Tips and Tactics

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Stem rust in wheat

Northern, Southern and Western Regions

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Choose resistant varieties to ward off stem rust

Wheat stem rust is an occasional, but devastating disease of wheat with the potential to cause crop failure. It can occur in all grain growing regions where susceptible varieties are grown.

Epidemics can cause serious reductions both in yield and quality and growers are urged to choose resistant varieties.

GRDC-funded economic analysis and research shows controlling stem rust through best management practices benefits the Australian grain industry by $478 million/year and prevents potential losses to growers of $40.09/hectare.

Conditions favouring stem rust

Spring rain and warm (with infection possible between 15°C to 30°C), humid weather.

The combination of susceptible varieties, inoculum build-up on volunteer cereals, and a wet spring.

Outbreaks are more likely following above-average growing season rainfall.

The widespread planting of susceptible varieties increases the risk of an outbreak.

Summer rains allowing the germination of volunteer cereals/weeds, creating a 'green bridge' to carry the rust inoculum from one season to the next. Autumn rains will support the early build-up of stem rust on volunteer cereals.

High levels of stem rust in the previous season increase the likelihood of carryover of inoculum into the next season. This risk occurs where there are outbreaks in the local area or neighbouring districts because stem rust inoculum can quickly spread long distances on the wind.

The presence of susceptible long season wheats in high rainfall areas can also facilitate a 'green bridge', particularly where early-sown crops are planted in close proximity to late-sown crops from the previous season.

KEY STRATEGIES

- Grow resistant varieties to prevent yield losses and reduce the build-up of stem rust inoculum.
- Eliminate volunteer wheat plants over summer/autumn (the 'green bridge') to reduce the carryover of stem rust inoculum between seasons.
- Monitor your crop to detect infection at the earliest stage possible.
- Be particularly alert during spring rain and warm, humid weather. These conditions favour stem rust development.
- Foliar fungicides can assist with stem rust management, but are of limited effectiveness by the time plant head infection occurs.

Figure 1: Stem rust can devastate wheat yield and quality. (Image: Hugh Wallwork)

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Management strategies

1. Make a strategic variety selection

The best tool growers have to control stem rust and prevent or reduce yield loss is to grow rust-resistant varieties (Table 1).

Resistant varieties reduce the build-up of stem rust inoculum, which can lead to epidemics, and they decrease pressure from existing stem rust pathotypes (strains).

If most crops in a district are sown to resistant varieties there will be considerably less inoculum than if the majority of varieties are susceptible or very susceptible.

Growers should use the latest information on each variety's reaction to stem rust because ratings can change if there are changes in the rust pathogens.

Consult the rust resistance ratings tables for your region provided by state departments of agriculture, the Rust Bust initiative, National Variety Trials and in bulletins released by the University of Sydney's Plant Breeding Institute (Useful Resources, page 4).

Understand the difference between all-stage resistance and adult plant resistance as this will impact on your crop management (Forms of Resistance, page 3).

2. Remove the 'green bridge'

Stem rust can only survive from one season to the next on living plants that grow over the summer and form a 'green bridge'. It does not carryover on seed, stubble or soil.

Growers should ensure all volunteer cereal plants are removed either by spraying, cultivating or heavy grazing at least four weeks before the next crop is sown, to reduce stem rust inoculum levels.

Particular care should be taken to destroy plants around sheds and silos, as stem rust often survives on plants in these areas.

It is also important to control host weeds during the growing season to prevent seed set that could contribute to 'green bridge' development in the next fallow period.

St Patrick's Day

17 March is considered an ideal time to control the 'green bridge' of overwintering cereals and host weeds.

Table 1: Wheat variety resistance ratings and potential maximum yield loss due to stem rust. (Source: DAFWA)

Resistance rating	Definition	Potential yield loss from stem rust (%)
Very susceptible (VS)	Early high disease build-up; can promote epidemic development	50–90
Susceptible (S)	High disease build-up	25–50
Moderately susceptible (MS)	Develops disease less quickly and so reduces the risk of loss	10–35
Moderately resistant to moderately susceptible (MRMS)	Some partial resistance; losses depend on disease pressure	5–25
Moderately resistant (MR)	High partial resistance; generally few losses	5–15
Resistant (R)	Highly effective resistance; no or slight losses	0–5
Highly resistant (HR)	Complete resistance	0

3. Crop monitoring

Careful monitoring of crops is crucial. Identification of rust infections in the previous year can help determine the threat of rust and other diseases in the following year of planting.

