White Pine Blister Rust

Non-native, invasive rust of five-needle pines

Pathogen—White pine blister rust is caused by *Cronartium ribicola*, an Asian fungus that was introduced into North America from Europe in the early 1900s. The disease continues to spread to five-needle pines throughout North America.

Hosts—All North American white pines (members of subgenus Strobus) are susceptible. In the Rocky Mountain Region, hosts include limber pine, whitebark pine, Rocky Mountain bristlecone pine, and southwestern white pine. Alternate hosts include currants and gooseberries in the genus *Ribes* and, occasionally, species of *Pedicularis* and *Castilleja*.

Signs and Symptoms—Signs of white pine blister rust are visible on *Ribes* spp. in the summer and fall (uredinia and later telia) on the undersurface of leaves. Symptoms such as leaf spots and premature defoliation occur on Ribes spp. but otherwise, the disease causes little damage.

Figure 1. Flagged branches on limber pine. *Photo: William Jacobi, Colorado State University.*

Bright red, recently killed "flagged branches" are the most obvious symptom of white pine blister rust from a distance (fig. 1). However, other agents, such as dwarf mistletoe and twig beetles, can cause flagging. The first detectable symptoms on pines are yellow needle spots. Diamond-shaped stem cankers are often swollen and resinous and sometimes have an orange margin. Cankers are most obvious in spring and early summer when pustules (aecia) full of orange aeciospores rupture through the bark. The cankered bark becomes roughened and dark as it dies following sporulation, but the fungus continues to expand into adjacent healthy tissue. Rodents often gnaw the bark off around cankers (fig. 2)

Disease Cycle—White pine blister rust cannot spread from pine to pine but is transmitted to pines from basidiospores produced on infected *Ribes* spp. leaves. Basidiospores are short-lived and primarily disperse short distances (usually less than 1,000 ft [300 m] but possibly a few miles). Pines are infected through needle stomata in the late summer and early fall. Following infection, the fungus grows down the needle and into the bark where a perennial canker forms (fig. 3). In spring to early summer 2-4 years later, spermogonia (pycnia) form within the canker (fig. 4), and aecia are produced in the same tissue the following year. Aeciospores can travel long distances (potentially hundreds of miles) in the wind to infect susceptible *Ribes* spp. Urediniospores are produced in orange pustules (uredinia) on the underside of infected *Ribes* spp. leaves throughout the summer. These spores re-infect other *Ribes* spp. leaves;

Figure 2. Canker with orange canker margin and rodent feeding. *Photo: William Jacobi, Colorado State University.*

Figure 3. White pine blister rust stem canker sporulating on limber pine. *Photo: Kelly S. Burns, USDA Forest Service.*

Figure 4. Infected limber pine seedling with needle spots and spermogonia. *Photo: Isabelle Lebouce, Dorena Genetic Resource Center, USDA Forest Service.*

Figure 5. *Ribes* spp. leaf with infection that is producing telia. *Photo: Kelly S. Burns, USDA Forest Service.*

they cannot infect pines. In late summer, hair-like columns (telia) with teliospores are produced on infected *Ribes* spp. leaves (fig. 5). Teliospores form basidiospores that later infect pines, completing the cycle.

Impact—White pine blister rust affects trees of all ages and sizes and can essentially eliminate white pines from certain ecosystems. Branch and stem cankers eventually lead to branch death, top-kill, or whole tree mortality. The probability of branch infections reaching the bole declines with distance, and branch infections more than 2 ft (61 cm) from the trunk will usually kill the branch before reaching the main stem. Small trees are especially susceptible because most infections occur close to the main stem, quickly girdling the tree. In the Rocky Mountain Region, mortality is common on larger trees without a stem infection when numerous branch infections occur throughout the crown. White pine blister rust may severely impact reproductive potential by weakening and killing cone-bearing branches. Infected trees may become susceptible to other damaging agents such as bark beetles.

Management—The most promising strategy for managing white pine blister rust is to increase the frequency of rust-resistant individuals across the landscape. The conventional approach is to develop a rust resistance breeding program in which seed is collected from putatively resistant trees, progeny are screened for resistance, and a seed orchard is established to supply seed for restoration and reforestation. An alternate strategy for areas not yet challenged by rust is to increase age class diversity by establishing young cohorts within mature stands. Upon invasion, natural selection would occur more quickly in the young cohort than in the mature cohort, ultimately accelerating the development of a more resistant stand.

Management strategies such as pruning and *Ribes* spp. removal to decrease inoculum potential may be used to reduce infections and prolong the life of existing trees. *Ribes* spp. removal may be feasible in certain high-value areas (for example, campgrounds) where all plants within 0.6 miles (1 km) of the area to be protected can be located and completely removed. Sanitation pruning is used to remove the infection before it reaches the main stem.

Burns and others (ref. 1) present detailed management options for white pine blister rust in the Rocky Mountain Region.

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