

TITLE: Long-term Monitoring of White Pine Blister Rust Infection and Survival at 10 Sugar Pine Evaluation Sites

LOCATION: Southwest Oregon and Northern California

DATE: 30 September 2008

DURATION: 3-years, Inter-regional, Inter-agency

FUNDING SOURCE: Fire Plan

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PROJECT OBJECTIVES:

1) Provide the first definitive quantification of the occurrence and spread of white pine blister rust (WPBR), and subsequent mortality of sugar pine (SP) over several decades and multiple sites; 2) Examine WPBR impacts on a common set of SP families with different levels of rust resistance at sites with varying levels of rust hazard in SW Oregon, particularly after a decade of the warmest years on record; 3) Monitor the stability of major gene resistance (MGR) to WPBR in SP and detect any occurrence of a virulent strain of rust on SP in Oregon; 4) Examine seed sources from throughout the range of SP for differences in WPBR resistance and survival under widely differing field environments; 5) Establish or refine estimates of adaptation of various provenances to various environments, as benchmarks for future planting recommendations in changing climates.

JUSTIFICATION:

Priority Issues Addressed – Invasive Species - Insects, Diseases, and Plants.

Linkage to FHM Detection Monitoring – Goheen and Goheen examined data from FIA plots throughout the range of five-needle pines (1991–2000 assessments, >15,000 plots). They found that 14% of the plots had five-needle pines present. This probably underestimates the historical occurrence of five-needle pines, which have been in decline for decades due to effects of WPBR and bark-beetles. These FIA plots provide only cursory data about forest health conditions, such as WPBR occurrence and damage. Aerial surveys are able to detect recent mortality in larger trees but do not detect lower level damage such as branch dieback, infections in smaller trees below the canopy, or bole cankers which have not yet killed the tree. Additional ground surveys are needed to accurately assess conditions, including changes in WPBR activity.

Significance in terms of geographic scale – The four provenance sites constitute the most complete test of SP provenances in existence. Early data from these trials has already enabled good estimates of sugar pine adaptation and seed transfer suitability. They will provide invaluable

information on WPBR resistance trends from throughout the geographic range of SP (including areas currently uninfected with blister rust). The unique nature of these trials will continue to provide insights into adaptability of SP that will better enable managers to care for SP populations under climate change and increasing fire frequency.

Biological impact and/or political importance – Sugar pine is an important species in a wide array of ecosystems in southwestern OR and northern and central CA, as well as having commercial value. There is great interest from the Forest Service (R5 and R6) and the BLM (Oregon) in restoring SP and maintaining diverse, healthy forests. However, it is faced with challenges from global warming and related changes in fire regimes, increased mountain pine beetle attack, and white pine blister rust, an introduced, exotic disease. Public and private land managers are reluctant to plant SP without knowledge of the level and durability of its WPBR resistance. An important feature in maintaining the species as a viable component of future forests is maintaining a wide degree of genetic diversity. This will help SP survive even in the face of warming conditions and the accompanying biotic and abiotic changes.

This is the only set of replicated field trials that includes the full range of sugar pine provenances planted in a variety of environments. Data from these plantings will permit better estimates of adaptation and seed transferability, which will, in turn, better enable restoration of sugar pine to succeed. In addition, the progeny test sites will provide the first long-term evaluation of field resistance levels of sugar pine over a range of site hazards for this species. Data from early assessments of these sites showed that WPBR reached high levels even on low hazard sites, but further data is needed to determine what types of resistance might be effective in the field.

The sites also provide additional opportunities: 1) to select additional trees for the WPBR resistance breeding programs in R5 and R6 and 2) an indication of whether the virulent race of the rust ('Happy Camp' strain) is now present in Oregon. Presence of the virulent race of rust will limit the utility of the relevant resistance mechanism (MGR) in breeding programs and sugar pine seed deployment.

Feasibility or probability that the project will be successfully completed – The feasibility of completing the assessments is very high. All ten sites are still accessible; evaluations have been completed at six. There is considerable interest from geneticists, tree improvement staff, and FHP staff to complete this assessment. Most have helped or have committed to helping with measurements.

