



# TREE NOTES

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Pete Wilson  
Governor  
State of California

Richard A. Wilson  
Director

Douglas Wheeler  
Secretary for Resources  
The Resources Agency

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## Western Pines & Western Gall Rust

David Adams

Forest Pathologist, L.A. Moran Reforestation Center, P.O. Box 1590, Davis, CA 95617

### Introduction

Western gall rust (*Peridermium* (= *Endocronartium*) *harknessii*) infects 22 species of two- and three-needle pines, and is common in California on Monterey, bishop, shore, lodgepole, and ponderosa pines, and the non-native Scots pine. This native rust was first noted on Monterey and ponderosa pines in California in 1880, although it undoubtedly has been associated with these pines for several millions of years and pines in general since they first formed during the Cretaceous over 200 million years ago. Western gall rust is 'autoecious,' that is, it completes its life cycle on only one host. Rust fungi are so-named because their spores frequently are yellow to rust colored. Infections are called galls when young, swollen, still covered with living host tissue, and capable of fruiting, and cankers when old, enlarging around dead host tissue, and no longer fruiting.

There are about 5,000 species of rust fungi found on many genera of plants ranging from ferns and grasses to trees—both flowering and coniferous. Several rusts of pine, both introduced and native, in the U.S. are economically very important. Western gall rust is a most important disease in Christmas tree and ornamental Monterey and Scots pine plantings. Stem and branch infections can severely impact health and growth of smaller trees, even during their first year of growth. Branch galls may stunt or kill branches leading to loss of green foliage on more mature trees.

### Gall—Host Relationship

Rust fungi are 'obligate parasites'—they can live and reproduce only on living host tissue. Once living tissue is denied them, either by death of the branch they are on, or by death of the whole tree, the fungus will soon die. Mature, fruiting galls may be attacked and killed by insects and several secondary fungi, but they generally have not become effective bio-control agents.

Gall rust impacts different pine species in different ways. Most pine seedlings are especially vulnerable to western gall rust infection and some may be killed. However, some young pine appear to be more tolerant of the disease and grow rapidly during these years in spite of rust infection at the base of their mainstem. These trees often live to old age and are noted as those veterans with large 'hip cankers' (Figure 1). Large, old hip cankers may occur on Monterey, lodgepole, bishop, and ponderosa pines. Dead branches with dead galls

are often common in Monterey pine forests (Figure 2). Knobcone pine, a close relative of Monterey pine, can support large galls on small diameter living branches (Figure 3). Conversely, galls on ponderosa and gray pines may kill the branch terminal within a few years.

### Infection Occurrence

Infection occurs principally through spores germinating on the wet surface of the youngest branch or mainstem terminal tissue. Needles do not become infected. The fungal germ tube directly penetrates the host cuticle and epidermal cells to develop a perennial infection in living tissue. Infection of the cambium stimulates gall formation. The fungus can remain alive as long as the infected host tissue lives which may be from a few to many years on branches to the life of a long-lived tree for basal mainstem infections. Terminal branch infections are often short lived. Rarely, wounds may become infected.

Most often infections are within 10 to 20 feet from the ground in Monterey, bishop, and Scots pine—small trees are especially prone to infection (Figure 4). Conversely, tall, mature ponderosa pines in some localities are heavily infected throughout their foliar crowns (Figure 5), while nearby young pine are only lightly infected. Flagging of branch terminals (needles dying and becoming brown colored) resembles pitch canker infection and insect attack (see Figs. 4 and 5). Rust infection high in the tree foliar crown can readily be distinguished from other diseases and insect attack by the presence of the 2-3 inch diameter galls near the dead terminals (Figure 5).

### Conditions of Pine Susceptibility

Infection occurs on moist, very young, immature shoot terminal host tissue; however elongated the shoot may be at that time during its growth period. Thus, galls can be located anywhere along the length of the stem or branch for that one year (Figure 6).

Annual infection of pine is a random event dictated by coincidence timing of three factors: host tissue susceptibility, rust spore production, and favorable environmental conditions. Infection occurs during wet and cool spring and early summer months. Conditions of successful infection depend on a spore landing at

just the correct place on the moist, very young stem or branch tissue, and the presence of proper environmental conditions for at least 24 hours. The spore must germinate, the germ tube mycelium penetrate host defenses, and the fungus become established while environmental conditions remain favorable. Constant moderate temperature and high humidity (near 100%) are optimal for infection to succeed. The precise environmental and host susceptibility conditions needed for infection may not occur every year in time with spore release from galls.

Pine gall rust infection does not occur uniformly year after year. Most years some minor amount of infection may occur; but occasional years will see heavy infection. These times of abundant infection are called 'wave years.' Numerous terminal branch infections noted in 1997 on large native ponderosa pine in the Santa Cruz mountains were dated to 1992 and 1993. Wave year infections are promoted by optimal conditions for host infection coinciding with plentiful, local sporulation by the fungus.

