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Technical Report

Phytophthora Root Rot and Collar Rot of Landscape Plants

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Phytophthora Root Rot

Phytophthora root rot is a widespread but often overlooked disease of landscape plants. Several species of Phytophthora attack the fine absorbing roots of plants and may invade larger roots and the root collar. The name Phytophthora is a Greek work literally meaning "plant destroyer". These fungi grow in the cambium and sapwood causing death of the tissue. Loss of water and nutrient absorbing capacity and stored carbohydrate reserves in the root cause a gradual, or sometimes-rapid decline of the above ground portion of the plant.

Phytophthora is a water mold therefore diseases caused by these fungi are most common on soils that are poorly drained or receive excessive irrigation. Root rot is common on newly developed sites where the soil was severely disturbed or compacted from construction activities. Phytophthora also is a common disease in nurseries. Decline and death of new plantings may result from outplanting diseased stock.

Hosts

Root and root collar rots commonly affect plant species that are intolerant of poor soil drainage. The disease is common on the following species:

Azalea
Rhododendron
Japanese holly
Boxwood
Hemlock
Mountain Laurel
Dogwood
Andromeda
Fir (Abies)
Camellia
White Pine
Taxus

Phytophthora is responsible for the root collar rots of woody ornamentals. Plants with soil or mulch covering their root collar are very susceptible to rot.

Oaks, beech, rhododendron, fruit trees (*Prunus, Malus*, Citrus, Avocado), dogwood, sugar and red maple and Zelkova are particularly prone to collar rot from buried root collars.

Several species of Phytophthora attack woody ornamentals. The pathogen *P. cinnamomi* commonly causes root rot while *P. cactorum* attacks root collars and stems. Phytophthora is a soil borne fungus, which overwinters or persists in soil or on dead plant material as mycelium (the vegetative stage of fungi) or thick-walled resistant spores (oospores). Oospores can remain

viable for many years. When soils are moist, oospores germinate and mycelium form reproductive structures call sporangia. These sporangia release mobile zoospores when soils are saturated with water. Zoospores use a flagella to swim to susceptible root tissues or may be transported longer distances in runoff. Zoospores are attracted to plant metabolites exuded from plant roots. Once spores contact succulent plant tissue or wounds, they germinate and mycelium invades host tissue. Infection is favored by warm temperatures (>65?F) and free water.

Plants under stress from drought, defoliation, low soil aeration, root collar disorders or other stress agents are most prone to Phytophthora root and collar rot. Stress stimulates secretions of metabolites by plant roots, which increases the likelihood of infection by Phytophthora.

Phytophthora is a poor saprophyte and is usually quickly overgrown by secondary microorganisms after plant tissue is killed. In these instances, Phytophthora will form survival structures (oospores) in dead tissue or soil. When soil moisture and temperature conditions favor disease development, Phytophthora can increase rapidly from undetectable levels in the presence of a host plant.

Symptoms

Symptoms of root rot vary depending on the susceptibility of the plant species, the virulence of the specific Phytophthora species and site (environmental) conditions. A chronic form of the disease causes a slow, progressive decline. Symptoms include a reduction in shoot growth; small leaves, thinning of the crown, chlorosis, twig and branch dieback and eventually death. Diseased roots are reddish brown and brittle. These symptoms are often confined to fine roots and lateral roots less than ¼" diameter. Decline occurs over a period of months or years before death occurs.

Rapid wilting and death of the entire plant characterize the acute form of the disease. Leaves turn red then brown and usually remain attached. Affected fine and large roots are reddish brown and brittle. Phytophthora lesions may extend into the root collar, which causes girdling of the stem and rapid collapse of the crown.

Diagnosis/Confirmation

Infection can occur months or years ahead of first visible symptoms. On some plant species, symptoms do not appear until root or collar rot is advanced. When Phytophthora is found on a declining plant, it is likely to be the agent causing the problem, or at least, a significant contributing factor. On plants suspected to be infected with Phytophthora, collect affected roots, place in a plastic bag and submit to a plant diagnostic laboratory. Where lesions exist on the root collar, sample affected sapwood tissue from margins of the root collar and submit for analysis. Affected tissue can be cultured for Phytophthora using standard microbiological techniques or analyzed using an ELISA test. ELISA test kits are also available for immediate "in-field" analysis of plant tissue.

