# New weapons improving the odds in rhizoctonia battle

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Farmers are much better equipped to tackle rhizoctonia now than they were even five years ago, thanks to improved understanding of the disease and registration of two fungicides for use against it.

Registration of the fungicide seed dressings Vibrance and EverGol Prime for use in rhizoctonia management means there is now a chemical option that can be used with the agronomic methods that are an essential part of any program to reduce losses from the disease.

Reducing the economic impact of rhizoctonia requires a dual approach of reducing the amount of disease in the soil and minimising the likelihood of crops sown into that soil being attacked by the fungus, said Dr McKay, who heads SARDI's diagnostics team.

Rhizoctonia, which is estimated to cost the Australian grains industry about $59 million a year, is caused by ***Rhizoctonia solani,*** a fungus that attacks plant roots in the top five to 10 centimetres of soil, reducing the ability of crops to access water and nutrients.

It is most prevalent, and damaging, in sandy soils in districts with low to medium-rainfall and is more common in SA and WA than the eastern States, although in recent years it has emerged as an issue for farmers in southern NSW.

Severe early-season infestations of the fungus are characterised by localised crop death resulting in bare patches in paddocks, a symptom that has seen it become known as 'rhizoctonia bare patch' or simply 'bare patch'. These characteristic patches of bare soil or severely stunted crop, which range from quite small to several metres across, are typically caused by the disease attacking the seminal roots of seedlings that germinate in areas where there is a high ***R. solani*** population.

Recent research has shown that the disease can also attack the crown roots of crops later in the season, typically around tillering, and cause significant yield losses without any characteristic bare patches.

"Rhizoctonia does not always cause obvious bare patches," Dr McKay said. "If the fungus becomes active only later in the growing period and attacks the crown roots at around tillering the only visual symptom is likely to be uneven crop growth, rather than the bare patches characteristic of seedling damage.

RHIZOCTONIA CAN HAVE A SIGNIFICANT IMPACT, AS THIS TRIAL-SITE PHOTOGRAPH TRIAL SHOWS. THE THREE ROWS ON THE RIGHT WERE TREATED WITH A FUNGICIDE AT SEEDING. THE LEFT THREE ROWS RECEIVED NO FUNGICIDE TREATMENT.

"Less crown roots mean less tillers, and less heads, so rhizoctonia can cause considerable losses in apparently healthy crops that grew well early and escape attack at the seedling stage.

"Growers who notice uneven growth in their crops would be well advised to pull or dig some plants, wash out the roots and check the tips in particular for damage.

"Even if there are no obvious symptoms, such as variations in crop height or areas of plants with less tillers, take some time mid season, around July is good, to dig up some plants and check the crown roots in particular.

"The dry summer and late start this year mean the risk of losses due to rhizoctonia is high in many districts this season, so it would pay to check crops during the growing season to see whether or not roots have been damaged.

"R. solani causes quite distinctive spear tipping, so finding roots with this characteristic damage shows the disease is causing damage and there is potential for more yield improvement."

The potential for losses from damage to the crown roots during the growing season highlights the value of knowing the disease status of paddocks ahead of seeding, particularly now there are seed dressings that can help reduce the impact of the disease, Dr McKay said.

"The yield effect of rhizoctonia is strongly influenced by seasonal conditions, but a pre-seeding PreDicta B test, which uses DNA technology to assess the level of ***R. solani*** and other diseases in soil samples, will give a good indication of the disease level in a paddock.

"In paddocks where Predicta B results indicate high levels of the fungus, or if paddock checks during the season or just ahead of harvest reveal a significant percentage of spear-tipped roots typical of ***R. solani*** damage, it may be advisable to sow a crop other than a cereal in the following year."

## Control options

Agronomic measures that can reduce the impact of rhizoctonia include soil disturbance, to disrupt the network of disease hyphae in the soil, control of grass weeds, including 'green bridge' weed control in autumn, good nutrition management and crop rotation.

