

Rhizoctonia

A variable and versatile nursery pathogen

Background

The *Rhizoctonia solani* complex represents an important group of soilborne pathogenic fungi that occur on many plants throughout the world. There are a number of different strains of this fungus found in the soils of agricultural, 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.

The Pathogen

R. solani refers to a species complex, comprising a number of genetically distinct groups with a wide range of variability in morphology, ecology and host range and virulence. Groups are defined by their ability to fuse when growing together, a form of asexual ‘mating’. In most cases, *Rhizoctonia* grow and reproduce asexually. However, *R. solani* has the basidiomycete *Thanatephorus cucumeris* as its teleomorph (sexual stage). Other species of *Rhizoctonia* have also been found in nurseries and are morphologically distinct, sometimes even at a cellular level. *Rhizoctonia* fungi do not produce conidia (asexual spores) and only rarely produce basidiospores.

Recognition and Detection

Rhizoctonia is relatively easy to recognise on diseased plants when using a 10x hand lens. This is particularly the case if reddish-brown lesions occur on the root or hypocotyl of the plant close to the soil surface, and where coarse brown fungal threads are obvious on the lesion and soil particles cling to the fungal threads after shaking the plant to remove excess soil. If a compound microscope is available, look for septate hyphae and characteristic 90° branching of the fungal growth (Fig. 2).

However *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



Fig. 1. *Rhizoctonia* causing an aerial blight on petunia seedlings.

pathogens and environmental conditions to cause a root disease complex which can result in more severe disease than that caused by a single pathogen. In the laboratory *Rhizoctonia* can easily be identified by isolating from diseased plant material onto culture media.

Commercial diagnostic kits are available for detection of *Rhizoctonia* by enzyme-linked immunosorbent assay (ELISA). The kit is reported to produce a stronger colour reaction with *R. solani* than it does with other *Rhizoctonia* spp. Other serological test kits such as lateral flow devices (e.g. Pocket Diagnostic Test Kit) are also available for identification of *Rhizoctonia* spp. (NGIQ supplies kits for a number of plant diseases).

Life Cycle

Rhizoctonia is a soilborne fungus with more or less continuous vegetative growth of brown threadlike branching mycelium in warm, moist soil conditions. These fungal strands grow between the soil particles and in dead non-living plant material to promote its decay and breakdown of organic matter. When soils dry the fungus becomes dormant as thick walled mycelium (momiloid) or produce sclerotia (mostly 0.5-1.0mm diameter but sometimes up to 5mm) which 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 over the surface eventually forming infection cushions and infection pegs which enable it to penetrate plant tissues and take up nutrients for continued fungal growth and development. Penetration can also occur 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. As stated above, *Rhizoctonia* does not produce conidia (asexual fungal spores) and only rarely produces basidiospores (sexual spores). However several important diseases do result from basidiospore infection.

Key Facts

- *Rhizoctonia* is a simple soilborne fungus consisting of brown fungal threads and sclerotes.
- *Rhizoctonia* consists of numerous strains which vary in host range and pathogenicity.
- It is present in most soils where it survives indefinitely.
- It attacks many plants causing damping-off, cutting decay, stem girdling and aerial blight.
- Spreads with soil, water, contaminated equipment and footwear, infested trays and pots.
- Spread can occur by transport of infected seedlings.
- Managing *Rhizoctonia* diseases requires an integrated disease management approach.
- Good hygiene is essential to reduce risk.
- Effective chemicals are available but should be used as protectants.
- Fungicides applied after infection rarely cure plants and disease may reoccur after leaving the nursery.



Fig. 2. *Rhizoctonia* causing an aerial blight on casuarina seedlings. Insert shows *Rhizoctonia* hyphae with branching at right angles and constriction at point of union.

Spread

There are many ways in which *Rhizoctonia* fungi can enter the nursery. These include infected seed; infected rooted cuttings and other contaminated plant material; contaminated potting mix; wind blown infested dust; contaminated irrigation water, especially where water is recycled and disinfection is insufficient to eradicate fungal pathogens; splash from overhead watering; infested flats or pots; infested tools or equipment; infested soil particles on hands or feet and poor sanitation practices during and between cropping cycles. The possibility of spread by airborne basidiospores should not be discounted. However spread in the nursery usually occurs by the transfer of mycelium and sclerotia in infested soil particles and infected plant tissue. In propagation trays, fungal growth can produce can grow metres across trays and benches to reach fresh plant material, particularly when trays are packed close together.

Symptoms

Rhizoctonia can attack below and above ground plant parts in nurseries.

1. “Damping-off is a very common symptom (Fig. 3).

- 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.

2. Cutting and stem rot (Fig. 4)

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

3. Web blight (aerial blight, foliar blight) (Figs. 1, 2 and 5)

- 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 (Fig. 5).

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 (Fig. 6). As the plant matures it becomes increasingly resistant to *Rhizoctonia* at the soil line. Some crop plants (e.g. crucifers) are attacked for a considerable time after the seedling stage. Plants with wire stem can fall over at the soil level during periods of high wind unless they are somehow supported.