If rusts were found in adjacent paddocks in the previous season, strict management guidelines involving the planting of resistant varieties and other control measures should be employed.

Growers should closely monitor crops during the growing season to detect infection as early as possible.

4. Seed and fertiliser treatments

There are currently no seed- or fertiliser-applied fungicides, or in-furrow applications, registered for the control of wheat stem rust. The effects of such treatments would wear off by the time stem rust became a problem, usually towards the end of the growing season.

5. Foliar fungicides

Foliar fungicides can assist with stem rust management, but are of limited effectiveness by the time plant head infection occurs.

Current fungicides are effective as protectants to stop infection rather than cure existing infections. Therefore they should be applied early in epidemic development.

Fungicides only protect the leaves and stems they are applied to and do not provide systemic protection or protection to new leaves or stems that emerge after the spray has been applied.

While fungicides may work on leaf rust and stripe rust, which affect the leaves more than the stems, they are less effective on stem rust, especially in thick canopies where they may have trouble penetrating and contacting the stems. Correct sprayer set up and nozzle selection is imperative.

Observe maximum residue limits and withholding periods.

Checklist: Should I spray my wheat crop?

- What is the yield potential of my paddock?
- Will I get an economic return on my spray investment?
- Am I too early/late to benefit from this spray?
- What is the length of residual of this spray? Will it require a second application?
- If I do not spray this crop will neighbouring crops be at greater risk of infection?
- Am I growing a susceptible variety?
- What is the disease status in the district?
- What was the disease status in adjacent paddocks in the previous season?
- Have the weather conditions favoured the development of the disease?
- Was there a 'green bridge' in this or adjacent paddocks over the summer/autumn months?

The disease

Stem rust is caused by the fungus *Puccinia graminis* f. sp. *tritici* (*Pgt*).

Like the other two wheat rust pathogens (stripe and leaf), it can only survive from one season to the next on a living host.

The most important hosts are susceptible wheat varieties, but *Pgt* can also survive on barley, triticale, rye and some grasses.

There are two types of spores that are produced on wheat, called urediniospores and teliospores. The spores that infect wheat, called urediniospores, are red-brown in colour and do not carry over on stubble, seed or soil.

The black teliospores of the rust survive on stubble. Teliospores germinate to produce a third spore, the basidiospore, which infects the alternate host, barberry (*Berberis* spp). Barberry only occurs in cool, wet climates of Australia, such as the southern tablelands of New South Wales and Victoria and in various parts of Tasmania, and does not occur near any wheat paddocks in Australia. Therefore, it does not play a role in the stem rust disease cycle in Australia.

Carryover of inoculum on wheat from one season to the next is greatest during wet summers and autumns which encourage the growth of volunteer wheat plants.

For this reason, the northern regions of the eastern Australia cereal belt, where a summer dominant rainfall pattern prevails, are especially prone to stem rust outbreaks.

Like all rust pathogens, stem rust urediniospores are wind-blown and can be spread over large areas in a short time.

Warm and humid weather accelerates the development of the disease. The optimal temperature for infection is 20°C to 25°C with infection possible between 15°C and 30°C (Table 2).

In contrast to other rusts, stem rust will infect the true stem, below the head, and hence it can drastically restrict grain filling and severely limit yield and quality. In severe cases it can cause crop failure.

Identifying stem rust

Stem rust is first seen as reddish-brown, powdery, oblong blisters, known as pustules, on the leaves and stems of the plant running parallel to the long axis of the leaf or stem (Figures 2, 3). These break open to reveal a mass of reddish-brown spores (Figure 4).

Later in the season, teliospores form in black, shiny pustules.

Stem rust and leaf rust are often hard to tell apart. Stem rust urediniospores are much darker in colour than leaf rust urediniospores. Leaf rust pustules are lighter brown to orange, small, circular to oval and mostly develop only on the upper surfaces of leaves and less frequently on leaf sheaths than stem rust.

Stem rust usually becomes evident later in the season than stripe rust or leaf rust.

Forms of resistance

There are two forms of resistance:

- All-stage resistance, which operates throughout the life of the plant.
- Adult plant resistance (APR), which develops as the plant matures (usually post node formation growth stage) and provides protection in a crop's post-seedling stages.