Disease Management/Prevention

Where soils are poorly drained and prone to inundation/flooding, use species that are tolerant to these soil conditions. Most moisture tolerant species are resistant to root rot or tolerate this disease. Tables 1 and 2 list common woody plants that are tolerant of poor soil drainage. Check hardiness of each species prior to planting in your geographic area.

Ensure the root collar is exposed and free of soil and mulch. Even species that tolerate poor drainage such as red maple and Zelkova are subject to collar rot when root flares are buried.

When using susceptible species in poorly drained soils create raised beds or provide sub-surface drainage. Plant with the root collar exposed. If soil is compacted, prepare planting area by cultivating and incorporating organic matter.

Avoid excessive mulch on susceptible species. A two-inch maximum mulch depth is recommended. Favor coarse mulches such as bark nuggets or wood chips. Avoid shredded bark products that tend to compact and hold water.

Irrigate as needed to maintain soil moisture, but not to excess. Use tensiometers to monitor soil moisture.

Phytophthora sensitive species planted on sites subject to saturated soils may require periodic treatment (annual to biannual) with fungicides to minimize new infections.

Remedial Treatments

Plants exhibiting chronic disease symptoms should be treated with an approved fungicide for managing Phytophthora. Treating surrounding susceptible plants on a preventative basis also is recommended. Repeat applications are recommended when soils are prone to saturation and temperatures favor infections. Consult *Bartlett Pest Management Recommendations* for fungicide, rates, timing and techniques for treating Phytophthora.

Improve soil drainage as needed; proper mulching, irrigation and root collar excavation as outlined under preventative treatments are recommended to reduce the incidence and severity of the root rot.

Where soils are poorly drained and/or subject to inundation, consider moving Phytophthora sensitive species to areas with good drainage. Replant poorly drained bed with species from Tables 1 and 2.

Table 1. SHRUBS FOR POORLY DRAINED SOIL (Phytophthora root rot tolerant)

Common Name	***Botanical Name***
Florida Anise	*Illicium floridanum*
Sarccocca	*Sarcococa hookerana*
Viburnum species	*Viburnum spp.*
Inkberry holly	*Ilex glabra*
Yaupon holly	*Ilex vomitoria*
Winterberry holly	*Ilex verticillata*
Chinese witchhazel	*Hamamelis virginiana*
Butterfly Bush	*Buddleia davidii*
Sweetshrub	*Calycanthus floridus*
Summersweet clethra	*Clethra alnifolia*
Crapemyrtle	*Lagerstroemia indica*
Mockorange	*Philadelphus coronarius*
Arborvitae	*Thuja spp.*

Table 2. TREES FOR POORLY DRAINED, CLAY SOILS AND URBAN AREAS

Common Name	**Botanical Name**
Amur Maple	*Acer ginnala*
Hedge Maple	*Acer campestre*
Red Maple	*Acer rubrum**
River Birch	*Betula nigra**
European Hornbeam	*Carpinus betulus*
Hackberry	*Celtis occidentalis**
Cockspur Hawthorne	*Crateagus crusgalli*
Leyland Cypress	*x Cupressocyparis leylandii*
Hardy Rubber Tree	*Eucommia ulmoides*
Ash	*Fraxinus sp.*
Ginkgo	*Ginkgo biloba*
Thornless Honeylocust	*Gleditsia triacanthos 'inermis'*
Crapemyrtle	*Lagerstomeia indica*
Sweetgum	*Liquidambar styraciflua**
Crabapple	*Malus spp.* (use disease resistant cultivars)
Metasequoia	*Metasequoia glyptostroboides*
Blackgum	*Nyssa sylvatica**
Norway Spruce	*Picea abies*
White Spruce	*Picea glauca*
London Plane Tree	*Platanus x acerifolia**
Callery Pear	*Pyrus calleryana* (use cultivars)
Sawtooth Oak	*Quercus acutissima*
Swamp White Oak	*Quercus bicolor*
Willow Oak	*Quercus phellos**
Japanese Pagodatree	*Sophora japonica*
Baldcypress	*Taxodium distichum**
Arborvitae	*Thuja occidentalis*
Lacebark Elm	*Ulmus parvifolia**
Japanese Zelkova	*Zelkova serrata**

* Tolerates temporary flooding