


Incidence and Severity of White Pine Blister Rust in Western White Pine in Washington

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Introduction

Western white pine (*Pinus monticola* Dougl.)(WWP) was once an integral part of many forest ecosystems in 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-needled pines. On-the-ground reactions to the exotic pathogen and the associated tree and forest damage varied across the region. *Cronartium ribicola* requires two hosts to reproduce and successfully cause new infections in WWP, so one reactionary attempt was to remove the primary secondary host, *Ribes* spp., or currants. When this method of disease control was unsuccessful, genetic breeding programs were established across the region to enhance WWP resistance to *C. ribicola*.

Many of the genetic breeding programs have been operating for over 40 years and have been producing genetically enhanced WWP seed for tree nurseries. The tree nurseries then provide genetically enhanced WWP seedlings to a variety of landowners. The Washington State Department of Natural Resources (DNR) plants WWP on state lands to increase forest stand diversity and to mitigate root disease, as the species is tolerant of the most common root diseases in Washington. However, due to the WPBR-caused mortality of WWP, the numbers of WWP used for reforestation remain low. In this study, we assessed young WWP for WPBR on WA state lands, to determine how the genetically enhanced trees are performing across the landscape.

Methods

- 21 sites in Washington (Fig. 1)
  - revisited sites that were established in 2002 and 2005 site characteristics: elevation, aspect
- Surveyed ~100 WWP/site
  - 10-14 yr. old
- Characterized main stem cankers
  - % stem girdled
  - bark reaction
- Counted branch cankers
  - within 6" of main stem
  - presence/absence of cankers beyond 6"

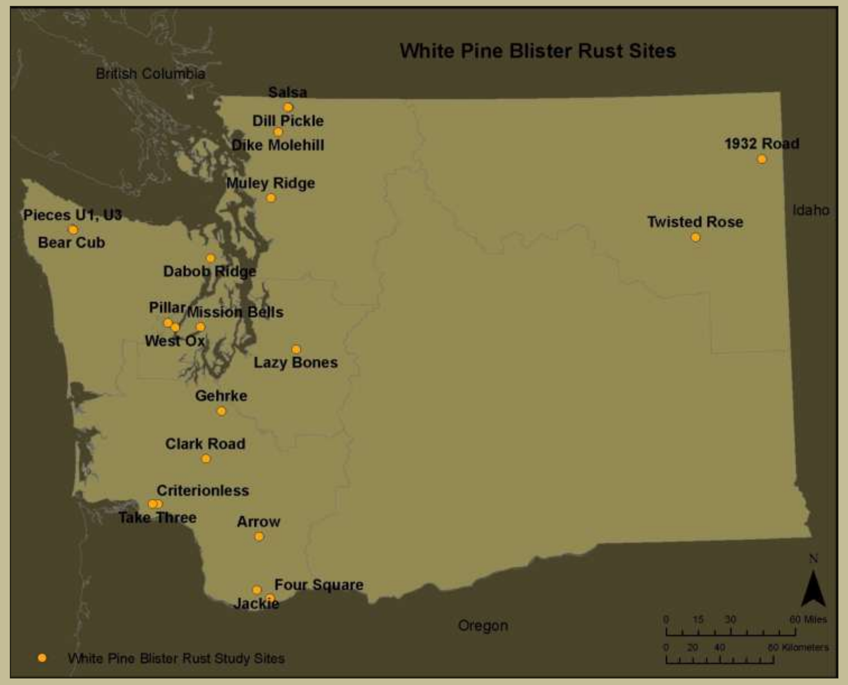
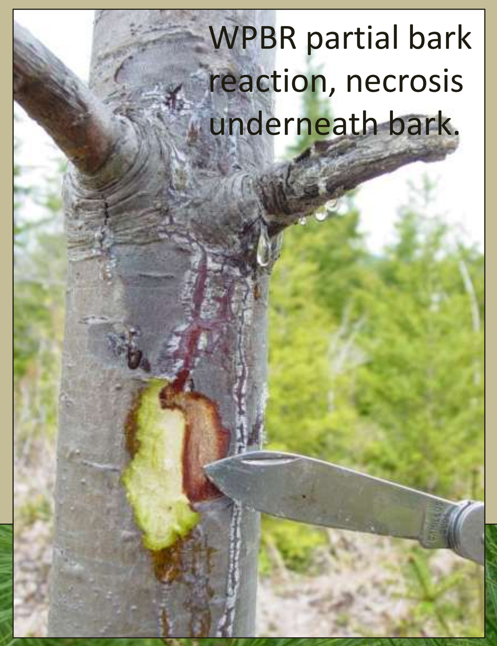


Figure 1. Location of surveyed sites.

