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# PHYTOPHTHORA

## ROOT AND CROWN ROT IN THE GARDEN

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*Integrated Pest Management for Home Gardeners and Landscape Professionals*

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Several species of soilborne pathogens in the genus *Phytophthora* cause crown and root rot diseases of herbaceous and woody plants. Almost all fruit and nut trees, as well as most ornamental trees and shrubs (including many California natives), can develop *Phytophthora* rot if soil around the base of the plant remains wet for prolonged periods, or when planted too deeply (Fig. 1). Tomatoes, peppers, eggplant, and other vegetable crops can also be affected by *Phytophthora* rot. In trees and shrubs, the pathogen kills plants by growing from the roots up through the root crown and into the lower trunk, where it kills the inner bark and causes a browning of the outer layer of sapwood. In many of these crops, different species of *Phytophthora* are involved. Losses to *Phytophthora* are minimized by providing good soil drainage and selecting the most tolerant rootstocks or varieties available. In general, *Phytophthora* requires warm, moist soils in order to cause disease. Another species of *Phytophthora*, *Phytophthora ramorum*, causes sudden oak death, which has very different symptoms and management than the species discussed here. See *Pest Note: Sudden Oak Death in California*, available online at <http://www.ipm.ucdavis.edu>.

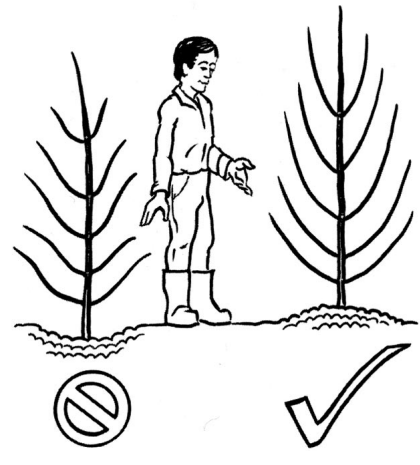
### SYMPTOMS

The leaves of plants affected by *Phytophthora* rot appear drought stressed. Trees or plants often wilt and die rapidly with the first warm weather of the season. Leaves may turn dull green, yellow, or in some cases red or purplish. Often, only plants in the most poorly drained area of the field or garden are affected. *Phytophthora* infections typically kill young trees, because their root systems and crown areas are small compared to those of mature trees.

Symptoms may develop first on one branch or stem then spread to the rest of a tree or plant. Trees may decline over a period of years before finally dying or they may be killed in a single season. Slow decline occurs when the roots are attacked; rapid decline occurs when the crown or basal stem is attacked and girdled, the damage completely encircling the stem in a single season.

Symptoms on roots and crowns may vary somewhat depending on the species of *Phytophthora* involved, the plant being attacked, the resistance of the plant variety, and soil moisture and temperature. In general, trees affected by *Phytophthora* develop darkened areas in the bark around the crown and upper roots. Gum or dark sap may ooze from the margins of the diseased trunk area. If bark tissue is carefully cut away, reddish brown streaks or zones can be seen in the inner bark and outer layer of wood. No mycelium (slender filaments of a fungus body) is visible in between the bark and wood in trees affected by *Phytophthora*, distinguishing this disease from *Armillaria* root rot, which is caused by a true fungus.

When tomatoes and eggplants are affected by *Phytophthora* root rot, roots of all sizes develop water-soaked spots that dry out and turn a chocolate brown as the disease becomes advanced. Early infections, caused by *Phytophthora* and other pathogens that cause damping-off diseases, kill seedlings. For more information on damping-off diseases, see Suggested Reading, *Pest Notes: Damping-Off Diseases in the Garden*. Later infections reduce plant vigor and may cause collapse and death of the plant. If you cut infected tap roots in cross section, you will see



**Figure 1.** Avoid planting in a hole or a low-lying area, except when planting in sandy soils.

that the stele (central core of conducting tissue) is brownish above the rot lesions. Stele discoloration may extend into the lower stem.

### BIOLOGY

*Phytophthora* species are soil-inhabiting pathogens that are favored by wet conditions. Although previously considered fungi, *Phytophthora* species are now considered to be in a separate classification called oomycetes. Species of *Phytophthora* produce resting spores that survive for years in moist soil in the absence of a suitable host. However, if the soil is completely dried out, these spores are less likely to survive for more than a few months. When a host is nearby and free water (water in soil pore spaces) is present in the soil, resting spores germinate to produce motile spores that can directly penetrate roots, branches, or crowns as long as free water is present. Wounds are not required for infection. Resting spores, decaying host tissue in the soil, and active cankers (disease-infected dead, sunken lesions in plant parts) can all be

sources for new infections. The pathogen can be spread in splashing rain or irrigation water, in surface irrigation, and runoff water, and by movement of contaminated soil, equipment, or plant parts. Flooded and saturated soil favors the spread of *Phytophthora* to healthy plants.

Some *Phytophthora* species are favored by warm weather, some by cool weather. Root rot of avocado, citrus, and tomato are favored by warm conditions, developing most extensively in late spring and early summer. Decay of crown, trunk, and branches of other tree species are favored by cool, wet conditions. These decays develop most rapidly in late fall and early spring.

## MANAGEMENT

The most important factor in reducing the threat of Phytophthora rot is good water management (Fig. 2). Avoid prolonged saturation of the soil or standing water around the base of trees or other susceptible plants. Irrigate only as much and as often as necessary; in an orchard, keep track of the soil moisture around each tree and water only when necessary. If you irrigate trees with sprinklers, use low-angle sprinkler heads and splitters to avoid wetting the trunk and lower branches. If using a drip system, place the emitters at least a foot away from the trunk. Avoid planting susceptible species on poorly drained or shallow soils. Water

stress and/or salinity make some plant species more susceptible to infection when wetted subsequently by irrigation or rains.

