Forest Health Management, Rocky Mountain Region

Western Gall Rust

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Introduction

Western gall rust is a disease of hard pines that is caused by a fungus which causes formation of galls on branches and stems. The fungus, *Peridermium harknessii* J. P. Moore, has a simpler life cycle than other tree rusts, although its taxonomy has been the source of debate for many years. The name *Endocronartium harknessii* has been used in most of the literature for some 20 years; however, several recent studies of the nuclear condition of the fungus indicates that the name *Endocronartium* is inappropriate.

The rust spreads directly from one infected pine to another without the need for alternate hosts. Other common names for the disease include pine-to-pine rust, globose gall rust, and Woodgate gall rust. The fungus causes growth reduction, stem deformity, and mortality.

Range and Hosts

The disease extends from northern Mexico to southeast Alaska and eastward through western Canada, the Lake States, New England and northward to Quebec and the Maritime Provinces (New Brunswick). It has been reported as far south as Virginia along the eastern coast.

The western gall rust infects more than 20 species of native and introduced hard pines. The fungus is most common in the West, where its principal hosts are lodgepole pine and ponderosa pine.

Besides lodgepole, ponderosa, and jack pines, the fungus has been reported on many other hard pines. Some of the most susceptible to infection are Monterey and Scots pine. The disease is particularly damaging to Monterey pine in northern California and southwestern Oregon. Heavy infestations of Scots pine in northern New York state in the early 1900's were caused by infected nursery stock from the West. It is also important on Scots pine in Christmas tree plantations in southern Michigan.

In the Lake States both western gall rust and eastern gall rust (*Cronartium quercuum*) coincide. The occurrence of infection by both fungi on individual jack pines has been reported.

Eastern gall rust, which has a more complex life cycle and alternates to oaks, produces similar appearing galls and spores on pines. Eastern gall rust can be distinguished from western gall rust by germinating the aeciospores. Eastern gall rust spores normally produce relatively long, unbranched germ tubes; whereas, western gall rust spores produce shorter, branching germ tubes.

A white-spored form of the fungus is present on ponderosa pine in several western states. In Colorado, the white-spored form occurs on ponderosa pine and the orange-spored form on lodgepole pine in mixed stands.

Life Cycle and Spread

The fungus is an obligate parasite. It grows perennially in the inner bark and xylem of its conifer host.

The fungus produces two types of spores: spermatia (which are rarely seen) and aeciospores. There is no evidence that the fungus has an alternate host as do most species of native tree rusts, but spreads directly from pine to pine.

The aeciospores are first produced in the late spring or early summer the second or third year after infection. New crops of spores are produced yearly thereafter until the host tissue dies. The spores are produced under bark scales in whitish sacs called peridia. High humidity causes the peridia to rupture exposing masses of orange powdery spores. As air temperature increases and relative humidity decreases during the morning, spores are released. Peaks in spore discharges occur before mid-morning and mid-afternoon.

Dispersal of spores by wind occurs immediately after the peridia rupture usually in May and June. After spores land on susceptible tissues, especially after rainfall, some germinate and cause new infections. Most infections occur on current-year shoots.

There is considerable yearly variation in the amount of infection in the West, where abundant infection in given stands occurs in relatively few years.

Damage

The fungus infects pines of all sizes and ages. Seedlings are the most susceptible and are often killed within a few years by girdling stem galls. In nurseries, galls may develop on seedlings as a result of infection by spores from surrounding infected stands and windbreak trees. Spores produced on outplanted, infected nursery stock

then infect surrounding areas. Economic losses can be substantial in nurseries and Christmas tree plantations.

Branch infections on mature trees usually are of slight importance; however, branch infections of highly susceptible trees may exceed 100 galls and consequently would reduce growth potential. Stem infections can result in growth loss and cull. Galls resulting in cankers may continue to grow slowly for more than 200 years eventually resulting in stem deformity. Cankers form weak points making stems and branches susceptible to wind breakage. Cankers also create avenues through which decay fungi can enter stems.

Cull may also result from stem cankers. Boards sawn from affected areas are structurally weak and the wood may be discolored. The number and position of cankers on the stem may prevent utilization.

Cankered trees may be found in most lodgepole pine stands in the Rocky Mountains. However, no extensive surveys have been made to evaluate gall rust damage. Infection may exceed 80 percent of stems in some stands.

Symptoms

Infection is known to occur through immature epicotyl tissues, hypocotyls and direct penetration through stomates. There may be no obvious symptoms on infected shoots during the growing season in which they were infected; however, during the summer of the second year, galls develop on the infected shoots. The following spring these galls produce spores and the cycle is repeated with spore dispersal and infection of pines.

Twigs may be girdled by the gall in one year, but more frequently development is slower. The galls are woody and perennial growing larger each year; however, the galls remain restricted in location on the branch. Eventually the branch is girdled and killed resulting in flags or dead branches. Rodents feeding on infected bark also cause the death of branches.

Older infections on main stems result in large open cankers. The swelling accompanying these cankers causes "hip cankers."

Because of the slow development of the fungus in host tissues, it is believed to be the longest-lived parasitic fungus.

Control Recommendations

No chemical controls are available for the treatment of forest stands. Removal of infected trees during stand entries for thinning, timber stand improvement and sanitation is the only practical method of reducing gall rust damage in forests. Trees

with stem cankers or with branch galls within a few inches of the main stem should be felled. The presence of a few branch galls is not sufficient reason for cutting a tree. Pruning infected branches is not practical. Infected trees with main stem cankers that encircle more than one-third of the circumference of the main stem should be removed in high use recreation sites to prevent possible tree failure and injury to recreationists.

Where the disease is common in timber production areas, it may be prudent to leave a surplus of potential crop trees in stands of precommercial thinning age to compensate for losses to the disease over the rotation age. Excess trees could be harvested commercially at a later date.

Infected windbreak trees surrounding nurseries should be felled or infected branches pruned annually to prevent dispersal of spores and infection of nursery stock. Where infection of nursery stock has occurred in the past, seedlings should be inspected after lifting and those with galls culled before shipment. Usually galls are visible within two years of infection, so they would be visible on 2-0 and older nursery stock. Shipment of infected nursery stock into the southeastern United States should be carefully monitored to prevent introduction of the rust into the natural range of susceptible southern species.

Well-timed applications of fungicides to nursery beds may reduce infection levels substantially.

Pure stands of susceptible species should not be planted in areas of high rust incidence. Individuals within a species vary greatly in their resistance to infection. Tree improvement programs should be designed to take advantage of this natural resistance.

Many species of fungi have been found on rust galls. These fungi may be saprophytes in dead gall tissues, parasites on rust aeciospores, or secondary parasites of diseased tissues. Some species may reduce damage from rust epidemics in localized areas by limiting spore production and causing gall mortality.

Various arthropods can destroy parts of cankers and galls by mining into tissues. Larvae of Dioryctria species are reported as causing most canker damage. These biological agents may have value some day in control programs; however, they are not currently practical.

Assistance

Landowners can get more information about identification and control by contacting a Cooperative Extension agent, the local state forestry office; or the Forest Health Management staff, U.S. Department of Agriculture, Forest Service.

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List of Figures (not yet available)

Cover - Lodgepole pine stand showing extensive damage to western gall rust.

Figure 1 - Closeup of fruiting gall.

Figure 2 - Aeciospores.

Figure 3 - Stem infection on seedling.

Figure 4 - Numerous infections of branches causing flagging.

Figure 5 - Large basal or hip canker.

Figure 6 - Wind breakage at canker.

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