Western Gall Rust

Yukon Forest Health — Forest insect and disease

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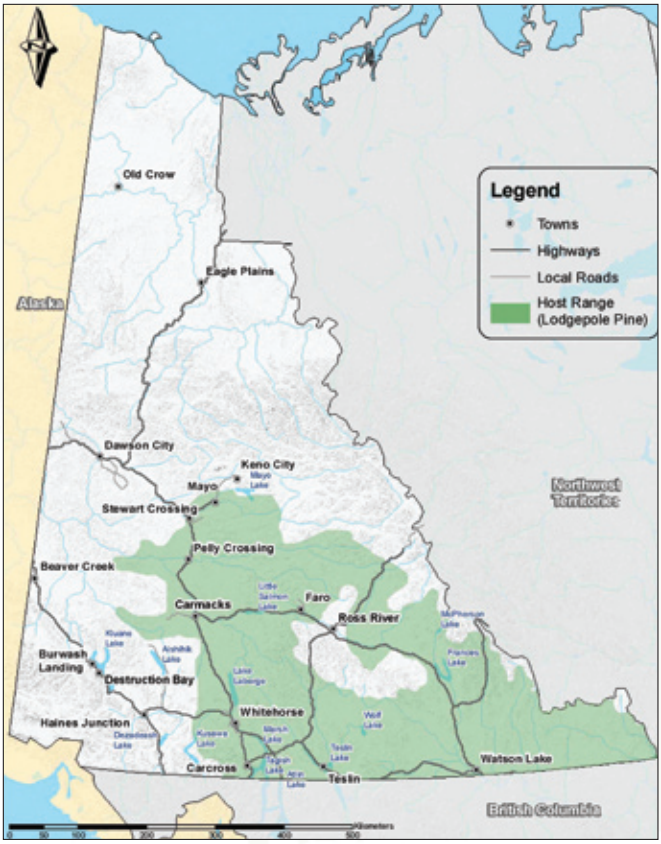
Yukon
Energy, Mines and Resources
Forest Management Branch

Introduction

Western gall rust is a stem and branch disease caused by the fungus *Endocronartium harknessii*. In Yukon this disease parasitizes live lodgepole pine (*Pinus contorta*). Unlike most other rusts, that alternate generations between more than one host, western gall rust is autoecious, completing its life cycle on a single host. It can therefore spread directly from tree to tree via wind dispersed spores. Once the tree is infected, the fungus stimulates production of the tree's growth hormones to cause extra growth in the vicinity of the infection, resulting in an enlargement of the tree's stem or branches, called a "gall." Stem and branch galls reduce growth, devalue the wood and create points of weakness. Gall rust rarely causes mortality, but when it does, it is by girdling the stems of young trees. It can indirectly cause the death of trees through breakage where gall formation has resulted in a point of weakness. Western gall rust is commonly observed at endemic levels throughout the pine host range in Yukon. Minor incidences of western gall rust were noted in surveys conducted in the Teslin Tlingit Traditional Territory.

Host Range for Western Gall Rust



(Source data: Yukon Government Forest Inventory Data [2008] and U.S. Geological Survey [1999] Digital representation of "Atlas of United States Trees" by Elbert L. Little, Jr. (http://esp.cr.usgs.gov/data/little/)
Disclaimer: The data set for historic incidence is likely incomplete and only extends from 1994–2008. Endemic or outbreak populations may have occurred or may currently exist in non-mapped locations within the host range.

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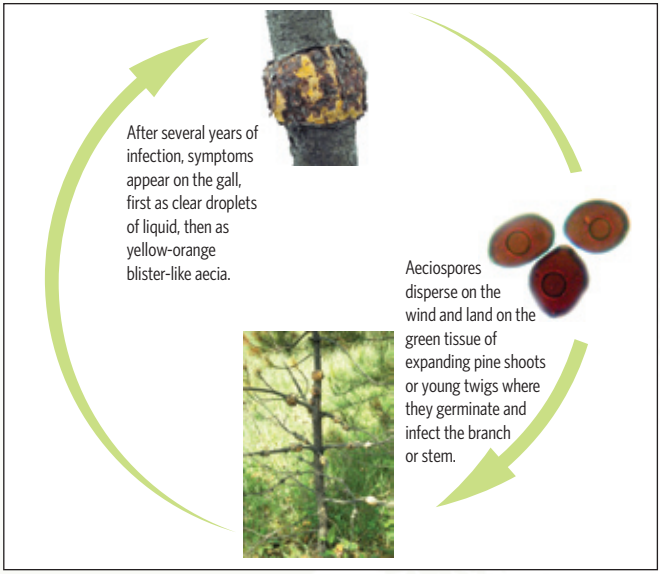
Disease Cycle



Western gall rust has two separate spore states. The pycnial state is a microscopic sexually reproductive form of the rust fungus, and is less relevant from a forest management perspective. The aecial state is responsible for dispersal and infection of other host trees.

