Establishment of white pine blister rust resistant seed orchards for whitebark pine in the Pacific Northwest

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Introduction

Whitebark pine (*Pinus albicaulis*) is a keystone species in high-elevation ecosystems in western North America. It has been severely affected by the combined impacts of successional replacement due to fire suppression, outbreaks of bark beetles, climate change, and most critically the introduced disease white pine blister rust (caused by the fungus *Cronartium ribicola*). A considerable investment has been made in the US Forest Service Pacific Northwest Region in the last ~15 years to identify individual whitebark pine trees with some level of resistance to white pine blister rust. To-date, over 220 trees have been identified. These individual trees are at risk of loss from fire, insect attack, windthrow, and other disturbances, making *in situ* conservation challenging. In an effort to preserve these resistant genotypes, scion from these "elite" parent trees has been grafted onto rootstock and these clones have been outplanted in *ex situ* clonal conservation banks at multiple tree seed orchards already established in Washington and Oregon. A secondary, but equally important, objective of these outplantings is to serve as seed orchards for production of rust resistant seed for future restoration or reforestation work. Seed orchards can help meet this need for reliable, easily accessible source of rust resistant seed will be one key factor in any successful restoration work throughout most of the range of WBP

Geographic Area	# Rust Resistant	# Scion Collected	# Dead or Lost	Orchards where grafts will be planted
W. Washington	51	23	18	French Butte, Pole Pick
E. Washington	51	31	18	Cedar Creek, Pole Pick
W. Oregon	78	49	7	Hazy, French Butte
E. Oregon	42	27	3	Hazy, Cedar Creek

Materials and Methods

- The range of whitebark pine in the Pacific Northwest Region was divided into four geographic areas: eastern and western WA and OR. (see fig 1)
- Each geographic area will be represented in two *ex situ* plantings to buffer against catastrophic loss or failure at any one site.
- ~100 ramets from 26 clones from western WA were outplanted at French Butte in October 2020. Survival though summer of 2021 has been above 90%.
- ~150 ramets from 34 clones from western OR and 80 ramets from 20 clones from eastern OR were outplanted at Hazy in June of 2021.
- ~50 ramets from 19 clones from western WA were outplanted at Pole Pick in October 2021.
- ~90 ramets from 30 clones from western OR were outplanted at French Butte in October 2021.
- Ramets from eastern Washington and eastern Oregon will be outplanted at Cedar Creek in fall of 2022.
- Scion from additional elite rust resistant parents will continue to be collected each fall/winter to add genetic diversity to these *ex situ* conservation plantings in the future.

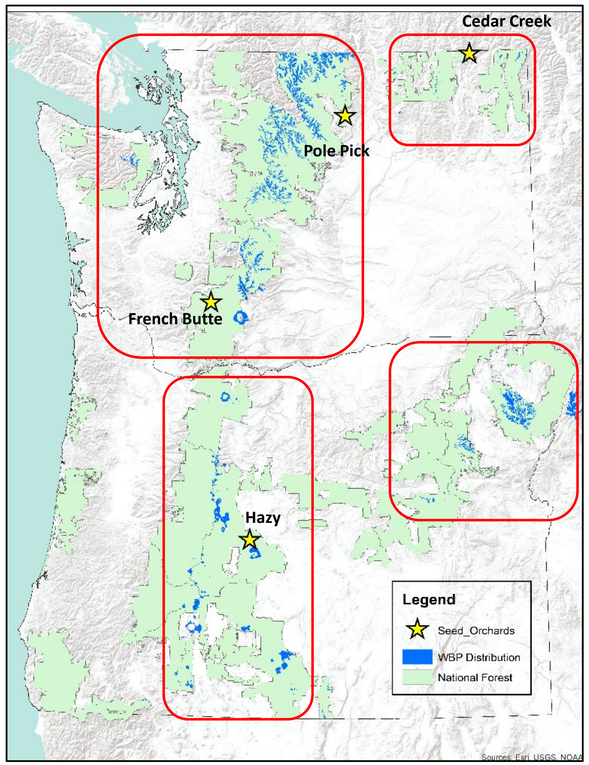

Figure 1. Whitebark pine habitat in Washington and Oregon subdivided into four geographic areas with four seed orchards being established.

Figure 2. Matching scion to rootstock (left) and a completed graft (right) (Photos: USFS, Dorena GRC)

Figure 3. French Butte seed orchard on the Gifford Pinchot NF, Cowlitz Valley Ranger District. Mulch mats were used to reduce competition from grass and to retain soil moisture

Figure 4. Hazy seed orchard on the Deschutes NF, Bend-Fort Rock Ranger District. A lack of grass and forb competition meant no mulch mats were needed, but a drip irrigation system was installed to provide water throughout the summer

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