What is adult plant resistance?

Adult plant resistance (APR) is resistance to any disease that becomes effective in a variety sometime in the post-seedling stage of crop development.

APR is often expressed as 'slow rusting'—it reduces rather than removes pustule formation.

The genes that control APR are often additive, meaning that the more APR genes present in a variety, the greater the cumulative effect on reducing rust infection. Depending on the APR genes present in a variety, the resistance can be activated from early in the crop's development, at tillering (GS20), through to full head emergence (GS59).

The expression of APR can vary with environmental conditions, and hence can vary from season to season. APR expression is normally lower in cooler conditions and when plants have high nitrogen content.

In the absence of all-stage resistance, varieties with APR will still be susceptible to rust at the seedling stage.

Figure 2: Stem rust is first seen as reddish-brown, powdery, oblong blisters, known as pustules. (Image: Ian Dundas)

Take action

Submit a sample

The Plant Breeding Institute (PBI) at the University of Sydney surveys Australia for pathotype (strain) variation in all the cereal rusts. The diagnostic survey relies primarily on people sending rust samples for pathotype identification. It provides the whole industry with a valuable snapshot of where rusts are tracking in a season. The survey is paid for by grower levy and is a free service.

If rust is suspected in your crop, plant samples should be sent in paper envelopes (not plastic bags) to the PBI. Leaves and/or stems with active pustules are required.

Free reply paid envelopes are available from PBI. More details on how to send in samples are available at the Rust Bust website http://rustbust.com.au/tips-for-busting-rust/samples/

Communicate

Growers need to work collaboratively, rather than as individuals, to ensure regional control of the 'green bridge' and management of the disease.

If you have a rust outbreak, inform your neighbours, agronomist and state plant pathologist.

Figure 3: Stem rust appears on both the leaves and stems of the plant running parallel to the long axis of the leaf or stem.

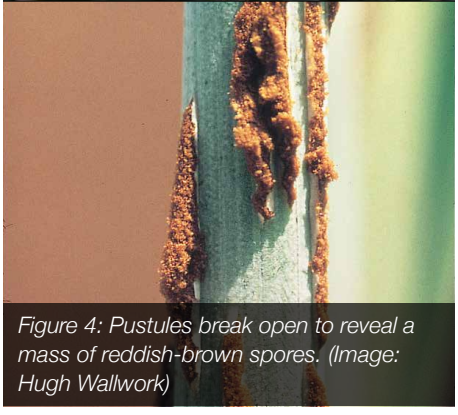

Figure 4: Pustules break open to reveal a mass of reddish-brown spores. (Image: Hugh Wallwork)

Further reading

The Rust Bust fact sheets www.rustbust.com.au/news-information/fact-sheets

GRDC Adult plant resistance fact sheet www.grdc.com.au/FS-AdultPlantResistance

GRDC Green bridge fact sheet www.grdc.com.au/Resources/Factsheets/2010/01/Green-Bridge-Fact-Sheet-National-Jan-2010

GRDC Foliar application of fungicides fact sheet www.grdc.com.au/Resources/Factsheets/2014/08/Foliar-applications-of-spray

GRDC Fungicide timing fact sheet www.grdc.com.au/GRDC-FS-FungicideTiming

GRDC GrowNotes www.grdc.com.au/Resources/GrowNotes

GRDC Wheat Rust: The Back Pocket Guide www.grdc.com.au/Resources/Publications/2011/03/Wheat-Rust-The-Back-Pocket-Guide

Useful resources

University of Sydney Plant Breeding Institute www.sydney.edu.au/agriculture/plant_breeding_institute/cereal_rust

The Rust Bust initiative www.rustbust.com.au

NSW DPI winter crop variety sowing guide www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

NVT Queensland Wheat Variety Guide www.nvtonline.com.au

Victorian Cereal Disease Guide www.agriculture.vic.gov.au

South Australian Cereal Variety Disease Guide www.pir.sa.gov.au

DAFWA Wheat variety guide for Western Australia www.agric.wa.gov.au

DAFWA Pestfax newsletter www.agric.wa.gov.au/crop-diseases/about-pestfax-newsletter

Plant Health Australia www.planthealthaustralia.com.au/nationalprograms/grains-farm-biosecurity-program

National Variety Trials www.nvtonline.com.au

APVMA registered fungicides www.apvma.gov.au

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