The general disease cycle is as follows:

1. The gall rust grows perennially within the gall. After two to four years of infection, symptoms appear at the point of infection in spring as droplets of clear, viscous liquid are produced from the gall (spermatia produced from pycnia). In late spring, this is followed by the production of yellow to orange, blister-like aecia (1–8 mm in diameter).

Definitions:

Teliospores: *thick-walled resting spores of some fungi from which basidium arises.*

Hyperparasitic: *a parasite that is parasitic upon another parasite.*

2. The aecia burst revealing yellow-orange spores (aeciospores) which, for approximately six weeks through June and into July, disperse on the wind to other pine hosts. The aeciospores of western gall rust are unusual in that they are aecidioid teliospores (spores having the morphological characteristics of aeciospores but germinating and functioning like teliospores).

3. The spores land on the green tissue of expanding pine shoots or young twigs where they germinate and infect the pine branch or stem.

4. Once infected, the cycle continues as per step 1. As long as the infected tree does not die either from the gall or from its weakened state, the gall will produce spores as long as it remains alive. Galls will live until the stem or branch above the gall dies or until it is invaded by a hyperparasitic fungus.

Host Species Attacked and Damage

Tree species attacked in Yukon: All age classes of lodgepole pine. All two and three needle (hard) pines are susceptible.

After one to two years of infection, galls begin to form, first as inconspicuous swellings, then growing each year to become obvious swellings of the branch or stem. Galls are weakened points on the tree and, depending on their exact location, can result in branch death or top-kill **(photo 1)**. The galls also inhibit the transport of water and nutrients essential for tree growth and survival. A tree with branch galls usually exhibits reduced growth and some deformation of branches **(photo 2)**. The gall is rarely the direct cause of tree death but a tree with a stem gall will be weakened considerably and may die as a result. Damage is greater and tree mortality more likely in young trees because of the girdling of small diameter stems.

Snowshoe hare (*Lepus Americanus*), squirrel (*Tamiasciurus hudsonicus*) and porcupine (*Erithizon dorsatum*) feeding damage is often seen on galls because of the higher sugar content of infected tissues. This can also result in branch or stem mortality if the feeding girdles the tree.

Key Features for Identification:

- Round or pear shaped enlargements (galls) on the stem and/or branches **(photo 3)**.
- Yellow-orange blister like fruiting bodies at the site of the gall **(photo 4)**.
- Orange-yellow spores in spring.
- Rodent and small mammal feeding damage around the gall.

Photo number:

1. **Stem weakened by gall rust.** Citation: I. Blakey Lockman, USDA Forest Service, Bugwood.org
2. **Tree damage.** Citation: Natural Resources Canada, Canadian Forest Service.
3. **Stem and branch galls.** Citation: Bob Erickson, Natural Resources Canada, Canadian Forest Service.
4. **Gall caused by western gall rust showing orange spores.** Citation: Natural Resources Canada, Canadian Forest Service.


1


2


3


4

Similar damage

Gall rusts can be confused with comandra blister rust (*Cronartium comandrae*) infections especially when spores are present. Blister rusts do not produce galls.

Risk Assessment

The following tables summarize the likelihood of occurrence and magnitude of impact of an outbreak at the stand level. These tables are a coarse guide for estimating the risk of an outbreak when populations are at endemic levels

Likelihood of Occurrence

Stand Infection Hazard:	**High → Low**	
Stand age[1]	Young	Mature
Previous year's summer climate[2]	Wet, warm	Dry
Pine component[3]	>50%	<50%

Notes:

1. Young pine stands are more susceptible to infection because of their proximity to the ground and the abundance of new shoots. They are also more susceptible to girdling (by the fungus or small animal damage) due to the small diameter of the stem. Galls generally occur at 1–2 m and taller trees are less likely to become infected because needles and new twigs are higher.
2. Wet/warm summers offer the best conditions for the spore to germinate, and consecutive years of warm wet weather in the summer can result in "wave years" when numerous infections occur in the same year, forming many galls on shoots of the same age class.
3. Stands with a greater component of infected pine increase the potential for inoculum, thus they are a higher hazard.

