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BP-206-W

PLANT PATHOLOGY IN THE LANDSCAPE SERIES

Root Rot in Landscape Plants

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Plant growth occurs above and belowground. However, we often overlook what grows underground—the roots. The major function of the root is to absorb water and nutrients while anchoring the plant to the soil. Unfortunately, the roots are rarely observed in their entirety even though the structure of the root system profoundly impacts plant health aboveground. As a result, root problems are frequently under- and misdiagnosed, when it is too late to save the plant (Fig. 1).

Figure 1. Root rot, combined with heavy winds, contributed to the failure of this tree.

Predisposing Factors

Unusually wet weather results in poor root growth, predisposing plants to problems. Simply stated, the plant failed to develop an extensive root system because water was too easily acquired. During these periods of excessive moisture, roots may even leak, attracting opportunistic fungi and water molds that infect and rot roots.

These infections may be completely asymptomatic in the aboveground portion of the plant until spring and summer rains change into summer heat, dry spells or drought. The poorly developed and/or infected roots that grew during the wet periods can no longer support the aboveground plant (stems, branches, leaves) in dry times. As the leaves and branches start to die, the plant produces less food (photosynthate) for the roots.

Figure 2. Root rot often causes vague symptoms of dieback or decline.

As the roots starve, they are unable to provide the water needed for photosynthesis. After this process has progressed for a few weeks, vague symptoms develop and include slowed growth, decline in the crown, smaller leaves that may or may not be chlorotic, heavier seed crops, and the simple description "It just doesn't look good."(Fig. 2)

As this decline progresses, secondary insects and opportunistic fungi attack these plants, and are blamed for the overall poor health. At this point, a 'negative feedback loop' where dying leaves fail to support dying roots can result in plant death, unless some type of equilibrium can be achieved and the loop is aborted. Plant death results in the plant not being able to take up sufficient water or nutrients to support the branch, leaf, flowers, or fruit development.

Diagnosis

A diagnosis of the root rot is necessary to develop an effective management plan, including the right fungicide, appropriate cultural controls, and what other nearby plants may be susceptible. Like many things, it is more easily said than done. Diagnosing a root rot requires observing the affected plant for symptoms, and collecting the infected tissue at the right time to culture out the pathogen or pathogens causing the problem.

Whenever possible, carefully excavate roots, and wash them. Often times, this requires extensive sampling because 100% of the root area is rarely infected. Using a hand trowel and/or small shovel, remove multiple ~1-cup samples of that includes soil, larger woody roots and small feeder rots from at least three locations around the tree. This should be performed from at least three sides of the affected tree. Store samples in a plastic bag, preferably in a cooler with ice to keep from drying out. Samples should include areas within the dripline, by the main stem, and somewhere in between. Any suspicious areas (crown rot, mushrooms, conks, fruiting bodies) should be included in the sampling. Samples, along with photos of the tree or shrub, should be submitted to the Purdue Plant & Pest Diagnostic Laboratory for diagnosis.

Above-Ground Symptoms

Other symptoms of root death to note include:

- Root rot infected plants, particularly those with multiple shoots, may show healthy, diseased and dead branches (Fig. 3).
- Slower growth compared to healthy plants. Shoot length is reduced compared to healthy neighbors, or there are even scattered dead shoots.
- Leaves turn yellow and wilt.
- Leaf scorch describes when the margin of leaves turn brown (Fig. 4).
- Small shoots to large side brances are dying or dead
- Cankering and dieback of shoots, branches and stem contributes to dieback and death.

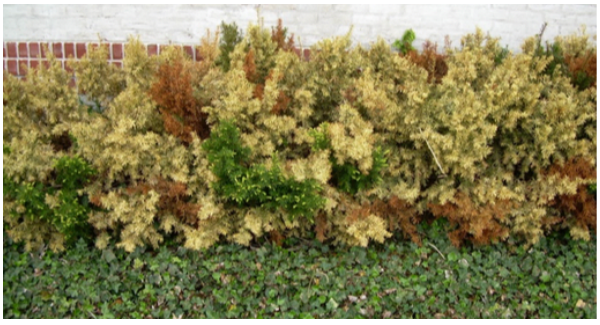

Figure 3. Calico symptoms on this yew show healthy, dead and dying shoots, caused by *Phytophthora*.

Figure 4. Scorch, the death of the leaf margin, results when a plant is unable to obtain sufficient water.

Figure 5. Comparison between rotted (left) and healthy roots(right).

Figure 6. Black rotted roots and rhizomes are classic symptoms of root rot.

Below-Ground Symptoms

Always make sure you know what normal roots look like when examining roots (Fig. 5). Rotted roots appear water soaked, and are discolored and soft (Fig. 6).

Unfortunately, examining the roots for established woody plants, particularly trees and shrubs, is difficult, and

may not be possible in all situations without a tree care professional. After removing the soil from the base of the tree or shrub, evaluate whether any of the following problems are involved:

- Excessive mulch
- Planted too deeply or shallowly
- Significant root or root flare damage
- Stem girdling, or root girdling root
- Few main roots or roots on only one side
- Feeding damage
- Root rot
- Galls

Figure 7. Armillaria mushrooms fruiting on oak roots.

Signs

Signs of root rot may include fungal structures that are visible to the naked eye. These include mushrooms and conks (Fig. 7). Other signs require microscopic observation to observe.

Figure 8. Ganoderma fruiting bodies, called conks, on the roots of a pin oak tree.

The primary causal agents of woody plant root disease are macrofungi like *Armillaria spp*., *Fomes spp.* and *Ganoderma spp*. (Fig. 8), but also micro-fungi like *Thielaviopsis basicola*, and *Fusarium spp.* (to name but a few!) 'Water molds' (also called 'oomycetes') from the genera *Phytophthora* and *Pythium spp.* are significant root rotters, but are not related to fungi. Regardless of the type of organism causing root rot, they all can survive on dead and dying tissue. Some of these microorganisms are opportunists, attacking those plants suffering from poor site conditions, drought, flooding, or other abiotic disorders commonly found in the urban landscape, whereas others are virulent primary pathogens that can attack an otherwise healthy host and kill it.

Managing Root Rot

Prevention is the best approach to managing root rots. If using plants that are known hosts for root rots (i.e., azalea, beech, pieris, rhododendron, for Phytophthora; Armillaria and oaks, etc.), avoid setting the plant up for failure. For Phytophthora-susceptible plants, avoid heavy clay, poorly draining soil, downspouts, and low spots that collect water. For Armillaria, remove any stumps completely via grinding to deprive the Armillaria fungus from a source of food.

Some root rots (e.g., caused by *Phytophthora*) are treatable, if caught and diagnosed early enough, or better still, treated prophylactically. It is possible for the plant to compartmentalize and outgrow root damage, although there are many factors that that make successful treatment of plant diseases challenging. Factors that impact successful treatment include the type of host plant, its susceptibility to the pathogen, its vigor and overall health, the site, and the type of pathogen. Remember that damage occurred over several seasons, and recovery may take just as long, even under the best of circumstances.

In some instances, saving a tree or shrub simply isn't possible or cost effective. Often times, cutting losses involves a chainsaw. Most plants can be replaced—sometimes with an identical clone of the same plant. Be sure to correct any underlying cultural problems that may have contributed to the failure, and see if a more resistant, or even immune host is available, thereby avoiding future problems, and hopefully achieving a newer, healthier tree or shrub, from shoots to roots.

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March 2020