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Dr. Yonghao Li
Department of Plant Pathology and Ecology
The Connecticut Agricultural Experiment Station
123 Huntington Street
New Haven, CT 06511

Phone: (203) 974-8601
Fax: (203) 974-8502
Email: Yonghao.Li@ct.gov
Website: portal.ct.gov/caes

PINE WILT

Pine wilt is one of the most destructive diseases of pine trees. The disease is caused by the pinewood nematode that develops in water-conducting tissues of a pine tree and cause wilting of the tree. The disease can kill infected trees within a season, especially under the condition of heat and drought stress in the summer (Figure 1). The nematodes attack most Pinus species. Among them, Scots and Austrian pines are highly susceptible, while mugo, Japanese black, and white pines are moderately susceptible or resistant.

Figure 1. A dead pine tree infected with pine wilt.

SYMPTOMS AND DIAGNOSTICS

The initial sympotm of the disease includes wilting and drooping of grayish green needles, which first appears on a few branches at the top of the tree. And then the symptom develops quickly throughout the canopy and kill the tree. Infected stems and twigs may dry quickly and become brittle, but brown needles may remain on dead trees for several months (Figure 1). Blue-stain fungi (*Ceratocystis* spp.) may be introduced to dying or dead trees by bark beetles and exhibit blue stain symptoms in the wood when cut (Figure 2). Bark beetles also mine the inner bark and cause further damages on weakened trees. When infested barks are removed, bark beetle galleries may be noticed on the wood (Figure 3).

Figure 2. Sectors of blue discoloration in pine log, caused by blue-stain fungi.

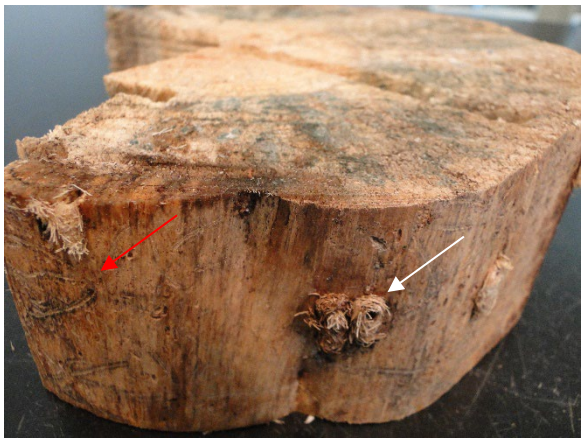

Figure 3. Bark beetle galleries under the bark tissues (red arrow) and sawyer beetle exit holes (white arrow) on a pine log.

Confirmation of pine wilt disease needs a microscopic detection and identification of the pathogenic nematodes in infested wood samples from the main trunk or branches.

DISEASE DEVELOPMENT

The pinewood nematode, *Bursaphelenchus xylophilus*, overwinters in infected trees and completes its life cycle from egg to adult between five and ten days depending on temperatures. During warm periods in the summer, the nematodes undergo rapid population growth and quickly spread throughout the tree. Pinewood nematodes feed on epithelial cells and resin ducts of living pine trees, but also survive in dead pine trees by feeding on blue-stain fungi. The pinewood nematodes are transmitted by pine sawyer beetles, *Monochamus* spp. In the spring, adult pine sawyer beetles emerge from infected trees and carry the nematodes to healthy trees through feeding on young shoots. In the summer, the sawyer beetles are attracted by stressed and dyng pine trees and lay their eggs under barks of the trees. After eggs hatch, larvae feed on the living plant cells lining the resin canals outer sapwood and burrow into woods. When adults emerge from infected trees, leave exit holes on the trunk (Figure 3). The pine sawyer beetles can complete their life cycles in 50 days to 60 days. Normally, more than 10-years old pine trees are volunable to pine wilt. Pine trees weakened by heat and drought stress or attacked by other pathogens are more likely to be killed by the pine wood nematodes. So, pine wilt involves complicated interactions between pine species, pinewood nematodes, pine sawyer beetles, bark beetles, blue-stain fungi, and environmental conditions.

MANAGEMENT

Resistant species: Eastern white pine, jack pine, and pitch pine are moderately to highly resistant. Other non-host conifers, such as larch, fir, spruce, and Douglas fir are commonly recommended as replacement trees for susceptible Scots and Austrian pines.

Cultural practice: If pine wilt is confirmed, the diseased trees cannot be saved. So, dead or infected trees need to be removed and destroyed by burning or burying before the pine sawyer beetles carry the nematodes from infected trees to healthy trees. Do not save wood from diseased trees for firewood. Keep trees healthy and vigorous by watering during extended drought periods to prevent beetle infestation.

Chemical protection: Healthy, high-value trees may be protected from pine wilt with trunk injection of abamectin or emamectin benzoate. Once a tree is infected with pinewood nematodes, pesticide treatments are no longer effective. The treatment should be applied by a certified arborist and repeated by following the instruction of the label.

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