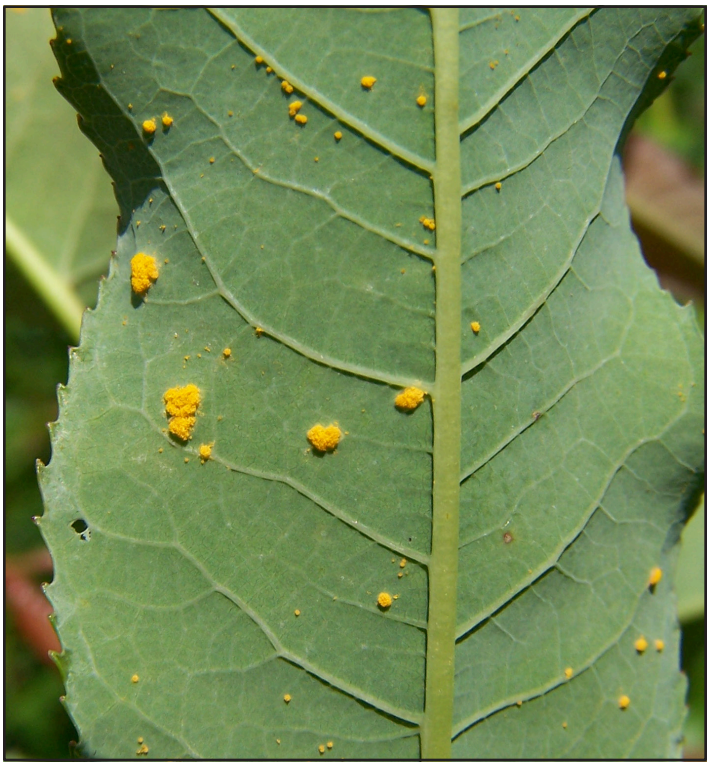
Cornell University
Department of Plant Pathology
and Plant-Microbe Biology

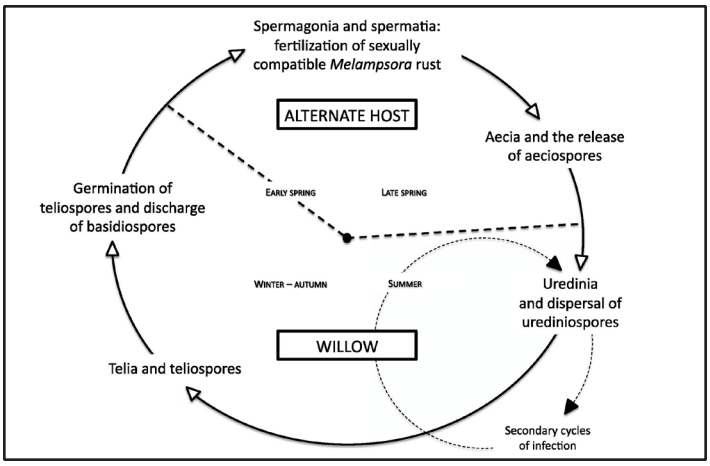
Leaf Rust

Introduction

Leaf rust of willow (*Salix* spp.), a widespread and common disease of native and cultivated *Salix*, can severely defoliate shrubs and/or trees with up to 100 percent of leaves shed six or more weeks prior to normal autumn leaf drop. The disease is caused by fungi belonging to the genus *Melampsora* (Uredinales: Melampsoraceae) and is considered the most serious disease affecting intensively managed willow plantations in North America and Europe.



Willow rust (*Melampsora* spp.): Uredinia and exposed urediniospores on the lower-leaf surface of *Salix ericocephala* (Tully, NY; August, 2009)



