

## **PHYTOPHTHORA ROOT ROT OF WOODY ORNAMENTALS**

Phytophthora root rot (PRR) is one of the most destructive diseases of woody ornamentals in both nursery and landscape settings. A wide range of woody ornamentals are susceptible to PRR, such as rhododendron, azalea, Japanese yew, mountain laurel, lilac, Fraser fir, arborvitae, juniper, boxwood, and dogwood. Plants can be infected at all growth stages from propagation beds to landscapes and fields. Young plants are more susceptible and can be killed by PRR in a single season when they grow in poorly drained soil and excessive water conditions.

### **SYMPTOMS AND DIAGNOSTICS**

PRR, a soilborne disease, initially attacks small feeder roots in the soil, and then develops up to the lower trunk through larger roots. When a significant portion of roots is

infected, the water and nutrient uptake capacity of the plant can be reduced, and aboveground symptoms may become evident. Common symptoms include browning of leaves/or needles, slow growth, stunting, leaf scorch, wilting, diebacks, and death of the plant (Figures 1, 2, 3, and 4). Development of aboveground symptoms may take weeks or months depending on the degree of root damages. Plants that are infected in propagation beds or nurseries may remain symptomless until being transplanted in fields and landscapes. In Christmas tree farms, the initial symptom of PRR appears one or few dead branches with brown needles at the lower part of the tree (Figure 3). As the disease progresses, the tree may decline over a period and die in a few months or years (Figure 4). When the roots and lower trunk of infected trees are examined, browning of



Figure 1. Bronzing and curling of leaves on a rhododendron.



Figure 2. Wilting and necrosis of new growth on a rhododendron.



Figure 3. Flagging of basal branches (arrows) on Fraser fir trees.



Figure 4. A dead Fraser fir tree.



Figure 5. Orange-brown feeder roots (red arrow) and inner bark tissues (green arrow) of lilac.



Figure 6. Reddish brown root (red arrow) and crown (green arrow) tissues of Fraser fir.

the outer layer of sapwood (Figures 5, 6, 7, and 8) and a clear demarcation between cinnamon-brown infected tissues and off-white healthy tissues can be observed (Figures 6 and 8).

### DISEASE DEVELOPMENT

Several *Phytophthora* species, *P. cinnamomi*, *P. parasitica*, *P. citricola*, *P. cryptogea*, and *P. cactorum*, can cause PRR of woody ornamentals. All these species belong to fungal-like organisms (also called water-mold) that survive as resting spores, oospores and chlamydospores, in the soil or plant

materials for many years. The pathogen spreads through water splashing, surface runoff water, movement of contaminated soil clinging to equipment and tools, and infected plants. A long-distance spread of PRR is through the movement of diseased seedlings and transplants between greenhouses, nurseries, and landscapes. When free water is available in the soil, resting spores germinate and infect roots directly or produce mobile zoospores that swim toward fine roots of susceptible host plants. After zoospores contact with susceptible tissue, they germinate and infect roots. Clay soil, severe

compaction, poor drainage, and excessive water are favorable for the disease development. Such conditions not only prefer spore movement and germination, but also weaken roots and make them more susceptible to PRR. Drought stress and nutrient deficiency may exacerbate root damages and aboveground symptom development.

## MANAGEMENT

Because there is no known cure for the disease, using an integrated pest management program is the key strategy to prevent PRR in nurseries and landscapes.

*Resistant species/varieties:* Avoid planting susceptible species/varieties on the site where has poorly drained soil and is known history of PRR. Winterberry, sweetgum, magnolia,

willow, ginkgo, and river birch are reported tolerant or less susceptible to PRR.

*Cultural practice:* Purchase disease-free nursery stocks or transplants from reputable sources. Quarantine incoming plants for several day to monitor any symptoms of PRR before transplanting. Remove any infected plants from the site and don't replace with susceptible plant species. In landscapes or fields, improve water drainage of the soil by breaking through the compacted layer, raising beds, and adding organic matter. In greenhouses and nurseries, use well drained potting mix for containers. Water plants when needed to prevent them from over- or under-watering. Avoid prolonged saturation of the soil or standing water around the base of plants in landscapes. Redirect downspout water for foundation plants. Keep a low soil pH (3.5 to 4.5) to suppress spore release and

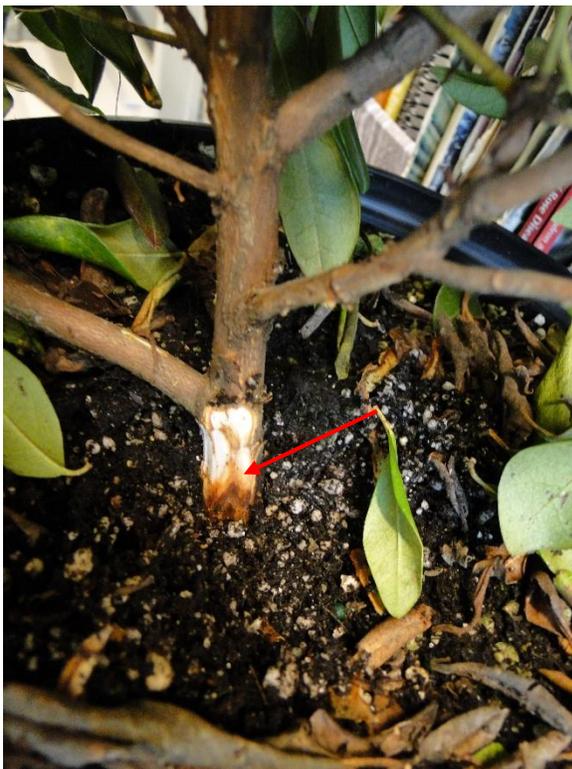


Figure 7. Brown necrotic inner bark and wood tissues (arrow) at base of the diseased rhododendron stem.



Figure 8. A sharp line of demarcation between the healthy and diseased inner bark tissues of Fraser fir.

promote the growth of acid-loving plants. Avoid high nitrogen fertilizers and ammoniacal sources of nitrogen. Avoid using water from ponds, rivers and streams as this water may be contaminated with Phytophthora. If irrigation water is reused in nurseries, monitor Phytophthora in recirculating irrigation water and disinfest the water source if it is contaminated with Phytophthora.

*Fungicides:* Systemic fungicide applications by dipping roots and drench soil may prevent PRR in nurseries and farms. But fungicide treatments are effective only when appropriate cultural practices adopted. Fungicides that are registered for PRR include fosetyl-Al, phosphorous acid, mefenoxam, metalaxyl, dimethomorph, oxathiapiprolin, mandipropamid, etridiazole, propamocarb hydrochloride, and pyraclostrobin + boscalid. Rotate fungicides with different mode of actions to minimize the risk of fungicide resistance. Always read and follow the label instructions when using any fungicides. In landscape settings, fungicide treatments are costly and generally impractical.

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