Tips and Tactics

GRDC GROWNOTES® Southern Region Know more. Grow more.

Rhizoctonia

Southern Region

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Root damage causes yield loss in cereals

Rhizoctonia root rot is an important disease of cereals in both the southern and western regions of the Australian grain belt. This is especially the case in the lower rainfall zones and on lighter soils. Yield losses in crops affected by bare patches can be over 50% and crops with uneven growth (Figure 1) may lose up to 20%.

The disease is caused by *Rhizoctonia solani* AG8, a fungus that grows on crop residues and soil organic matter and is adapted to dry conditions and lower fertility soils.

The fungus causes crop damage by pruning newly emerged roots (spear-tipped roots) which can occur from emergence to crop maturity. The infection results in water and nutrient stress to the plant, as the roots have been compromised in their ability to translocate both moisture and nutrients.

KEY POINTS

- Management of *Rhizoctonia* requires an integrated approach to reduce inoculum and control infection and impact on yield.
- *Rhizoctonia* inoculum levels will be greatest following cereals, particularly barley.
- Grass-free canola is the most effective.
- But legumes can also help reduce inoculum loading.
- Disturbance below the seed at sowing promotes rapid root growth away from the *Rhizoctonia* and disrupts hyphal networks. The ideal depth is 5-10 cm.
- Fungicides applied through in-furrow liquid banding can provide useful suppression of *Rhizoctonia* disease.
- Herbicides that slow root growth can exacerbate the problem.

Figure 1: Above-ground symptoms of crop unevenness (main picture) are seen when Rhizoctonia damages crown roots, even when seminal roots (inset) escape the infection.

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Management options

Summer weed control

Summer weed control will reduce inoculum levels and the disease in the following winter by decreasing the living host plants for the disease. This complements the moisture and nitrogen conservation benefits of summer weed control.

Crop choice/rotations

Cereals and grassy fallows promote the build-up of *Rhizoctonia* inoculum, with barley being the worst of these.

Crop rotation with a grass-free non-cereal crop is one of the best available management strategies to reduce the impact of *Rhizoctonia* disease.

Trials across the lower rainfall cropping region of southern Australia indicated that grass-free oilseeds, pulses, pasture legumes and fallow can result in significant reductions in *Rhizoctonia* inoculum in a cropping sequence.

Non-cereal crops can be infected by *Rhizoctonia*, however, most do not allow the build-up of inoculum. Lupins may be a less effective break crop and can suffer from yield damage in the presence of *Rhizoctonia*.

The beneficial effect of rotation on reducing *Rhizoctonia* inoculum generally lasts for one cereal crop season.

Fungicide treatments

Fungicide treatments need to be used as part of an integrated management strategy.

Responses in barley are greater than wheat. Yield responses can vary between seasons with the greatest responses occurring when spring rainfall is above average. In GRDC-funded trials in southern Australia and Western Australia, on average seed treatments gave 5% (0 to 18%) yield responses in wheat and barley.

Several products have been registered for liquid banding. GRDC-funded research has shown that: Product(s) registered for dual banding, in-furrow 3-4 cm below the seed and on the surface behind the press wheel, gave the most consistent yield and root health responses across seasons.

Impact on plant roots - what to look for

Roots of infected plants will be short with brown and pinched ends (spear tips).

Figure 2: Left: Healthy roots. Middle: Seedling severely infected with Rhizoctonia. Right: Crown root fully infected with Rhizoctonia (Image: Sjaan Davey).

Seed treatment combined with in-furrow application can provide intermediate benefit between seed treatment alone and a split application.

Nitrogen

Nitrogen-deficient crops are more susceptible to *Rhizoctonia*.

Intensive cropping with cereals and stubble retention result in very low levels of mineral nitrogen over summer as soil microbes temporarily utilise all available nitrogen while breaking down the low nitrogen stubble residues. Application of adequate N fertiliser at sowing is necessary to ensure early seedling vigour so plants can push through the layer of inoculum concentrated in the top 10 cm.

Ensure good nitrogen nutrition is present. Crops with adequate N will be less affected by the disease.

Table 1: Management of Rhizoctonia disease in cereal crops.

