



Seedling Root and Crown Rots of Woody Plants

What they look like

Above ground parts of affected plants wilt, the foliage turns brown, and the plants fall over if stems are rotted. Below ground, rotted roots turn brown, disintegrate when handled, and easily break off if the soil is gently teased away. When the root crown is infected, fine feeder roots often remain a healthy white to tan color, and hold the root ball together well. However, when the soil is washed away, brown areas are visible on the cortex of the larger diameter roots as well as the root crown, or base of the stem.

Vulnerable plants

Plants with roots and stems that remain succulent for an extended period of time are the most susceptible to these diseases. For example, conifer seedlings are susceptible to root rot diseases for a longer period of time after germination than many other woody plants. Seedlings or rooted cuttings whose roots and stems become hard and woody soon after they are established are more resistant to these diseases. The most common root and crown rot fungi are *Rhizoctonia* and *Pythium*, but *Phytophthora*, *Fusarium* and *Cylindrocladium* are also important for certain woody plants and specific growing conditions.

How infection occurs

Root and crown rot fungi live in the soil as saprophytes on dead plant material or survive by producing resistant resting structures. When new susceptible plants are transplanted into soil, the fungi grow into succulent roots and stems. *Rhizoctonia* survives by producing resistant resting structures called sclerotia that can move as soil is moved (e.g., blowing soil, or by running or splashing water). *Fusarium* lives on dead plant tissue and in soil, and overwinters as thick-walled, resistant spores called chlamydospores. *Cylindrocladium* survives on dead plant material and as resistant resting structures called microsclerotia in the soil.

Pythium and *Phytophthora* are blown with infested soil or splashed by rain or irrigation water. *Pythium* survives by producing resistant structures called oospores in dead roots. Immature, succulent roots and stems are most susceptible to significant plant damage when infected by *Pythium*. Well-developed woody plant seedlings have thicker, lignified cells that limit the spread of *Pythium*, so only the feeder roots are rotted. Fine feeder roots are vulnerable to damage at any stage of plant growth, but a plant with good vitality can limit the extent of *Pythium* growth into older roots.

Phytophthora overwinters as oospores or chlamydospores in infected roots or stems. When favorable (warm, wet) conditions resume, the resistant spores germinate by liberating mobile, swimming spores (zoospores). These are blown or splashed onto nearby susceptible plants which become infected. Dormant fungal structures in roots or stems begin growing again when circumstances are favorable, and cause additional damage to plants they have previously infected.

Environmental conditions significantly influence the development of root and crown rot. Cool temperatures (50-60°F) that slow germination of seeds and growth of cuttings keep the plants in a vulnerable, succulent condition for a longer period of time. When the soil is sodden with moisture for extended periods, fungi such as *Pythium* and *Phytophthora* are active and infect plants. Drier soil conditions, but with high relative humidity, are favorable for *Rhizoctonia*. Most woody plants grow best when the light intensity is high. Conditions that maintain high humidity around plants such as cloudy weather, excessive shading, and plants growing too close together also promote disease. Plants growing in soils that are fine textured and poorly drained are more prone to root and crown rot. Adequate soil fertility promotes seedling vitality, but applying fertilizers with high nitrogen composition induces excessive succulent new growth, prolonging the period when plants are vulnerable to fungal infection.

Management strategies

Suppression of seedling root and crown rot involves the integration of a number of approaches including all or several of the following: site and soil preparation, sanitation, plant selection, proper fertilization, and chemical treatments.

Site and soil preparation - maintain good drainage! Minimize overhead irrigation and avoid splatter from puddled water. If plants are in ground beds, make sure the soil is well drained and not previously contaminated with plant pathogens. Place container plants on gravel or a porous ground cover. Do not put them on plastic film or bare soil. Prune plants and space them well to ensure adequate air circulation and sunlight penetration. Avoid exposing young plants to hot conditions and drying winds, but be sure they have adequate light (most woody plants need at least 6 hours of sunlight unless they are shade tolerant, understory plants).

Sanitation - Wash used containers in soap and water, then disinfect them by soaking them in a fresh 10% (1 part bleach and 9 parts water) solution of household bleach. Pasteurize or steam treat all soil used for potting plants, whether it is an amendment to a soil-less mix or used as the whole planting medium. The entire soil mass must be heated to 180°F for 30 minutes. In addition, prevent recontamination of the sterile soil with dirt from unclean benches, containers, or attached to tools and equipment. Monitor plants regularly, and promptly remove affected plants and the soil from the root zone.

Plant selection - When root and crown rot are persistent problems consider growing plants that are resistant to the diseases and/or are better adapted to grow under the site conditions.

Proper fertilization - Avoid excess fertilizer applications, especially quick release nitrogen. This practice stimulates spindly, succulent growth that prolongs the period during which young plants are most vulnerable to root and crown rot diseases.

Chemical treatment - Fungicide drenches are frequently used in nurseries for management of root and crown rot diseases in containers. Obtain a laboratory diagnosis to determine the cause of the root rot. Most fungicides registered for use against *Rhizoctonia*, *Fusarium* and *Cylindrocladium* do not control *Pythium* and *Phytophthora*. Remove and dispose of seriously affected plants and the soil they were growing in. Soil fumigation with methyl bromide or other soil sterilants may be practical in field nursery situations. This is a costly and short term measure, but reduces nematode and weed seed populations, as well as root and crown rot fungi. Handle fumigants carefully. Some are highly toxic, and residual fumigant in treated soil can kill plants.

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