Rhizoctonia: A variable and versatile nursery plant pathogen

Rhizoctonia causing damping off of casuarina seedlings; fine strands of fungal growth can appear like a spider web amongst the crop.

Rhizoctonia *represents an important group of soilborne pathogenic fungi that occur on many plants throughout the world. Strains of this fungus are ubiquitous, found in agricultural soils, forests and other natural environments. The name* Rhizoctonia*, commonly referred to as "rhizoc", is derived from the Greek rhiza 'root' and ktonos 'killer'. However, it is extremely versatile and can cause fruit, stem, and leaf diseases. Besides being an important pathogen of ornamental nursery plants, vegetable seedlings and bedding plants, it also causes a wide range of significant diseases in horticultural and field crops e.g. bare patch of cereals, brown patch of turf, root canker of lucerne and black scurf of potato.*

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THE *RHIZOCTONIA* COMPLEX OF FUNGI

Fungi in the *Rhizoctonia* complex have variation in morphology, host range, and virulence. Most strains grow asexually. Some species have one nucleus and others have two or more nuclei in each cell. Members of the genus *Rhizocotonia* are characterised by one nucleus or multi-nucleate cells. Species that have two nuclei are generally in the genus *Ceratobasidium*, which is now commonly being detected in nursery samples associated with disease symptoms.

Rhizoctonia solani is the most well-known species. It is widespread and has a host range that includes over 500 plant species. *R. solani* is divided into different groups based on their ability to asexually mate, referred to as AGs (anastomosis groups). These groups are genetically distinct from one another. Members from each AG also vary in morphology, pathogenicity, and host range. For example, isolates from AG-3 cause disease in lettuce and solanaceous hosts, and AG-12 isolates cause disease in greenhood orchids. Some *Rhizoctonia* spp. are opportunistic secondary pathogens or live as saprophytes but are not well characterised. Other *Rhizoctonia* are pathogens of specific hosts, such as *R. zeae* on turf, and *R. oryzae* on rice.

Necrotic spots on bean seedlings caused by *Rhizoctonia*.

Ceratobasidium species are also divided into AGs. Many strains of *Ceratobasidium* are saprophytes, and some strains are endomycorrhizal symbionts with orchids. There are also several species that may act as saprophytes and plant pathogens such as *C. theobromae* (vascular streak dieback of cacao) and strains that cause black root rot in strawberry. The pathogen *C. cereale* typically causes disease in cereal and grass hosts. The sub-tropical pathogen *C. noxia* causes disease in multiple woody crops such as black rot of coffee and web blight of citrus. Some *Ceratobasidium* spp. may even act as protectants against aggressive *Rhizoctonia* spp.

For the purposes of this factsheet, all species within the complex will be referred to as *Rhizoctonia*.

LIFE CYCLE

Rhizoctonia is a soilborne fungus with continuous vegetative growth of brown threadlike branching mycelium. These fungal strands grow between the soil particles and in dead non-living plant material to promote decay and break-down of organic matter. When soils dry, the fungus becomes dormant as thick-walled growths or produce sclerotia that allow it to survive for many years. Infection is initiated when sclerotia or hyphae are attracted to plants by chemical exudates from actively growing plant cells. After contact, fungal hyphae grow specialised structures to penetrate plant tissues and take up nutrients for continued fungal growth and development. They may also enter plant cells through natural openings (lenticels, stomata) or wounds. As the fungus kills plant cells, hyphae continue to grow and colonize dead tissue, often forming sclerotia. New inoculum is produced and the life cycle repeated when fresh plant material becomes available. *Rhizoctonia* does not produce conidia (asexual fungal spores) and only rarely produces basidiospores (sexual spores). However, several important diseases do result from aerial basidiospore infection, e.g. in citrus, tomato and other hosts. The aerial spread of basidiospores can result in a relatively fast spread of disease compared to soil borne fungal growth.

SPREAD

Rhizoctonia can enter and spread around production nurseries via:

- infected seed, rooted cuttings, and other contaminated plant material
- contaminated potting mix, through contact with infested soil or other organic matter
- wind-blown infested dust
- contaminated irrigation water, especially where water is recycled and disinfestation is insufficient to eradicate fungal pathogens
- splash from overhead watering
- infested flats or pots, tools or equipment
- infested soil particles on hands, shoes and tools.

