Monitoring Blister Rust Resistance, Pathogen Virulence and Genetic Adaptability of Western White Pine in Washington and Oregon (RV20 Field Test Series)

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OVERVIEW

Western white pine (WWP, *Pinus monticola* Dougl.) is a wide-ranging forest tree species (Fig. 1) of high economic and ecological value. However, due to several factors, including the inadvertent introduction of the non-native fungal pathogen *Cronartium ribicola* Fisch. (cause of white pine blister rust (WPBR) disease) around 1910, there has been extreme levels of mortality in many natural populations of WWP, and a greater reluctance to use this species in reforestation and restoration. Fortunately, some genetic variation in resistance exists in within WWP.

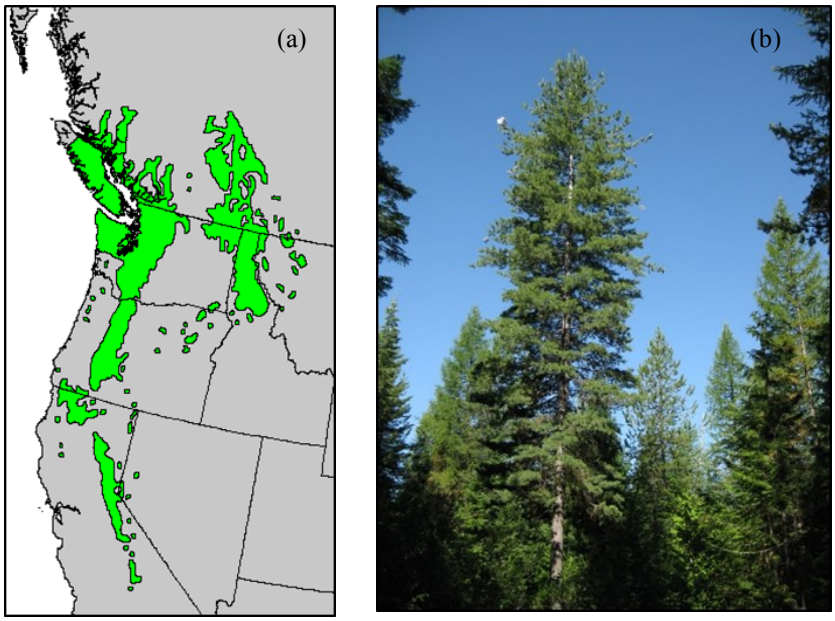

Figure 1. (a) *Range-map of western white pine (P. monticola) (adapted from U.S. Geological Survey 1999, http://esp.cr.usgs.gov/data/little/);* ***(b)*** *Resistant parent tree 21105-052 from Colville National Forest. Seedlings from this parent tree are included in the trial. (Photo: B. Mayo, US Forest Service).*

The development of genetically resistant populations of WWP is well under way (Sniezko *et al.* 2014), but field trials are needed to test the resistance in a range of environments. The Washington Department of Natural Resources (WA DNR) and the U.S. Forest Service's (USFS) Dorena Genetic Resource Center (Dorena GRC) have partnered to undertake a series of field trials to evaluate WWP.

Trials such as the RV20 test series planted in winter 2014/2015 in western Oregon (1 site) (Fig. 2) and eastern Washington (6 sites) (Fig. 3), complementing another test series planted in 2006/2007 in western Washington (6 sites, RV11 Test Series) (Ramsey *et al.* 2014), will provide key information on the efficacy of rust resistance over time, as well as the adaptability of different seed sources of WWP in a changing climate.

Figure 2. *Western white pine trial (Tyrrell site in SW OR) in March 2015, several months after planting. At the far end of this trial is RV7 trial of WWP planted in 1999.*

