005 and 2006 include the sites established in 2005.

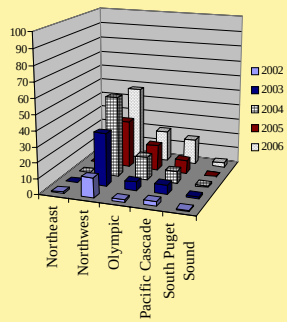


Figure 3. Regional WPBR infection rates for each assessment year. 2002 – 2004 % rates are for only twelve sites (those established in 2002/2003), while the % rates for 2005 and 2006 are for all 22 sites (including the ten established in 2005).

Table 1. Canker classes and descriptions.

Canker Class Letter	Canker Description
B	Minor: canker > 24 inches from main stem
C	Moderate: canker between 24 and 6 inches of main stem
D	Severe: canker within 6 inches of main stem
E	Stem canker: canker present on main stem, but not girdling; live foliage above and below the canker
E*	Stem needle canker: canker present on main stem; infection point from needle on main stem, not on attached branch
EF	Severe stem canker: canker present on main stem that appears to be girdling the tree, but there is no sign of upper tree death
F	Top kill: canker has girdled the stem and killed the portion of the tree above the canker; live foliage below the canker
G	Dead: canker has girdled the stem and killed the entire tree; no live foliage

Discussion

The WPBR infection rates increased each year on those plots where WPBR was present. The incidence and severity of the WPBR infection levels among the plots showed that even though the rates of infection on several plots were relatively high (59-76%), the rates of mortality were low (1.1%).

Future Work

F3 WWP progeny will be planted in six plots across the state in the winter of 2006/2007. All plots will continue to be monitored over time for the presence and severity of WPBR, in order to better evaluate the field performance and resistance mechanisms of F2 and F3 genetically resistant WWP.

Natural Resources

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