Tolerance, and complete resistance to infection, is known in several pine species. Maturation resistance, i.e., becoming resistant with age, is reported from Monterey pine.

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## ***Gall Appearance, Lifespan, and Spore Production***

Immature, globular--shaped, slightly greenish--colored galls appear a year after infection (Figure 6). Young galls may be very difficult to find in densely foliated trees, but will become readily apparent as they enlarge and mature. The fungus is always completely covered by host bark except during fruiting. Mature galls can be conspicuous with their brightly colored spore mass erupting through cracks in the brown bark (Figure 7). Millions of spores may be released from one gall in any season, but usually will successfully cause infection.

Dormant branch buds closely associated with a new infection on Monterey pine are frequently stimulated to break dormancy giving the tree a stunted, bushy appearance at the infection site. This occurrence often gives away the presence of a very young gall (Figure 8).

The fungus will mature within several years of infection. Fruiting (spore production) usually occurs from December to July; timing of actual fruiting will vary locally depending on the particular climate of the area. Infections can live for many years, but will eventually lose their ability to produce spores. Those old, non-spore producing hip cankers on Monterey, lodgepole, ponderosa, and other pines are very nearly as old as their host—perhaps 100 or more years old.

Western gall rust disseminates by spores (technically called 'aeciospores') that can be blown several hundred miles to create new infections on pine. Aeciospores represent an asexual form of reproduction. Sexual reproduction is not known with this fungus. This disease is also called pine-pine gall rust to note that unlike some related rust fungi that require cycling between both a pine and flowering plant host to

complete their life cycle, pine is the only required host for this disease.

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## ***Control***

Gall removal by branch pruning is possible. However, latent infections and small galls are easily missed. Removal of large, well established galls, can deform the tree.

Removed mature, fruiting galls must be prevented from continuing to fruit at that time. If left lying on the ground in a shady location or buried in plant refuse piles, spores will be produced until the tissue dries out. Immediate burning, burying, or confinement in sealed bags will contain spore dissemination through death of the gall and the tree tissue supporting it.

Gall removal within a plantation may help reduce infection within the area, but most certainly will not abate infection altogether. Local control is warranted however, as nearby galls provide the greatest risk of new infections. Even so, new infections may originate, during time of spore dispersal, from active galls several or many miles away.

Chemical control as a protectant is occasionally used. Bayleton (50% Dry Flowable Fungicide, EPA Reg. No. 3125-320) is registered for use in California for control of western gall rust, and other rusts on Christmas trees, excepting concolor fir (*Abies concolor*). Bayleton is not labeled for use on seed and seedlings in California. Follow label directions for proper material rate and application. This is a systemic fungicide, i.e., it works from within, rather than externally as would a contact fungicide. Therefore, do not exceed label rates since using excess chemical may be harmful to the tree's mycorrhizal fungi. Tree stunting may occur if these root-enhancing fungi are harmed.

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## ***General References***

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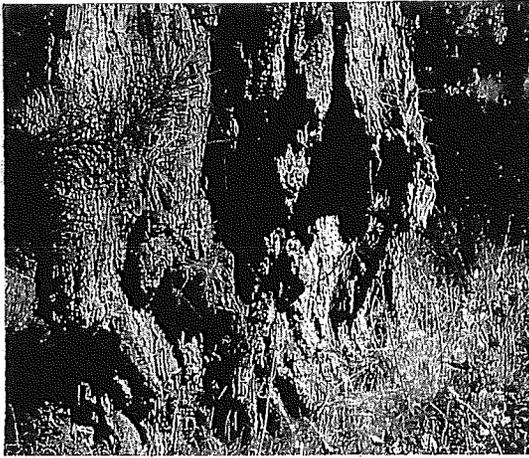


Figure 1. Hip cankers—Monterey pine.



Figure 2. Dead branch galls on Monterey pine.



Figure 3. Live gall on knobcone pine.