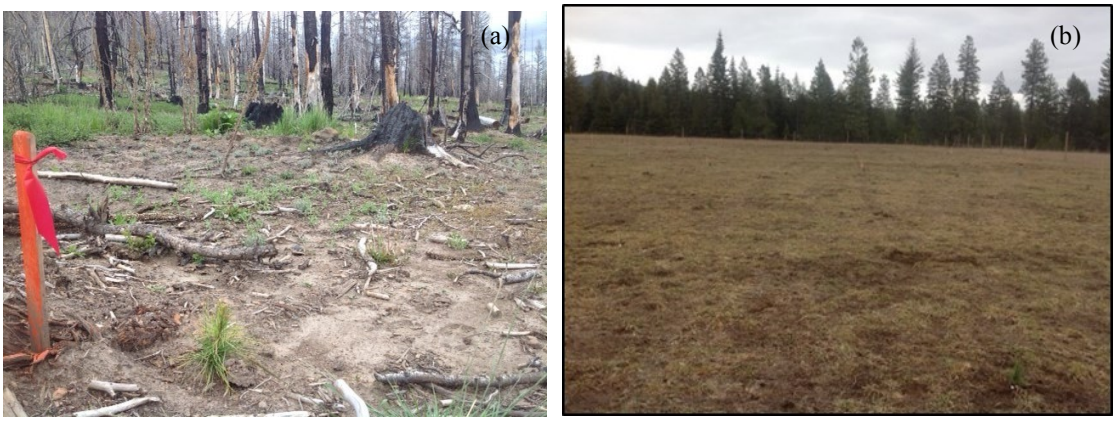

Figure 3. *Western white pine trials planted in winter 2015 in eastern Washington,* ***(a)*** *Table Mountain site, and* ***(b)*** *Kalispel site.*

These trials include both the most advanced seed orchard lots currently available, as well as seedlings from parents spanning the full range of resistance types currently known for WWP. The parent trees for this trial originate from Oregon, Washington, Idaho and British Columbia and are part of the three programs to develop blister rust resistance located in Oregon, Idaho and British Columbia. A subset of these seedlots were also planted in field trials in British Columbia in winter 2014. This series of trials will provide information on genetic resistance to white pine blister rust, on adaptability of seedlots from different geographic sources in these locations, and serve as sentinel plantings to monitor impacts of pathogens and insects or impacts from abiotic events associated with a changing climate.

Project Objectives

1) Use resistant materials from three different resistant programs to establish the most advanced trial series for blister rust resistance evaluation.
2) Monitor durability of major gene resistance (MGR) and temporal evolution of the virulent *vcr2* genotypes of blister rust.
3) Assess impacts of abiotic and biotic agents (e.g. *Dothistroma*) on diverse WWP seed sources.
4) Provide updates to landowners on the levels of rust incidence and field resistance currently available.
5) Link these trials with related trials being planted in British Columbia in 2014/2015.
6) Examine growth, general vigor and reproductive status of WWP seedlots from very diverse geographic areas to help evaluate seed movement potential in a changing climate.
7) Assess rust incidence and impacts of several types of rust resistance in varying environments and a changing climate in six western WA, six eastern WA, and one OR trial.
8) Use trials for fieldtrips, conservation education, and potential student projects.

Study Design

Seven sites (six in eastern WA, one in western OR), approximately four to five acres in size, were established winter 2014/2015 (Figure 4) in a randomized complete block design . Each site was comprised of eleven replicates of 97-98 seedlings each, with 45 different WWP seedlots in each replicate. Two year old seedlings were used for 43 seedlots, and one-year old seedlings for the other two seedlots. Seedlings planted within a replicate were randomized, with an approximate twelve feet spacing between trees. Each site also included a demonstration plot, which included 26 seedlings planted in a specific sequence among all sites .

Figure 4. *Locations of white pine blister rust resistance trials installed in eastern Washington (six sites) and western Oregon (1 site) in winter 2014/2015 and western Washington (6 sites) in winter 2006/2007.*

Future Work

All sites will be visited for the first two to three years to assess for seedling establishment success. At approximately seedling age seven, seedlings will be assessed for growth, WPBR presence and severity, general vigor and reproductive status. Other assessments will occur as rust, abiotic and other biotic agents begin to appear and as resources permit.

Cooperators

1) Washington Department of Natural Resources (WA DNR)
2) Kalispel Tribe of Indians (KTI)
3) U.S. Department of Interior Bureau of Land Management (USDI BLM)
4) U.S. Department of Agriculture Forest Service (USFS)

Literature Cited

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Further Background on Western White Pine

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Hines, Susan. 2013. Return of the King: Western White Pine Conservation and Restoration in a Changing Climate. Science You Can Use Bulletin. April/May 2013. Issue 4. U.S. Forest Service Rocky Mountain Research Station. Fort Collins, CO. 10p. http://www.fs.fed.us/rm/science-application-integration/docs/science-you-can-use/2013-03.pdf. (Issue 4 explores the ways in which new research can inform smart restoration of western white pine, a foundational ecological species that once contributed to the health, resilience, and economic vitality of forests in the Interior Northwest, in today's era of climate change).

Acknowledgements

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