

Sugar Pine (*Pinus lambertiana*) Partial Resistance Heritability Study

J. Dunlap^{1, *}, D. Burton², D. Davis², D. Vogler³, and B. Westfall⁴

¹ USDA Forest Service, Region 5 Genetic Resources Program, Placerville Nursery, Camino, California, USA

² USDA Forest Service, Region 5 Genetic Resources Program (retired)

³ USDA Forest Service, Pacific Southwest Research Station, Institute of Forest Genetics, Placerville, California, USA

⁴ USDA Forest Service, Pacific Southwest Research Station, Albany, California, USA

*jdunlap@fs.fed.us

The health and regeneration of sugar pine (*Pinus lambertiana*), a major species in the mountain forests of California (USA), has been substantially affected by an exotic pathogen, *Cronartium ribicola*, which causes white pine blister rust. Seedlings from trees with major gene resistance (MGR) are being used to increase field survival in plantations. Partial resistance (PR) due to multiple genes is considered to be more durable than MGR, providing protection to sugar pines exposed to a virulent form of blister rust. In 2006, a field study was established on the Klamath National Forest to examine PR traits and their inheritance in progeny from 128 families whose parents were known to produce rust-susceptible (FR) or PR progeny as well as parents having PR traits but without information about their progeny. The crossing scheme was a mixed-factorial diallel; the field design was randomized incomplete blocks with noncontiguous single-tree plots. Trees were planted at close spacing, irrigated, and naturally exposed to blister rust over multiple years from onsite *Ribes* species, the alternate hosts. Data on mortality from rust, number of rust cankers, and canker types were collected from 2010 to 2013. Progeny from PR parent(s) had a substantially lower percentage of trees that died from blister rust (8 to 53 percent with three to one PR trees in a family) when compared to progeny from FR parents (64 to 99 percent with one to two FR parents in a family). Progeny of PR parents also had a higher percentage of trees that were clean of rust (6

to 23 percent) and with no active infections (17 to 58 percent) compared to progeny from FR parents (0 to 2 percent clean of rust; 0 to 10 percent with no active infection). Progeny from other selected parents, based on their PR phenotypes, performed more like progeny from one PR parent or intermediate between one and two PR parents, depending on the trait examined. Quantitative analyses from 2-year data revealed that 58 and 78 percent of the variance in PR inheritance was additive (compare with Kinloch et al. 2012). Further analyses are needed on more parents and to examine components of heritability. Seed orchards with trees having MGR, PR, or both traits have been established for the western Sierra Nevada and are in development for northern California forests.

REFERENCES

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