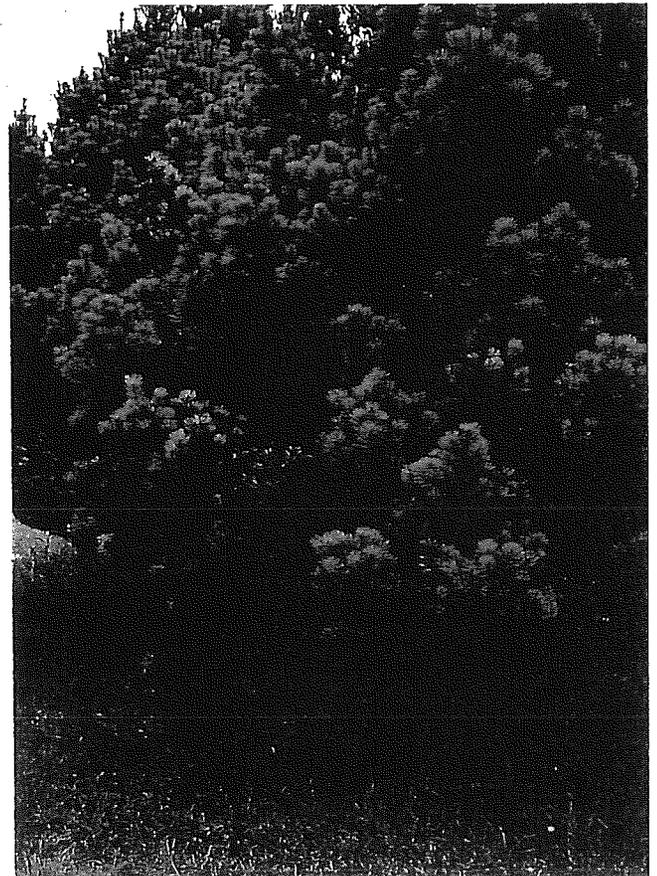


Figure 4. Bishop pine with many galled branches.

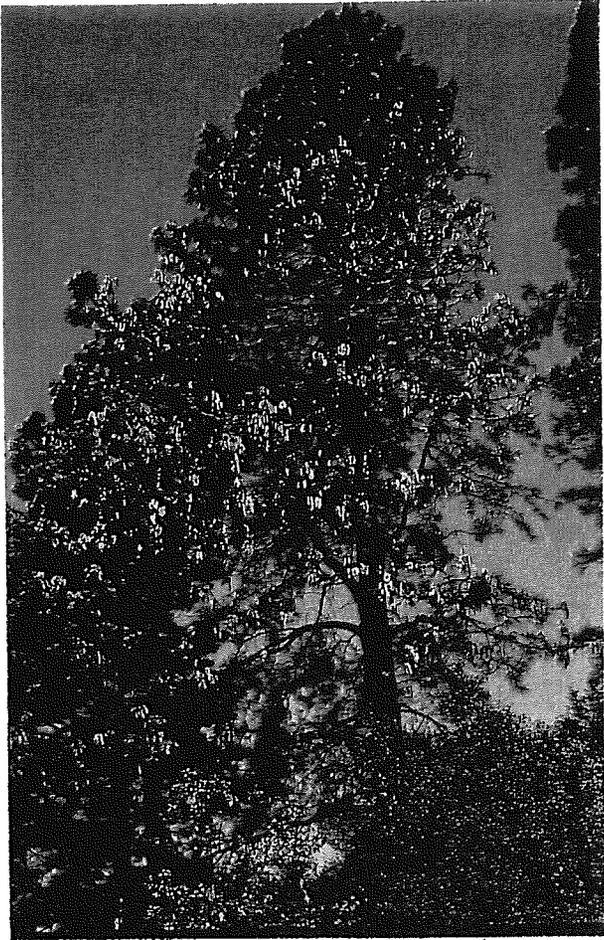


Figure 5. Severely galled, mature ponderosa pine.



Figure 6. Year old galls, Monterey pine. Successive infections in the same year.

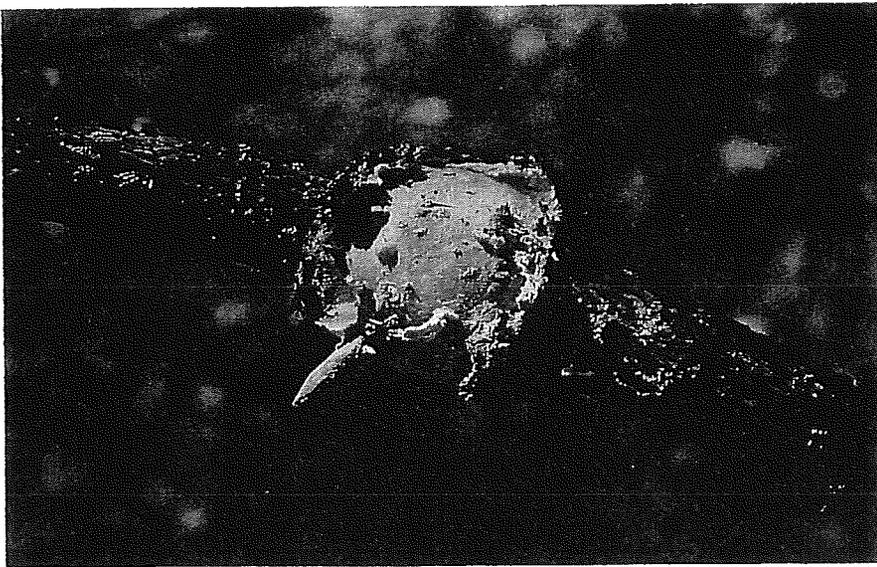


Figure 7. Fruiting gall, ponderosa pine.



Figure 8. Bud stimulation of young, gall rust-infected Monterey pine.