Fig. 3. *Rhizoctonia* causing damping off of sage seedlings (*Salvia* spp.). Photo by R.K. Jones, North Carolina State University, Bugwood.org



Fig. 4. *Rhizoctonia* rot on bean seedling showing sunken, brown cankers on the hypocotyl (top right) and *Rhizoctonia* crown rot showing dark cankers on silver beet (top left). Cutting failure caused by *Rhizoctonia* (below).

Disease management

The potential for strains of the *R. solani* complex to cause severe disease in the nursery and in transplants in the field is enormous. Nurseries should aim to produce pathogen free stock, not plants which appear to be disease free but have symptomless pathogen infections. Therefore, emphasis must be placed on excluding the pathogen from the nursery. There are a number of nursery practices that can be used to produce pathogen free plants.

- Grow seedlings in soil-less potting mix or in sterilised or pasteurised soil.
- Use disease free seed or propagative material.
- Maintain optimum conditions for good growth (older plants are more resistant) and avoid wounding plants as these will allow entry of the fungus.
- 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.
- Reduce plant stress by not allowing a build up of high levels of soluble salts in the root zone.
- Use and maintain footbaths in high risk areas and on entry to the nursery.

Prevention is the key to managing *Rhizoctonia*



Fig. 5. Foliage blight of melaleuca (above) and zonate leaf spots on *Philodendron* (below) all caused by *Rhizoctonia*.

- Use pathogen free irrigation water, either by using an appropriate pathogen disinfection technique or pathogen free water source (e.g. mains water, most bores).
- Manage fungus gnats and shore flies proactively (refer to the fungus gnat pest management plan available on the NGIA website).
- Regularly disinfect tools and equipment and wash hands.
- Reduce dust by concreting paths or laying gravel; 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.
- Remove infected plants hygienically, e.g. incinerate or deep bury.
- Reduce watering as disease is more severe in wet soils.

- Drench with registered fungicides. These will not eradicate the pathogen, but will help protect healthy plants. The following active ingredients are registered or have a minor use permit available for use against *Rhizoctonia* for at least some nursery crops.
- Actives with systemic properties include: azoxystrobin, cyprodinil + fludioxonil (fludioxonil is not systemic), iprodione + trifloxystrobin, propiconazole and thiophanate-methyl + etridiazole.
- Actives without systemic properties include captan, chlorothalonil and mancozeb.

Nursery practices can be modified to suppress disease symptoms but the fungus will probably regain activity again once plants leave the nursery. However, 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.

Disease control should never be based on the use of fungicides alone

Biosecurity threats relating to *Rhizoctonia*

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 is no doubt that a better understanding of the different strains would help in developing better management strategies.

Therefore when any disease symptoms are found in nursery stock it is important to identify the causal organism. This will help reduce pathogens being introduced into new areas.

Further reading

Schisler, D.A., Neate, S.M., Masuhara, G. 1994. The occurrence and pathogenicity of *Rhizoctonia* fungi in South Australian plant nurseries. *Mycological Research* 98(1), 77-82.

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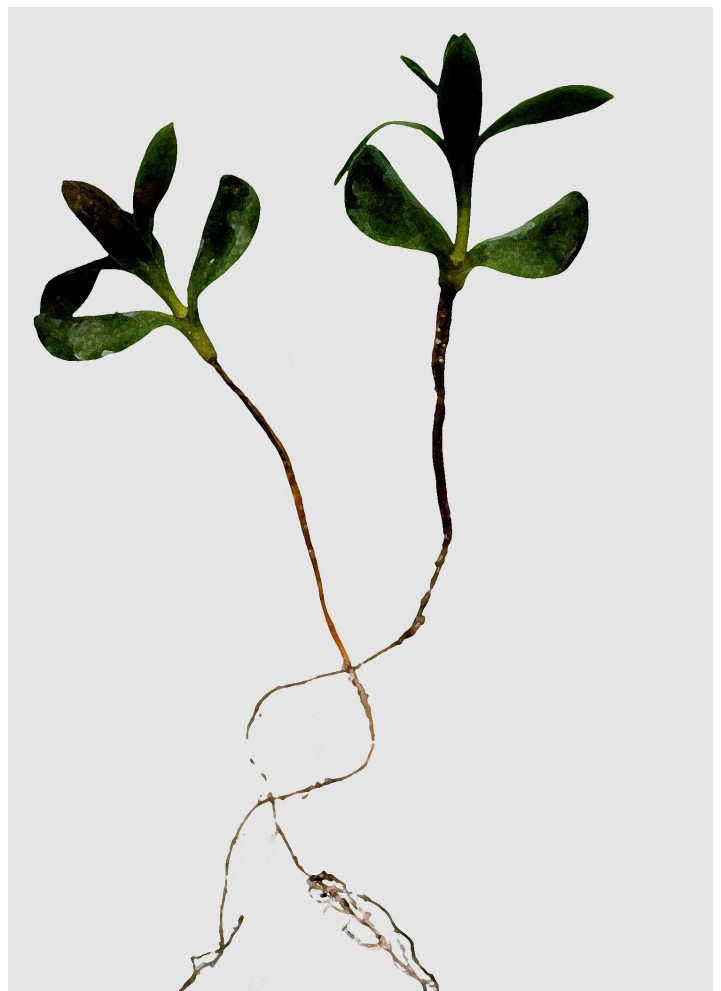


Fig. 6. Wire stem on *Protea* (above) and root lesions (below) caused by *Rhizoctonia*.