In addition to removing rhizoctonia hosts, effective weed control over summer and autumn helps conserve soil moisture and maintain moist soil conditions that cause disease levels to decline.

The seed dressings Vibrance and EverGol Prime can reduce yield loss from rhizoctonia by an average of about 5%, suggesting they are likely to have greatest benefit in paddocks where levels of the disease are low to moderate, and to be best used in conjunction with recommended cultural control measures, Dr McKay said.

"Growers need to calculate whether or not using a fungicide is likely to be cost-effective, taking account of seasonal conditions and the level of fungus in the soil. If losses due to rhizoctonia are likely to be high a fungicide is unlikely to achieve sufficient yield response to cover the costs involved."

A decade ago soil disturbance, ideally paddock-wide full-cut cultivation at or ahead of seeding, was considered the only effective means of controlling rhizoctonia, which in extreme conditions can reduce wheat and barley yields by up to 50%. Losses of five to 20% are more common in modern farming systems because crops are being sown earlier, while soils are still warm, and are generally better managed, with more attention paid to nutrition and seeding depth, for example, than was the case last century.

In no-till systems, setting knife-point tines deep to disturb the soil beneath the seed at seeding can provide similar benefits to full-cut cultivation.

In 2010 trials, ***R. solani*** levels along rows sown with knife points set to work to 10 cm deep were much lower than in rows sown with a triple disc seeder that worked to 6 cm depth, with intermediate disease populations where the crop was sown using a rippled coulter working to 10 cm.

And CSIRO scientist Gupta Vadakattu has shown that rotation, particularly with canola, can significantly reduce the impact of rhizoctonia in wheat. Other pulse crops and broad-leafed pastures can also reduce levels of the disease, provided they are grass-free, but canola or mustard crops provide the greatest rotational benefits. Lupin is not a good break-crop option for rhizoctonia.

Dr Vadakattu has found that grass-free canola, mustard, field peas, chickpeas, medic pastures and fallow all reduce ***R. solani*** levels and increase the yield of a following wheat crop by between 47% and 9%, but that this effect lasts for only one season, with the fungus population building up again on the first cereal crop following the break.

Keeping paddocks grass-free is a critical element of any rhizoctonia control program because, while the disease can attack a wide range of plants and grow on crop residues, its main hosts are grasses and volunteer cereals.

## Seasonal factors

When there are no host plants present the disease survives on organic matter in the soil, producing a 'web' of hyphae in the topsoil. ***R. solani*** populations are usually highest in the top 5 cm of soil, but it can attack roots to a depth of 10 cm during the growing season.

The fungus is most active in cold, relatively dry soil, causing most root damage at soil temperatures of around 10°C, Dr McKay said.

### KEEPING ABREAST OF THE TECHNOLOGY

**Trials are underway in SA and WA to establish whether or not current-generation fungicides registered for use as seed dressings or in-furrow application can be applied effectively using liquid delivery systems.**

**The work, which is also examining whether efficacy changes when an in-furrow chemical is positioned above, below or beside the seed, is being done by a team headed by SARDI scientist Dr Alan McKay.**

**Chemicals being used in the trials include Vibrance and EverGol Prime, seed dressings that can reduce the impact of rhizoctonia in some situations. However, the research is focused on keeping abreast of developments in application technology, not specifically efficacy of those products, Dr McKay said.**

**Depending on the results of the trials, which are in their final year, some chemical companies may decide to do the work needed to have their products registered for application by banding into the furrow liquid delivery systems, he said.**

**However, the results from the first two years' research have been quite variable, and there is no guarantee the team's findings will prompt chemical companies to seek registration of current products for in-furrow application through liquid delivery systems.**

ALAN MCKAY AND SARDI SENIOR RESEARCH AGRONOMIST DR PAUL BOGACKI COMPARING ROOT DAMAGE ON PLANTS SAMPLED FROM A RHIZOCTONIA TRIAL.