Objectives

- To assess the incidence and severity of white pine blister rust (WPBR) on WWP on Washington State lands
- To determine how well WPBR genetically enhanced tree stock is performing on the landscape



Results

- Individual site data summarized in Table 1.
- WPBR Incidence: 0-98% trees infected within sites
  - includes any tree within a site infected on stem or branch with at least one canker
- WPBR-caused mortality: 0-77%
  - 77% (Salsa site) is an outlier, with next highest mortality on a site at 11%
- Resistant seed sources/seedlings:
  - general trend of lower WPBR infection rates in resistant seed sources when compared to non-resistant seed sources
  - primarily no bark/tree reactions to WPBR, but some partial and complete bark/tree reactions were observed
- No statistically significant differences among variables

							White Pine Blister Rust Severity		
Site Name	Site Location (WA)	Seed Source	Seed Resistance	Year planted	Trees (no.)	WPBR Incidence (%)	Mortality (%)	Trees with 1 or more stem cankers (%)	Avg. # stem cankers/tree
1932 Road	Ruby	IETIC[2]	resistant	2000	96	2	0	2	0.02
Arrow	Cougar	unknown	unknown	2000	100	6	0	3	0.04
Bear Cub	Sappho	unknown	unknown	2000	93	59	5	25	0.31
Clark Road	Marys Corner	WDNR[3]	non-resistant	2000	100	94	5	54	1.06
Criterionless	Cathlamet	IDL, Moscow[1]	resistant	2002	97	7	0	4	0.04
Dabob Ridge	Leland	IDL, Moscow[1]	resistant	2002	99	31	3	18	0.14
Dike Molehill	Van Zandt	IDL, Moscow[1]	resistant	2002	95	21	0	9	0.11
Dill Pickle	Maple Falls	unknown	unknown	2002	92	57	0	32	0.50
Four Square	Washougal	IDL, Moscow[1]	resistant	2002	100	35	4	27	0.22
Gehrke	Rainier	unknown	unknown	1999	92	10	0	4	0.04
Jackie	Washougal	unknown	unknown	2002	95	32	1	21	0.20
Lazy Bones	Black Diamond	IDL, Moscow[1]	resistant	2002	100	21	0	10	0.11
Mission Bells	Belfair	WDNR[3]	non-resistant	2000	87	51	1	20	0.21
Muley Ridge	McMurray	WDNR[3]	non-resistant	2000	100	95	11	67	0.87
Pieces U1	Sappho	unknown	unknown	2000	96	57	11	48	0.51
Pieces U3	Sappho	unknown	unknown	2000	97	35	3	31	0.31
Pillar	Hoodsport	WDNR[3]	non-resistant	1999	97	2	0	1	0.01
Salsa	Maple Falls	WDNR[3]	non-resistant	1999	100	98	77	93	0.35
Take Three	Cathlamet	IDL, Moscow[1]	resistant	2002	100	4	0	3	0.03
Twisted Rose	Springdale	IETIC[2]	resistant	2000	67	0	0	0	0.00
West Ox	Hoodsport	unknown	unknown	2002	100	12	0	9	0.12

Table 1. Site summary data, including white pine blister rust incidence and severity.

Results and Discussion

Blister rust caused mortality of WWP has increased among the sites from an average of <0.01% in 2006 to 5.8% in 2010. However, over 50% (11/21) of the sites surveyed do not have any mortality and over 33% of the sites (7/21) have ≤ 5.0% of WPBR-caused western white pine mortality. Due to the high variability among the sites, (seed source, resistance of seed source, site location, influence of environmental variables and WPBR risk hazard level determined by the abundance of alternate hosts), it is difficult to determine from this data whether the WPBR- caused mortality rates will continue to increase.

There was a general trend of less mortality in resistant stock than in non-resistant. Some of the trees exhibited WPBR resistance-type reactions, which were quantified by characterizing whether or not there was a bark reaction with the fungus, but the majority of trees surveyed (87%) did not have observable bark reactions to *C. ribicola*. Trees with bark reactions were not limited to resistant stock and bark reactions were observed on trees on sites planted with both non-resistant and unknown seed sources.

Western white pine is currently a risky species to plant on a commercial scale due to its susceptibility to WPBR and the economic uncertainty of western white pine wood, but can be used in root disease infested areas when more susceptible species will not grow and/or in areas with high browse pressure. Proper pruning (Fig. 2) may decrease the incidence of WPBR on WWP. Site characteristics (e.g. slope, aspect, landscape position, soil type) may also influence the incidence and severity of WPBR on WWP, but the influence of these factors are not well understood in Washington.

Figure 2. Incorrectly pruned western white pine. The lowest branches are critical for potential white pine blister rust infection and were not removed.

Future WPBR and western white pine studies will include an expanded site survey network, with the objective of trying to determine which variables, if any, may be used to predict the mortality of western white pine from WPBR. Other potential work includes investigating the economic viability of western white pine through a cooperative effort between the DNR and the US Forest Service, setting up permanent plots in mixed-conifer stands to monitor competition and establishing permanent plots to monitor the effects of pruning and WPBR on western white pine.

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