

USDA Forest Service Botany in the News

RMRS Scientist First to Define Blister Rust Resistant Allele in Limber Pine

Limber pine (*Pinus flexilis*) is being threatened by the lethal disease white pine blister rust (WPBR), expanding bark beetle pressure, and climate change in mountain environments. The upper subalpine and treeline ecosystems dominated by limber pine are ecologically valuable to landscape dynamics, watershed protection, and biodiversity; maintaining their health is important for ecological sustainability and to society. Consequently, limber pine is approved for endangered species status under The Wildlife Act in Alberta (Canada) (Government of Alberta, 2012) and active conservation efforts in the Southern Rocky Mountains are underway (Burns et al 2008, Schoettle et al. 2011). Impacts of WPBR are evident in the northern populations; the pathogen is still spreading and many southern populations are threatened but not yet invaded (Kearns et al. 2013). The types and frequencies of genetic resistance to the rust will likely determine the potential success of proactive or restoration measures (Schoettle and Sniezko 2007).

In a recent publication in the journal *Phytopathology*, Forest Service researchers report on the first of a series of studies using individual families to examine complete resistance to WPBR and its inheritance in limber pine. Dr. Anna Schoettle and colleagues report that 14% of the 105 tested limber pine families show segregation of a disease-free trait consistent with inheritance by a single dominant gene, which they name *Cr4*, and the *Cr4* resistance allele appears to be distinct from the *Cr2* resistance allele in western white pine (Schoettle et al. 2014). This confirms limber pine as the fourth North American white pine species to show a major gene for resistance to WPBR. The frequency of the *Cr4* allele across healthy and recently invaded populations in the Southern Rocky Mountains was unexpectedly high (5.0%; ranging from 0 to 13.9%) compared to resistance allele frequencies in western white pine or sugar pine. The research suggests that *Cr4* is not a product of a recent mutation and may have other adaptive significance within the species possibly related to other abiotic or biotic stress factors. Field verification of the expression of the *Cr4* allele under natural conditions is underway and the research team is also conducting studies to identify and quantify other resistance mechanisms to WPBR in limber pine and bristlecone pines. The identification of *Cr4* and other resistance types in native populations of limber pine early in the invasion progress in this region enables the Forest Service to optimize cost effective treatments by timing interventions to maximize forest health benefits, consistent with the recommendations of the National Strategic Framework for Invasive Species Management (Dix et al. 2013).



The images above display infection spot types on limber pine needles following artificial inoculation with *C. ribicola*. Susceptible-type needle spots on seedlings that develop WPBR (A, secondary needle; B, primary needle); discrete necrotic-type spots on a cotyledon (C), primary needle (D) and secondary needle (E and F) on seedlings with the *Cr4* allele that remain disease-free. Spots such as shown in image C were rare. Inoculation studies were conducted at the USFS Dorena Genetic Resource Center, Cottage Grove, OR. (From Schoettle et al 2014).

References:

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