DESCRIPTION

Background:

SP Provenance trials: Sugar pine seed was collected from 62 sources (provenances) from as far south as Baja, CA to as far north as the Mt. Hood NF. In 1984 and 1988, different sets of these provenances were planted at sites with varying elevation in CA and southwest OR (2 sites, each). 42 sources are common to all four test sites. A fifth site (Harrell), planted in 1992, contains all provenances and families planted at the other sites. These sites were established by the PSW R.S. and the Siskiyou and El Dorado NFs for the purpose of evaluating seed-transfer guidelines. They were measured at regular intervals for growth and survival, but only a single, cursory survey was done for WPBR. Much data about WPBR infection is likely to be lost if these trials are not measured in the next few years, since many cankers are on branches that will self-prune, some trials need thinning, and trees are being lost to other causes.

Progeny Tests of rust resistant families: Six sites (5 BLM, 1 FS) were established in 1982-83 to examine field resistance of 53 of the earliest selections from the rust resistance program. Progeny

of a subset of these selections was planted at each site; 31 families are common to all 6 sites. The trials have been assessed three times, most recently in 1996-97. That assessment showed a large increase in infection at several sites, including sites rated as low hazard. Two of the sites have been evaluated more recently (2005, 06, and 08) for growth and WPBR infection. These assessments have shown a high level of infection and rust mortality, plus other interesting rust behavior.

Methods: All sites are being assessed for tree status (alive, dead, and/or damaged), incidence of rust and reproductive status. Diameter (DBH) and height will be measured as feasible to provide growth information and the impacts of rust on tree growth. The Harrell site in California might be substituted to compensate for one of the sites (Cannon) which has been severely affected by a different tree disease. SAS and other scientific software will be used to analyze the data.

Products: Information will be provided to land managers on the growth and survival of sugar pine in OR and CA. Posters and publications to various groups, as well as presentations to genetics and forest pathology meetings, are also planned.

Schedule of Activities: Funding permitting, assessments of the remaining sites will continue in the spring and summer of 2010. Analyses will begin in 2010 and continue into 2011. Time during winter and spring of 2011 will be dedicated to final data analysis and report writing. The final summary at the end of the project will be presented at the annual Forest Health Meeting in early 2012.

Progress and Accomplishments: Scouting and evaluations have been completed on the four primary provenance trial sites. These were accomplished by a combined effort of Dorena GRC, R-5 Blister Rust, and PSW personnel, and with the assistance of the Forest Silviculturist from the Rogue River-Siskiyou NF. Scouting of the four remaining BLM progeny test sites was completed by DGRC personnel, in preparation for conducting the evaluation visits in FY 2010. This occupied about 27 days (~120 man-days) in the spring and summer of 2009. Thus, evaluations have been completed at six of the ten sites included in the proposal. Data checking and preliminary analyses are underway. We anticipate completing all field assessments in FY 2010.

Significant blister rust infection and mortality was found at all sites except Cannon (over 80% infection and up to around 50% rust mortality). The larger of the two California sites was thinned after the evaluation there to decrease tree density and permit continued development and flowering. Some funds from the grant were transferred to PSW for use in improving provenance site documentation and monumenting.

Aluminum tags have been purchased to retag all of the BLM plantings. BLM is contracting to apply these new tags. Tagging has already been completed at one of the sites and is scheduled for a second site.

COSTS:

YEAR: FY 2009-11	Item	Requested FHM EM Funding			Other Funding*	Source
		2009 Last Year	2010 Current Proposal	2011		
Administration	Salary or Overtime	1,000	1,000	0	> 70,000	DGRC, other R-5 & R-6 FS & BLM personnel, PSW
	Overhead					
	Travel	20,000	20,000	3,000		
Procurements	Contracting					
	Equipment	1,000				
	Supplies	1,000				
Total		23,000	21,000	3,000	> 70,000	

*BLM and FS offices funded the establishment, maintenance, and assessment of the progeny sites for the first 15 years of these trials as did the FS for the provenance trials. These early costs totaled probably several hundred thousand dollars. The \$70,000 for other salaries is a very conservative estimate of the salary costs over the remaining time of this project (funded from other agency sources).