Year 1 crop (Sept-Nov)	Summer (Dec-April)	Season break (April-May)	Year 2 crop (May-August)
Check for inoculum build-up	*Facilitate inoculum decline*	*Select appropriate crop*	*Manage infection and disease impact through management practices*
• Paddocks can often be identified in the previous spring by estimating the area of bare patches and/or zones of uneven growth during spring – verify that poor plant growth is due to *Rhizoctonia* disease	• In wet summers, early weed control will reduce inoculum. In dry summers, inoculum levels do not change • Adopt practices that prolong soil moisture in the upper layers (e.g. stubble retention and no cultivation) which helps maintain higher microbial activity • Consider soil testing for pathogen inoculum level (PreDicta B™ test in Feb-March), to identify high disease risk paddocks, if disease is not confirmed in the previous cereal crop, especially if planning to sow cereals back on cereals	• Select a non-cereal crop (e.g. canola or pulses) if you want to reduce inoculum levels • Remove autumn ‘green bridge’ before seeding with good weed control	• Sow early; early-sown crops have a greater chance of escaping infection • Use soil openers that disturb soil below the seed to facilitate root growth – knife points reduce disease risk compared to discs • Avoid pre-sowing SU herbicides, • Supply adequate nutrition (N, P and trace elements) to encourage healthy seedling growth • Avoid stubble incorporation at sowing to minimize N deficiency in seedlings • Consider seed dressings and banding fungicides to reduce yield loss • Remove grassy weeds early • Apply nutrient/trace elements, foliar in crop, if required

Seeding systems and tillage

- Soil openers can have a significant influence on disease severity.
- Disturbance below seeding depth helps roots escape infection and reduces disease impact.
- Disease risk is greater with single disc seeders than knife points.
- Tillage can redistribute inoculum to deeper in the soil.

Disease risk identification

PreDicta B™ is a unique DNA-based service which identifies soil-borne pathogens, such as *Rhizoctonia*, so cropping programs can be adjusted before seeding to include strategies to minimise soil-borne risk.

High *Rhizoctonia* disease-risk paddocks can also be identified by examining crown roots of cereals in areas of poor growth (not necessarily bare patches) in the previous spring.

Why is *Rhizoctonia* a problem?

Rhizoctonia root rot is difficult to control because:

- the fungus can survive in soil in the absence of a live plant host on cereal stubbles – this is termed 'saprophytic ability';
- the disease is more severe in cold, dry and compacted soils where low levels of inoculum combined with slow root growth can cause disease;
- it has a wide host range and can build-up quickly under cereals/grassy pastures, hence is difficult to eradicate;
- there are no resistant cereals;
- it is strongly influenced by soil and environmental conditions;
- the disease is worse when the crop is under stress from other factors such as poor nutrition and limited moisture.

Key factors influencing occurrence and severity

While *Rhizoctonia solani* AG8 fungus is likely to be present in many soils, it is not necessarily going to cause a problem. One reason for this is that beneficial soil micro-organisms and high microbial activity have been shown to suppress the expression of the disease and reduce the level of disease.

In cereals, *R. solani* AG8 inoculum builds up from sowing to crop maturity and generally peaks at crop maturity, while rain post-maturity of a crop and over the summer fallow causes a decline in inoculum (Figure 3).

Crown root infection late into the crop season results in the build-up of inoculum in cereal crops.

In the absence of host plants including weeds, summer rainfall events of >20 mm in a week can substantially reduce the level of inoculum. Dry spells, on the other hand, offer little opportunity for pathogen inoculum breakdown, with disease levels likely to remain stable if a host, or stubble, are present.

Cropping systems with stubble retention, suppressive activity has been shown to increase over a five to eight year period. GRDC-funded CSIRO research showed suppressive soils generally contained higher populations of specific fungi and bacterial groups capable of antibiosis, mycoparasitism, plant growth promotion, nutrition and improved plant defences.

Basic biology

R. solani AG8 fungus generally occurs in the top 0 to 5 cm of soil on decaying crop residues (Figure 4). During the growing season levels increase throughout the profile.

It grows through soil as a network of fungal hyphae or filaments.

Inoculum levels increase on the roots of living host plants. Crop residues can also host inoculum but may also contribute to reducing overall rhizoctonia levels. This is because they retain moisture which both assists with stubble breakdown and promotes other soil organisms that can suppress rhizoctonia.

This ability to survive on crop residues is strongly influenced by the soil conditions – soil type, fertility, moisture, temperature and biological activity.

Rhizoctonia disease is often a problem in low fertility, sandy or calcareous soils of southern and western Australia.

R. solani AG8 can infect, and cause spear tips in, a wide range of crops including weeds, but multiplies greatest on cereals and grasses.