For all vegetable and orchard plants, provide good soil drainage. Good soil drainage is best provided before planting. Drainage should be plentiful to the rooting depth of the plants, generally 3 to 6 feet for trees, 2 to 4 feet for shrubs, and 1 to 2 feet for bedding plants. During favorable weather you do not want the roots and crown of a plant to remain wet for the 4 to 8 hours that are required for *Phytophthora* to infect the plant.

Provide adequate drainage by breaking through soil compaction and hardpan. In poorly drained soils, or in an area where you know *Phytophthora* is present, consider planting trees and shrubs on mounds. The mounds should be 8 to 10 inches high. Planting depth after settling should be no deeper than as received from the nursery, with the upper roots near the soil level and the graft union well above the soil line. Do not install irrigated turf around the base of trees, remove all weeds, and do not water the crown area directly. Never cover the graft union with soil or mulch. If you are not sure where the graft union is, ask someone at the nursery to show you and mark it. Raised beds provide good drainage in vegetable garden situations also. Group plants

according to their irrigation needs. Separate those needing frequent, light irrigations, such as potatoes and strawberries, from those needing infrequent, deep irrigations, such as tomatoes and melons.

At the first signs of aboveground symptoms, examine the tree at the soil line for crown rot. Carefully cut away bark that looks affected. If crown rot is present, trees can sometimes be saved by removing soil from the base of the tree down to the top of the main roots and allowing the crown tissue to dry out.

## Sanitation

It may be possible to slow the spread of *Phytophthora* within an orchard by avoiding movement of infested soil, water, and plant parts from an area where Phytophthora rot has developed. Surface and subsurface drainage water and anything that can move moist soil can carry the pathogen to a new area, including boots, car tires, and tools. If the physical setting allows drainage water to flow from infested to uninfested areas within the garden during wet weather, consider putting in drains to channel the water away from healthy plants.

## Selection of planting stock

Plant only certified nursery stock from a reputable source, and choose the most resistant rootstocks or varieties available for your area. Less susceptible

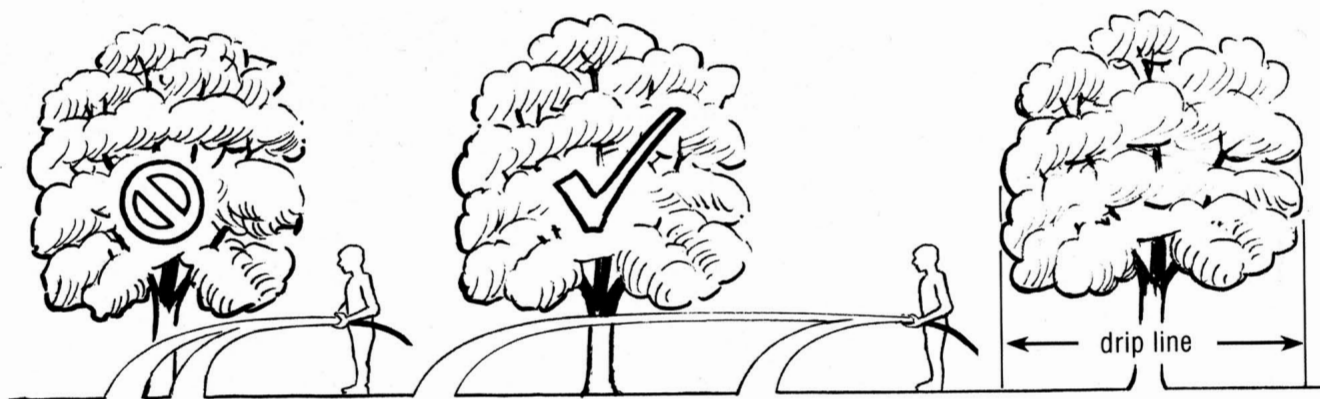


Figure 2. Do not water established trees and shrubs near their trunks, as this promotes root and crown disease. Water plants when needed around the drip line and beyond. Adjust sprinklers or install deflectors to prevent wetting of trunk bases. Move drip emitters away from the base of the trunk after plants are established.

rootstocks or varieties are available for almonds and stone fruit, apples, cauliflower, and strawberries. Carefully select individual plants that are free of symptoms and/or that come from healthy lots of material.

### Rotation

If tomatoes have been affected by *Phytophthora* root rot, avoid planting tomatoes or other susceptible plants such as eggplant or peppers in the same soil for at least one or two seasons. Plant a resistant crop such as corn instead, or leave the soil unplanted and do not irrigate, but keep it well worked to allow the soil to dry as deeply as possible. Different species of *Phytophthora* attack beans and cole crops, so these plants

can be substituted as well. Consult a nursery or farm advisor for possible alternatives in your area.

### Chemical control

The most effective way of preventing *Phytophthora* rot diseases is to provide good drainage and to practice good water management. Along with the appropriate cultural controls, the fungicide fosetyl-al (Aliette) may be used on a number of ornamental plant species to help prevent *Phytophthora* infections. When applied as a foliar spray it is absorbed by foliage and moves into roots. However, do not rely on fungicide applications alone to control root and crown rot diseases.

### SUGGESTED READING

*Pest Notes: Damping-Off Diseases in the Garden*. Aug. 2006. Perry, E. J. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 74132 UC Statewide IPM Program. Also available online at <http://www.ipm.ucdavis.edu>.

*Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide*. 1998. Flint, M. L. Oakland: Univ. Calif. Agric. Nat. Res. Publication 3332.

*Pests of Landscape Trees and Shrubs*. 2004. Dreistadt, S. H. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 3359. ❖

For more information contact the University of California Cooperative Extension in your county. See your telephone directory for addresses and phone numbers.

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#### WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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