Willow rust (*Melampsora* spp.) life cycle

Biology

Willow-infecting *Melampsora* species have complex life histories during which they alternate between willow and an unrelated host to complete their life cycles. Two species, *M. epitea* and *M. paradoxa*, exist in N. America. Important alternate hosts of *M. epitea* in New York State are balsam fir, white fir, and saxifrages. *Melampsora paradoxa* infects willow as well as European larch, western larch and tamarack. Yellow to orange pustules (uredinia) appear on the underside of willow leaves beginning in late spring and continue throughout the summer. These pustules eventually rupture the epidermis to release large numbers of golden-yellow spores (urediniospores). This stage of the rust life cycle, referred to as the "repeating phase", serves to continuously reinfect the initial *Salix* host as well as to spread the rust to surrounding willows. In mid-autumn, uredinia change to orange-brown or dark brown telia that overwinter on fallen willow leaves and release fragile basidiospores the following spring. Basidiospores are wind-disseminated and infect the foliage of the alternate host (e.g., balsam fir). Spermagonia appear shortly after infection in the late spring and are followed by aecia containing yellow to orange aeciospores, which are dispersed by wind and infect the current growth of willow. Within two-weeks,

Willow rust (*Melampsora* spp.): uredinia bearing urediospores on the lower-leaf surface (28x) of S*alix ericocephala* (Constableville, NY; August 2009).

uredinia and urediniospores are produced on the lower surface of willow leaves; thereby, renewing the fungus life cycle. There is good evidence to suggest that special forms of *Melampsora spp.* can overwinter as mycelium or uredinia within dormant willow buds and stems. If so, this eliminates the need of an alternate host and shortens the annual disease cycle.

Susceptibility

Severe infestations of willows with *Melampsora* spp. can result in defoliation, premature leaf senescence, and predispose the host trees to abiotic stressors (e.g., competition and drought) as well as secondary disease organisms (e.g., foliar and/or canker pathogens). These compounding factors can lead to significant reductions in biomass. The susceptibility of native *Salix* species (e.g., *S. discolor, S. eriocephala, S. nigra, S. pyrifolia*) to *Melampsora*-infection has not been elucidated and warrants future study, however, all willows endemic to cool temperate regions of N. America are thought to be susceptible to at least one *Melampsora* species. In biomass-producing plantations in NY, the majority of *S. eriocephala* appear to be highly susceptible to *Melampsora* rust. Several *S. purpurea* cultivars as well as crosses between *S. viminalis* and *S. miyabeana* also are susceptible to infection; yet, leaf infections on these clones are limited to the lower third of the canopy and rust-associated defoliation is rare. Further field and inoculation studies are required to quantify rust resistance among willow clones and genotypes destined for commercialization.

Management

Severe reductions in yield can be avoided by planting mixtures of willow clones that differ in resistance to *Melampsora* rust. Six to ten genotypes are commonly planted in European coppice plantations where disease pressure is high. Fungicides (e.g., triadimefon or mancozeb) also are effective at protecting willow against rust. However, regular fungicide applications often are impractical economically and environmentally. Sufficient chemical coverage for the control of rust is further complicated 1-3 years after coppicing by stool/stem-density and the intermingling of foliage. Therefore, fungicide application is not a favored method for controlling rust in short-rotation coppice plantations.

Selected References

Bagyanarayana, G. 2005. The species of Melampsora on Salix (Salicaceae). Pages 29-50 in M. H. Pei and A. R. McCracken, editors. Rust diseases of willow and poplar. CAB International; Cambridge, MA, USA. 264 pp.

Cornell University Cooperative Extension. 2007. 2008 Pest management guide for commercial production and maintenance of trees and shrubs. Cornell University; Ithaca, NY, USA. pp.107.

Johnson, W. T., W. A. Sinclair, and J. L. Saunders. 1976. Insects and diseases of willow and poplar. Cornell University; Ithaca, NY, USA. pp. 7.

McCracken, A. R., and W. M. Dawson. 2003. Rust disease (Melampsora epitea) of willow (Salix spp.) grown as short rotation coppice (SRC) in inter- and intra-species mixtures. Annals of Applied Biology 143:381-393.

Shawn C. Kenaley[1], George W. Hudler[1], Dawn Dailey O'Brien[1], Kimberly D. Cameron[2], and Lawrence B. Smart[2].

[1]Department of Plant Pathology and Plant-Microbe Biology, Cornell University, Ithaca, NY 14853, [2]Department of Horticultural Sciences, Cornell University, New York State Agricultural Experiment Station, Geneva, NY 14456.

Funding provided by New York Farm Viability Institute to LB Smart.

Published August 2010
Cornell University