Magnitude of Consequence

The magnitude of consequence is a subjective assessment of the potential consequences of an outbreak. This list is not exhaustive and is intended to stimulate thought on potential impacts to consider over time.

Value	**Impact**							
	-							**+**
Traditional Use[1]								
Comment:	No impact anticipated							
Visual Quality[2]								
Comment:	No impact anticipated							
Timber Productivity[3]	■	■	■	■				
Comment:	Growth reduction (-)							
Wildfire Hazard[4]								
Comment:	No impact anticipated							
Public Safety[5]								
Comment:	No impact anticipated							
Hydrology[6]								
Comment:	No impact anticipated							
Time Scale (years)	20+	15	10	0-5	0-5	10	15	20+
Comment:	Impact refers to a predicted, substantial positive (+) or negative (-) impact on a value for an estimated time period							

Notes:

1. In this context, traditional use values considered are hunting, trapping and understory shrub/plant use. Given that western gall rust outbreaks rarely occur in Yukon, no impact is anticipated.

2. Visual quality is not impacted, as gall rusts usually do not cause stand level symptoms.

3. Infection rarely causes tree mortality but galls, combined with secondary fungi, or animal feeding damage, can girdle the stem causing either branch-kill, top-kill or tree mortality depending on the location of the infection. The growth rate of the tree and quality of the wood is diminished by stem gall rust infections.

4. Given that gall rust only affects a limited portion of the tree and rarely causes mortality, no impact is anticipated.

5. Given that gall rust rarely cause mortality, no impact is anticipated.

6. Given that gall rust rarely cause mortality, no impact is anticipated.

Implications of Climate Change

General Circulation Model (GCM) results in the 2007 Intergovernmental Panel on Climate Change (IPCC) report indicate that warming in northern Canada is likely to be greatest in winter (up to 10°C) and warmer by 3–5°C in summer. Mean annual precipitation is also predicted to increase (particularly in fall and winter). More rainfall is expected on windward slopes of the mountains in the west, therefore the rain shadow effect of the St. Elias Mountains may mean that southern Yukon does not experience increased rainfall. High temperatures will increase levels of evaporation and transpiration, and ultimately lower soil moisture levels. Therefore, even if summer rainfall is maintained at current average levels, higher temperatures would result in limited soil water availability and cause moisture stress in trees. Currently, climate scenarios suggest that Yukon will experience a warmer climate that will be wetter or drier in the future depending on the region.

Temperature and precipitation are likely to be the dominant drivers of change in pathogen abundance and tree responses as it influences pathogen development, dispersal, survival, distribution and abundance. As with other pathogens, moisture is a critical factor during spore dispersal and germination for the western gall rust. Increased precipitation combined with warmer temperature during the spring months would mean more successful infection of new host material.

Management Options

Monitoring

Western gall rust is best monitored from ground surveys due to its limited extent and damage. The best time of year for monitoring is early summer when the orange spores and fruiting bodies are most conspicuous. For efficiency, monitoring should focus on recently planted or young stands. Monitoring can also be completed during thinning or stand tending. For strategic planning information, refer to the Forest Management Branch risk-based monitoring strategy (Ott, 2009).

Direct Control

Because the rust rarely causes significant damage to pine stands in Yukon, direct control is not generally recommended. If treatment is required to protect high value trees, the gall rusts can be pruned off the trees. However, if it occurs on the main bole, the top of the tree including the gall would have to be removed. Removal is the only practical direct control approach. Preventative fungicide sprays can be used on high value trees during the spore release period but should be repeated twice each growing season to adequately protect new shoots as they expand. In general, fungicide application should be avoided to prevent the development of resistance in the rust.

Definitions:

Bole: *the main stem of a tree.*

Harvesting Considerations

Harvesting of pine may occur either as a by-product of private/industrial land clearing or if a commercial forestry operation is undertaken. Harvesting will not likely contribute to the spread of the disease.

Silvicultural Considerations

Silvicultural considerations are relevant if a stand is being managed for commercial forestry or if an area is being replanted. Consider managing for increased stand biodiversity by utilizing a range of preferred and acceptable species for planting. Heavily infected trees should not be retained as seed trees and seed should not be collected from stands with high levels of infection. Nursery and ornamental stock that is infected should be destroyed.

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