White Pine Blister Rust

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Introduction

Cronartiumribicola, also known as white pine blister rust, obtained its common name from the tell-tale symptom of rust colored cankers that appear on the branches of infected trees. If left alone, the expansion of the perennial cankers along the stem to the main trunk eventually kills the afflicted tree. This unique pathogen is one of the most well known and devastating plant diseases brought to North America. Though fungicides are not effective in the control of white pine blister rust on pine trees, there are management techniques which can help to reduce its impact.

Pathogen History

Originating from Asia, *Cronartiumribicola* was imported to Europe long before international plant transport regulations were established. Pine, a historically valuable lumber for the United States, became depleted in many parts of the country. In an attempt at reforestation, the disease was accidently brought from Germany to the United States around 1900 on eastern white pine seedlings. It was first documented on *Ribes* in 1906 in Geneva, NY and observed soon after along the northeastern coast on white pine seedlings in 1909. The introduction of blister rust to the west originated in 1910 from a shipment of eastern white pine seedlings transported from France to British Columbia.

Without previous exposure to white pine blister rust, the pines had no natural resistance to the completely foreign pathogen, and as a result, the disease quickly proliferated. White pine blister rust spread through forests, wiping out substantial populations of white pines, causing not only great economic losses, but negatively impacting forest ecosystems as well.

Disease Life Cycle

White pine blister rust cannot pass from one pine to another. The fungus has a macrocyclic, heteroecious (multiple host) life cycle. This means for the fungus to complete its life cycle, it requires two unrelated hosts; in this case the hosts are white pines and *Ribes* species. The most susceptible species of *Ribes* are European Black Currants (*Ribesnigrum*), however red currants, (*Ribes rubrum, R. sativum and R. petraeum*) as well as American and European gooseberries (*Ribeshirtellum* and *Ribesuva-crispa*) are also adequate hosts. Additionally, Indian paintbrush (*Castillija spp.*) and snapdragons (*Pedicularis spp*.) have recently been identified as potential hosts for white pine blister rust.

The fungus is very complex and takes on five spore forms throughout its life cycle: pycniospores, aeciospores, urediniospores, teliospores, and basidiospores. The fungus overwinters in the cankers, or pycnia on pine trees. In the spring of the second year, aeciospores develop and are released from the cankers of infected pines and carried by wind, traveling distances as far as 300 miles. When the aeciospores come to rest on a host *Ribes* plant, uredinia form on the undersides of the foliage and produce urediniospores, which can also spread more broadly to other nearby *Ribes* species hosts. In the late summer teliospores are produced in the infected area of the *Ribes* host plant and germinate to produce delicate

basidiospores, which are then released in the fall and dispersed into the air, traveling distances of between a few hundred feet to a few miles. The basidiospores land on a suitable pine host species, germinate and the fungus mycelium enter through the stomata of a pine needle (tiny openings which allow for gas exchange) during cool, damp conditions. Once the fungus enters the needle, it continues to gradually grow within the tree and down the twig, through the branch and then toward the stem. The pathogen overwinters on the pine, and the following spring, pycnia (stem rust or cankers) form on the bark. In following years, aeciospores continue to be released from the pycnia, until the branch dies. Ultimately, the disease reaches a main stem and by that point death of the tree is unavoidable.

Identifying Symptoms of White Pine Blister Rust

Symptoms of white pine blister rust begin on the needles of susceptible pine species. Small yellow or red spots on the needle can be observed upon close inspection in the spring, most likely found on young trees and lower branches, particularly those closest to the ground. The very early symptoms can easily go unnoticed. Subsequently, the disease makes its way into the branches and becomes more apparent the following year, as dead sunken areas, or cankers appear. Within a year or two of infection, cankers can swell and may have a yellowish rust-like margin. There may also be resin flow or evidence of ‘chewing’ from rodents feeding on the cankers. Infected branches will die within a few years leaving a branch of red needles, also known as a“branch flag”.

On *Ribes* host plants, symptoms appear in the summer on the undersides of the foliage, where the orange spotted urediniospores can be observed. By late summer and early fall telia, or brown hair-like projections begin to form in the same area.

Conditions Conducive for White Pine Blister Rust

Five needled white pines are the most susceptible host, with the most prominent at risk species being eastern white pine *(P. strobus),* western white pine *(P. monticola),* sugar pine *(P. lambertiana)*, whitebarkpine *(Pinusalbicaulis)*, limber pine *(P. flexilis)*, foxtail pine *(P. balfouriana),* *s*outhwest pine *(Pinusstrobiformis)* and bristlecone pine *(P. aristata)*.

Blister rust favors cool damp conditions, especially in topographic depressions and areas of poor drainage. Aeciospores can travel many miles and live for months in suitable conditions, spreading easily to host plants throughout damp valleys and areas with poor air circulation. Pines subsiding on ridges and upper slopes tend to be less vulnerable to blister rust.

The spores typically begin their damage within nine feet of the ground, leaving low lying branches and young pine trees at a much greater risk of infection. Lower needles tend to stay moist for longer periods of time, creating a comfortable environment for the fungus to thrive.

White Pine Blister Rust Prevention and Remediation

The most effective control for the disease thus far has been the removal of European Black Currants (*Ribesnigrum)* from areas where white pines are present. The pathogen cannot infect pines without having a second host plant to germinate and produce the basidiospores that infect the pines. Basidiospores are delicate and short lived. Infected pines need not be

removed, since the disease cannot spread from tree to tree. Removing infected branches, by pruning no less than four inches from the stem, can salvage a tree. Preemptively pruning off lower branches, especially in sites with moist situations or poor air circulation, may decrease the occurrence of the disease. No more than one third of the branches should be pruned at one time. Young trees should be monitored closely, as they are especially susceptible. For detailed pruning instructions and illustrations, please see the USDA Forest Service link "How to Manage Eastern White Pine to Minimize Damage from Blister Rust and White PineWeevil": http://www.na.fs.fed.us/spfo/pubs/howtos/ht_white/white.htm

Improved Resistance Breeding

As certain species of *Pinus* have displayed resistance in the wild since the 1950's, current breeding programs are focusing on disease resistant species of white pine to release into the market, which appears to be promising. The University of Minnesota has released a variety known as 'Silver Splendor' which shows good resistance, however it is not one hundred percent, therefore it is intended for urban planting, not reforestation efforts.

For Further Reading

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_white/white.htm

http://ohioline.osu.edu/hyg-fact/3000/pdf/3205.pdf

http://www.fruit.cornell.edu/berry/production/pdfs/ribescultreview2012.pdf

http://www.researchgate.net/publication/48856457_Pine_Blister_Rust_Resistance_Screening_in_Ribes_Germplasm

https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5302971.pdf

See Also

NJ Department of Agriculture White Pine Rust Quarantine:

http://www.nj.gov/agriculture/divisions/pi/prog/plantpest.html#Blister Rust

http://www.state.nj.us/agriculture/divisions/pi/pdf/AmendedFinal05-NJAC220Quarantines.pdf

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