Spread in the nursery usually occurs by the transfer of mycelium and sclerotia in infested soil particles and infected plant tissue. The possibility of spread by airborne basidiospores should not be discounted. In propagation trays, fungal growth can advance metres across trays and benches to reach fresh plant material, particularly when trays are packed close together. Optimum conditions for *Rhizoctonia* to thrive is when the growing media is kept wet and the aerial environment is humid, with temperatures between 20–30ºC. It can also survive in infested growing areas that have not been appropriately disinfested between crop cycles.

SYMPTOMS

Rhizoctonia can attack below and above ground plant parts in nurseries in a wide range of hosts.

1. DAMPING-OFF IS A VERY COMMON SYMPTOM.

- Seed may decay before germination or the seedling rots before it emerges from the soil (pre-emergent damping-off).
- Seedlings may be killed after they emerge from the soil (post-emergence damping-off). Such seedlings develop stem cankers near the soil surface.
- Seedlings emerge and do not die but conspicuous red-brown cankers are present on the stem (sore-shin or wire-stem). With wire-stem, infection is confined to the cortical tissues, whereas in post-emergence damping-off, decay extends through the stem.

Damping off in Petunia caused by *Rhizoctonia*.

2. CUTTING AND STEM ROT

- Cuttings may progressively rot from the cut end. Stem infection results in dark coloured rots and sunken cankers above or below ground.

Damping off in Petunia caused by *Rhizoctonia*.

3. WEB BLIGHT (AERIAL BLIGHT, FOLIAR BLIGHT)

- With this disease *Rhizoctonia* spreads from leaf to leaf or stem to stem through the tops of seedlings or cuttings. It occurs during periods of high humidity. Severe defoliation may occur with fallen leaves webbed to the stems and one another by the coarse brown mycelium of the pathogen. Leaf spots can also occur .

Leaf dieback on *Pinus* cuttings from *Rhizoctonia* webbing blight.

4. INFECTIONS ON MATURE PLANTS

- In addition to “damping-off” and “cutting-decay” in young plants, *Rhizoctonia* causes serious losses when seedlings with wire stem (stem girdling lesions) are transplanted into the field. Plants with wire stem can fall over at the soil level during periods of high wind unless they are sufficiently supported. Some crop plants (e.g. crucifers) are attacked for a considerable time after the seedling stage, however, as plants mature they become increasingly resistant to wire stem.

Distinctive leaf spots caused by *Rhizoctonia*

Foliage blight caused by *Rhizoctonia*.

DETECTION AND DIAGNOSIS

Rhizoctonia can appear similar to other diseases. When it forms orange aerial webbing it can be very distinctive and recognisable; coarse brown fungal threads may be present around plants and on lesions, and soil particles may cling to the fungal threads.

Rhizoctonia may be present on the roots of a diseased plant without being pathogenic. It is then sometimes blamed for the disease damage when other pathogens such as *Pythium*, *Phytophthora*, *Fusarium* or soft rot bacteria are the cause of the disease. *Rhizoctonia* can also interact with other root pathogens and environmental conditions to cause a root disease complex which can result in more severe disease than that caused by a single pathogen.

It is recommended to submit plants that have symptoms to a reputable diagnostic laboratory. All Australian production nurseries receive 6 free samples per year until the end of 2025 through the diagnostic service Grow Help Australia.

DISEASE MANAGEMENT

Once plants are infected, they may always be infected. Therefore, it is important to prevent plants from becoming infected so that plants are sold without pathogens. There are a number of nursery practices that can be used to produce pathogen free plants, including those listed below. Refer to the factsheet on preventing diseases in nurseries for more details.

- Grow seedlings in sterilised or pasteurised soil-less potting mix. Growing nursery stock in-ground increases risk of infection.
- Use disease free seed or propagative material.
- Maintain optimum conditions for good growth, particularly for seedlings (older plants are more resistant).
- Avoid wounding plants as they are a potential point of entry for many pathogens.
- Set plants with adequate spacing to avoid crowding and the formation of high humidity.
- Do not overwater as disease is more severe in very wet soils.
- Use and maintain footbaths in high-risk areas and on entry to the nursery.
- Do not over fertilise.
- Use pathogen free irrigation water, either by using an appropriate pathogen disinfestation technique or pathogen free water source (e.g. mains water).
- Manage fungus gnats and shore flies proactively. They spread many pathogens.
- Regularly disinfect tools and equipment and wash hands.
- Reduce dust by concreting paths or laying gravel and separate parking areas from the growing area.

» Use fungicides as a preventative strategy only, e.g. treat cuttings with a fungicide to lower risk of disease infection.

In the case of an outbreak, there are a number of practices that will reduce the severity of disease with a goal to eradicate the pathogen from the nursery.

» Improve air circulation around seedlings.