Of the cereals, oats are most tolerant followed by triticale, wheat and then barley.

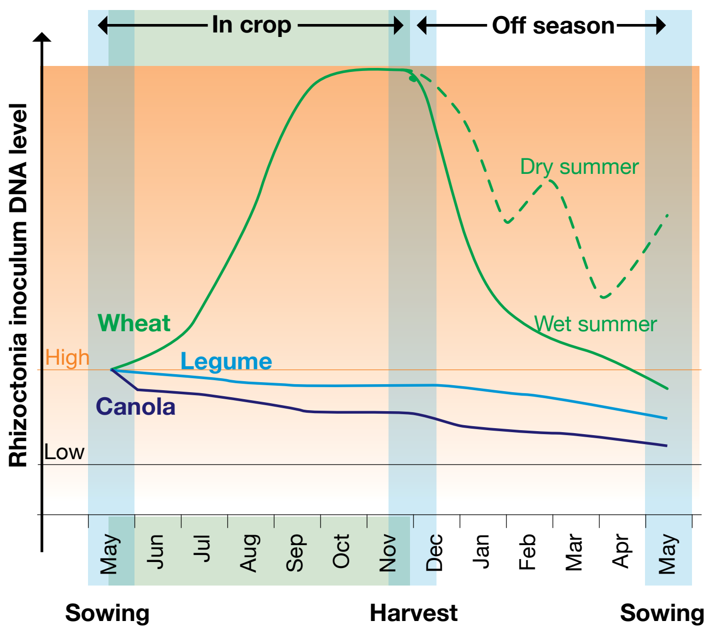

Figure 3: R. solani AG8 inoculum levels in soil build-up in-crop but decline during summer following rainfall under wheat, while under grass-free canola and legume crops inoculum levels decline in-crop and over summer.

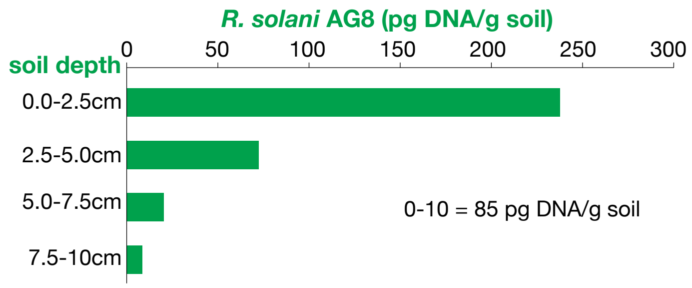

Figure 4: Distribution of R. solani inoculum in the soil profile collected at pre-sowing 2010. Inoculum levels increase in cereal crops at all depths.

Bare patches

Severe seedling infection causes patches of poor crop growth from very small to several metres across (Figure 5).

This can occur in cold/dry soils and conditions that restrict seminal root growth (e.g. compaction, lack of moisture, herbicide residues).

Uneven growth at tillering

Warmer soil temperatures and adequate moisture are less conducive to the disease as crops escape seminal root infection, but crown roots can be affected by *Rhizoctonia* under low soil temperatures and poor nutrition leading to uneven growth at tillering.

Figure 5: Rhizoctonia infection of seminal roots results in distinct patches of poor growth.

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Disease suppression

- Biological disease suppression can help control *Rhizoctonia* disease occurring in grower's crops.
- Disease suppression is a function of activity and diversity of the microbial community.
- A management regime that increases C inputs and turnover over a number of years (5 to 7 years) may improve suppressive activity. Management practices which encourage suppression include reduced tillage and stubble retention, controlling weed hosts, no grazing or stubble burning and avoiding bare fallows.
- However, it would be difficult to improve suppression where yields are less than 60 per cent of water-limited potential because the amount of carbon inputs are inadequate to support adequate biological activity.

Further reading

Gupta, V.V.S.R., et al. (2015) Management of soil-borne *Rhizoctonia* disease risk in cropping systems. MSF 2014 Compendium articles, MSF Inc, Mildura. pp.1-5. http://msfp.org.au/wp-content/uploads/2015/02/Vadakattu_*Rhizoctonia*-disease-risk.pdf

McKay, A.C., et al. (2014). *Rhizoctonia* control improved by liquid banding of fungicide. GRDC update article. http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/*Rhizoctonia*-control-improved-by-liquid-banding-of-fungicides

Useful resources

Soil quality website www.soilquality.org.au

For more information on crop diseases and management, see the GRDC GrowNotes at www.grdc.com.au/GrowNotes

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