WHEAT PLANTS WITH HEALTHY SEMINAL AND CROWN ROOTS AND PLANTS DAMAGED BY A 'LATE' RHIZOCTONIA INFECTION AT ABOUT TILLERING. THE DISEASED PLANTS (RIGHT) HAVE FEWER SEMINAL ROOTS AND ONLY SPEAR-POINTED STUBS OF THE CROWN ROOTS.

THESE TWO PHOTOGRAPHS SHOW A MATURE WHEAT PLANT WITH HEALTHY ROOT SYSTEM (LEFT) AND A PLANT OF THE SAME AGE SEVERELY AFFECTED BY RHIZOCTONIA (RIGHT), WITH THE 'SPEAR TIPPING' CHARACTERISTIC OF RHIZOCTONIA DAMAGE CLEARLY EVIDENT.

"Rhizoctonia causes most damage to slow-growing roots and root growth can be slowed by cold soil, poor nutrition, soil compaction and herbicide residues.

"Low temperatures favour the disease and slow root growth, maximising the chance of roots being attacked, whatever the growth stage of the crop.

"Providing conditions that improve the chance of rapid root growth will minimise the risk of losses due to rhizoctonia."

Measures to improve root growth include:

- sowing early into warm soil, which favours root growth and limits ***R. solani*** activity, so seedlings are more likely to get roots into the subsoil before the disease in the topsoil becomes active
- sowing seed deep, to minimise the exposure of seedling roots to the high disease population in the top 5 cm of the soil
- working deep below the seed to ensure compaction is not an issue and to break up ***R. solani*** hyphae, reducing the risk of the crop plants coming into contact with the disease
- ensuring good nutrition, particularly adequate nitrogen and trace elements for germinating seedlings, to encourage rapid early root growth.

In districts where rhizoctonia is known to cause problems, increased seeding rates can reduce the impact of tiller reduction that can result from ***R. solani*** attack on crop crown roots later in the growing season.

## Healthy soils

'Healthy' soils that contain sufficient soil carbon to support diverse and resilient populations of soil organisms can also reduce populations of the fungus, to such an extent that some cropping soils are said to be 'suppressive' because the populations of soil organisms they contain prevent build-up of ***R. solani.*** Suppressive biological activity can provide almost complete control of rhizoctonia in some situations.

According to Dr Vadakattu, a leader in the study of 'suppressive' soils, suppressive activity can be significantly improved by increasing the level of carbon returned to the soil in stubble and root residues.

Carbon input is maximised by growing big crops with full stubble retention, an approach that can produce a 'suppressive soil' in five to eight years, depending on conditions, he said, with the high carbon input needing to be maintained to support the 'suppressive' soil organisms.

Less crop growth due to drought, for example, or a move away from full stubble retention, will reduce carbon input and is likely to reduce suppressive activity and increase the risk of rhizoctonia and other root diseases.

Seasonal conditions also impact on ***R. solani*** populations.

"Changes in the ***R. solani*** population in-crop and between harvest and seeding are far more dynamic than previously believed," Dr Vadakattu said.

"The disease builds up as the crop develops, especially during spring, and reaches maximum levels as the crop matures.

"Long, dry periods over summer can allow the fungus to build up, while rain at or after harvest causes a decline in inoculum.

"Summer rainfall of more than 30 mm in a week after that time will reduce ***R. solani*** populations because the fungus does not compete well with other micro-organisms in a warm, moist soil environment," explained Dr Vadakattu.

"Major rainfall events over summer can substantially reduce ***R. solani*** levels. Autumn rainfall is also beneficial but has less effect because microbial activity is lower in cooler soils.

"However, disease levels can recover in long periods between summer rainfall events and remain high during summer and autumn if there is little or infrequent rainfall.

"Summer rainfall also mineralises high levels of nitrogen, which in suppressive soils can change the soil biology, reducing the level of disease suppression until the excess soil nitrogen is used up or lost from the system."