» Reduce nitrogen fertilization, if possible, while still maintaining good growth.

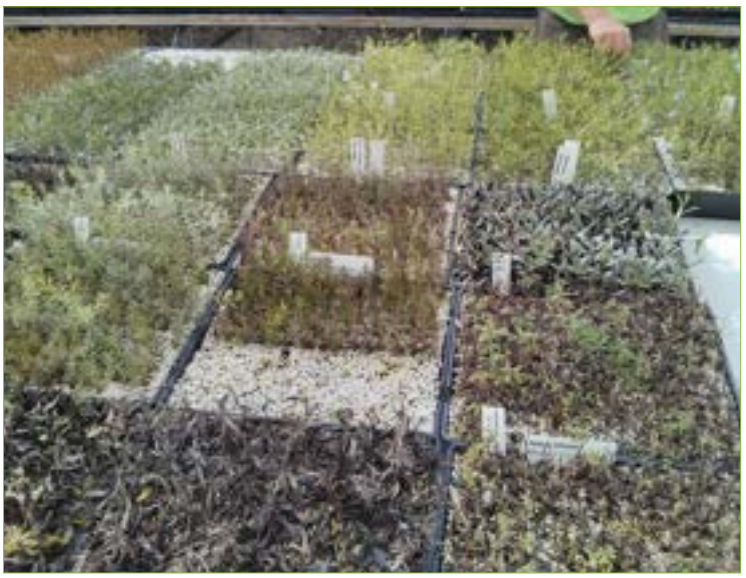
» Remove infected plants hygienically, e.g. incinerate or deep bury. Do not discard plants into a compost heap on-site.

» Reduce watering as disease is more severe in wet soils.

» Drench healthy plants with systemic fungicides (Table 1), rotating between mode of action groups. Contact products are only likely to have a significant benefit to leaf diseases caused by *Rhizoctonia*. These will not eradicate the pathogen but will help protect healthy plants. It may be worthwhile considering that plants that appear healthy that had been growing next to plants with disease are high risk. They can either be quarantined to confirm they are free of disease or may need to be discarded.

» Clean the growing area after removing infecting plants, remove organic matter and disinfect the benches, pathways, glasshouse and polytunnel walls and other surfaces to reduce risk of inoculum reinfecting subsequent plants.

It is not recommended to sell plants that appear healthy, but are infected. Such plants are likely to gain disease symptoms in the future and will spread the pathogen. Fungicides may be used to prevent infection during highly susceptible stages of plant growth, particularly if other plants in the growing area have become infected. Once plants are large enough to be resistant to *Rhizoctonia*, fungicides should not be necessary, except perhaps in cases of foliar infections.



Cutting rot caused by *Rhizoctonia* webbing blight.

TABLE 1. FUNGICIDES REGISTERED FOR USE AGAINST RHIZOCTONIA IN NON-FOOD NURSERY CROPS. PLEASE NOTE THAT OTHER PRODUCTS MAY BE AVAILABLE IN CERTAIN CASES. REFER TO AVPMA FOR LABELS/PERMITS.

MOA GROUP	ACTIVE INGREDIENT	PERMIT DETAILS	MOBILITY IN PLANT
1 + 4	Thiophanate-methyl + etridiazole	PER91752	Systemic
7 + 11	Pyraclostrobin + fluxapyroxad	PER92782	Systemic
11 + 3	Azoxystrobin + tebuconazole	PER91752	Systemic
9 + 12	Cyprodinil + fludioxonil	As per label	Systemic + contact
19	Polyoxin-D zinc salt	PER94353	Translaminar
M3	Mancozeb	PER91756	Contact

BIOSECURITY

Most diseases of nursery crops caused by *Rhizoctonia* species have a worldwide distribution and therefore pose little biosecurity threat to Australian production nurseries. However, *Rhizoctonia* is a complex organism with a number of different strains — not all strains can infect all hosts and some strains are not pathogenic. There are many diseases that may appear similar to those caused by *Rhizoctonia* that are not present in Australia. If in doubt, it may be worth contacting a diagnostic laboratory to have plants tested; knowing what is wrong with your plants will assist you to manage the problem and reduce their spread. All production nurseries receive 6 free samples per year until the end of 2025 through diagnostic service, Grow Help Australia.

FURTHER READING

- The occurrence and pathogenicity of Rhizoctonia fungi in South Australian plant nurseries
- Rhizoctonia solani anastomosis groups and their hosts
- Preventing disease in production nursery propagation areas
- Managing disease transmission into production nurseries
- Soil borne disease management plan

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