

Cause

Phytophthora species cause several diseases of citrus worldwide. These include phytophthora root rot, collar rot, and brown rot of citrus trees and fruit. They are soil-inhabiting and only attack under favourable wet conditions causing root, stem and fruit decay. The main *Phytophthora* species infecting Australian citrus include *P. citrophthora* and *P. nicotianae*. Poorly drained soils, spores splashing onto trunks, leaves and fruit, and ant and snail activity all contribute to *Phytophthora* species infection.

Description

Phytophthora root rot

Leaves: yellowing and leaf drop.

Roots: fibrous feeder roots die first and more quickly than they are replaced (Figure 1). As the disease progresses, the larger roots die, leaving only the main anchor roots, which will be brittle and blackened.

Trees: as the depleted root system cannot support the canopy, trees will show signs of stress, including wilting and twig dieback beginning at the tips (Figure 2). The canopy top thins and fails to form vigorous new growth, which will be weak. If only part of the root system is destroyed, one or two branches will die, while the rest of the tree remains alive.

Collar rot

Trunk: the base of the scion exudes gum. The bark discolours (brown-black) and is initially soft and wet. Over time, the bark dries, re-hardens and cracks.

Trees: ringbarking and death can result (Figure 3).

Brown rot

Leaves: appear as dark brown spreading blotches.

Fruit: develop a rapidly spreading brown rind discolouration with the rind staying firm (Figure 4).

Trees: fruit usually falls from the tree.



Figure 1. Unhealthy feeder roots on a seedling infected with phytophthora (left) and healthy feeder roots (right).



Figure 2. A citrus tree infected with phytophthora root rot.



Figure 3. Gum exuding from a citrus stem (left) and the death of a young tree ring-barked by collar rot (right).



Figure 4. Brown rot symptoms on lemon leaves and fruit (left) and oranges infected with brown rot (right).

Disease cycle

Phytophthora spp. are microscopic soil-borne pathogens. They survive for many months or even years as survival spores in soil, roots or decayed plant material (fallen fruit/leaves), awaiting favourable wet conditions. Spores spread to healthy citrus trees via water and soil (rain or irrigation splash, flooding, or soil containing spores can be carried by ants, termites and snails). During wet conditions, spores become active or infectious, and invade tree tissue through wounds or natural cracks in the roots, bark, or leaves (Figure 5). Once tree tissues are invaded, the infectious spores grow and reproduce, causing symptoms to develop.

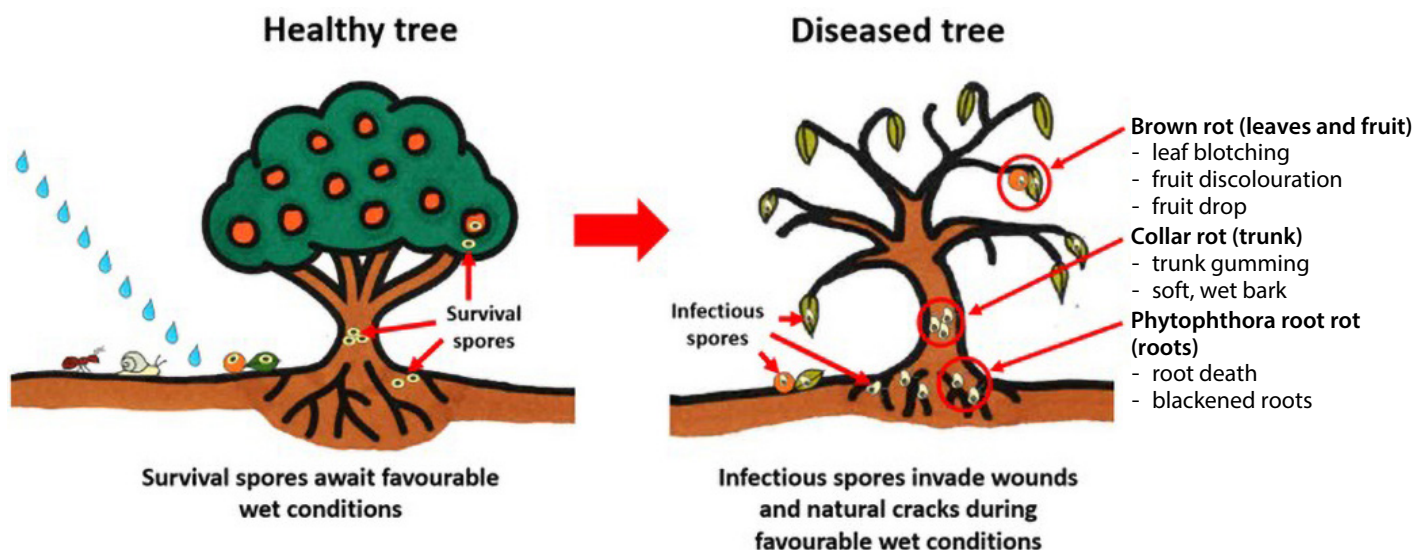


Figure 5. Generalised disease path of *Phytophthora* spp.

Damage

Phytophthora root rot depletes the tree root system, causing weak new canopy growth.

Collar rot causes stem damage with ringbarking and death in severe cases.

Brown rot causes fruit breakdown, resulting in fruit drop.

Risk period: prolonged wet periods and significant rain increases the risk of spores spreading.

Monitoring

Check for symptoms as part of your regular IPDM monitoring.

Note that phytophthora-like symptoms might be caused by other diseases or disorders. Peeling bark and gumming may also be due to infection with viruses or viroids. Ants and termites feeding on bark lead to trunk or root girdling in young trees; gum can exude from these injuries resembling phytophthora symptoms.

Management and control

Biological

Boosting the population of soil micro-organisms (bacteria and endophytic fungi) and plant defence mechanisms with best practice management should reduce the likelihood or effect of phytophthora infection.

Cultural

Phytophthora root rot: use phytophthora-tolerant rootstocks such as *Citrus (Poncirus) trifoliata*, citrange hybrids, or Swingle citrumelo. Sweet orange and rough lemon stocks are highly susceptible. Plant healthy nursery trees, ensure adequate soil drainage and manage irrigation appropriately.

Collar rot: at planting, ensure the bud union is above ground level to avoid water splashing onto the susceptible scion. Avoid trunk injuries and skirt trees to improve air circulation and reduce infection. Monitor tree guards for ant colonies.

Brown rot: skirting trees reduces the risk of soil splashing onto the tree canopy and low-hanging fruit. Soils with high organic matter content are less favourable to phytophthora, as this supports a higher population of inhibitory micro-organisms. Ensure pickers do not pick fallen fruit from the ground.

Chemical

Phytophthora root rot: a registered systemic fungicide can help manage phytophthora.

Collar rot: affected tissue can be scraped away, and a protective barrier can be applied with paint containing a fungicide. Under-tree sprays (e.g. copper) can reduce infection. Control ants and snails to reduce spore transportation onto tree stems, canopy and fruit.

Brown rot: apply copper-based fungicides in autumn.

More information

Barkley P (2004) *Citrus diseases and disorders*. NSW Agriculture, 2nd Edition, Camden NSW.

Creek A, Donovan N, Falivene S, Golding J, Kare M, Khurshid T, Mo J and Monks D (2023) [Citrus plant protection guide 2023–24](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/1482785/Citrus-plant-protection-guide-2023-web.pdf), Department of Primary Industries, https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/1482785/Citrus-plant-protection-guide-2023-web.pdf

IPDM for the citrus industry Project CT19011

