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Managing stripe rust and leaf rust of wheat

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Summary

- Avoid sowing very susceptible varieties. Use resistant or intermediate varieties wherever possible.
- Destroy wheat volunteers that will harbour rust in autumn.
- For susceptible to intermediate varieties, if there is a high risk of local carryover associated with 'green bridge' (see below), use fungicide at seeding or spray fungicide at stem elongation to prevent early infection. Monitor crops for signs of infection from early flag leaf emergence (Z37).
- When no early fungicide was applied, monitor crops from early stem elongation (Z31) and apply foliar fungicide at the first sign of stripe rust or leaf rust according to the stage of crop development and variety susceptibility.
- Response to fungicide in susceptible varieties diminishes with delayed application and with increasing variety resistance.

Stripe rust (*Puccinia striiformis* f. sp. *tritici*) and leaf rust (*Puccinia triticina*) can be a significant threat to wheat crops in Western Australia in some seasons. Rust in wheat appears as brown to orange dusty pustules on leaves. Stripe rust and leaf rust can be distinguished by the colour and shape of pustules and the location of the infection. Stripe rust pustules are yellow-orange. Initially they are small and circular but develop into yellow stripes on upper leaf surfaces, leaf sheaths and awns and inside glumes. Leaf rust pustules are orange-brown in colour, circular to oval in shape and chiefly found scattered on the upper surface of leaves.

Colour depends on the freshness of the pustule. Because most spores are produced overnight, pustules are best observed in the morning. Refer to Bulletin 4539 *Identifying wheat leaf diseases* for further information including distinguishing stripe and leaf rusts from stem rust.

Because there are different strains of leaf, stem and stripe rusts, care must be taken when travelling interstate or receiving interstate or overseas visitors, since spores carried on clothing could introduce new strains of rusts. Thoroughly wash potentially contaminated clothes, shoes and so on before visiting crops after travelling interstate or overseas or when receiving visitors from these locations.

Risk factors

Wheat varieties

Very susceptible to susceptible varieties (CVT rating 2–3) increase the risk of rust infection in two ways. During the growing season, rust can develop rapidly on these varieties from very slight infections (for example, stripe rust on Brookton, EGA Bonnie Rock, H45 and Westonia varieties). During the summer and autumn non-cropping period, varieties in this category represent good volunteer wheat hosts that greatly enhance the survival opportunities for rust to carryover the non-cropping period.

Green bridge proximity

Summer rains permit the development of volunteer cereal hosts and autumn rains permit the early build-up of rust on these volunteers known as the 'green bridge'. This happens readily after wet summers. Cropping areas that receive summer rain resulting in self-sown green bridge cereals are at risk of early infection with stripe or leaf rusts. While wheat leaf rust only infects wheat, wheat stripe rust can infect tall wheat grass and may also infect barley grass and brome grass.

The amount of rust present in the previous season also determines the risk of leaf and stripe rusts. The more rust in a given year means there is more chance of carryover into the next season.

Weather

While resistance will influence individual crop risk, the overall risk of serious rust outbreaks is influenced by summer and winter weather factors (rainfall and temperature) which can be considered in your region each season.

Both stripe and leaf rusts require moisture for spores to infect leaves. A stripe or leaf rust epidemic is more likely if the winter and/or spring is suitably wet.

Leaf rust has a warmer mean daily temperature optimum than stripe rust. The mild winters in Western Australia result in leaf rust being relatively active in winter and into spring, particularly in the northern agricultural areas. Early sown crops, on which infections establish prior to the cooler winter months, are more at risk from early leaf rust which can develop rapidly in spring. The lower temperature optimum for stripe rust results in the disease being relatively more active in winter than later in the season. Warm spring conditions, particularly in the northern agricultural areas, can increase the time taken between infection and resultant new spores being produced (the latent period) (Table 1).

Table 1. The approximate time taken for an infection to result in new spores (latent period) and indicative optimal temperature ranges for rust foliar diseases in wheat

Disease	Latent period (days)	Optimal average daily temperature (˚C)
Stem rust*	7–10	18–30
Stripe rust	10–14	7–15
Leaf rust	7–10	10–20

*Further information is available in Farmnote No. 73/04 *Managing stem rust of wheat*.

How to monitor crops

The aim of crop monitoring is to detect infection at the earliest stage feasible. Inspect the most susceptible and earliest sown crops carefully over a wide area of the paddock. Examine leaves at the top and bottom of the canopy for scattered light infections. In green bridge areas also look for infrequent heavily-infected hot spots.

Crops prone to infection at young stages (CVT rating 2–6) should be inspected at seven to 10 day intervals from early stem elongation (growth stage Z31) or from early flag leaf emergence (growth stage Z37) if seeding fungicide treatments registered to control rust diseases have been used.

For confirmation on disease diagnosis, send six to 10 infected stems or leaves to AGWEST Plant Laboratories, Department of Agriculture, Locked Bag 4, Bentley Delivery Centre 6983 (ph 9368 3721). Post in a paper envelope (no plastic) with date, location, name and contact details. Broadacre diagnostic submission forms are available from your local Department of Agriculture or on-line (<www.agric.wa.gov.au>; search for 'broadacre form').

Yield losses

Yield loss will depend on the disease resistance of the variety and on how early the disease starts in the crop (Table 2). In general, yield losses are greatest in susceptible varieties and with early infection. Severe disease will cause grain shrivelling (but grain is otherwise sound). For stripe rust, quality reductions such as lower hectolitre weights and grain staining (rare), can add to high yield loss impacts.

Disease management

Utilise variety resistance

Resistance to one rust is normally independent of resistance to other rusts and so varieties may express a range of resistance to stripe or leaf rust in three broad categories:

- Resistant to very resistant at all plant stages from seedling to adult (CVT rating 7–8). Fungicide is not required. Normally based on a single gene resistance, experience around the world has shown this resistance can sometimes be rendered ineffective ('breakdown') through rust mutation.
- Partially resistant (CVT rating 5–6), susceptible at young crop stages and gradually increasing in resistance as the crop develops during late stem elongation, expressing maximum adult plant resistance around heading/flowering. These varieties usually develop rust slowly unless they become infected early.
- Very susceptible to susceptible (CVT rating 2–4) throughout all stages, rapid rusting causing significant yield losses. Promotes epidemic development and pathogen mutation. Rust is more difficult to control with fungicides in varieties with low resistance ratings (2–3).

When selecting varieties, consider responses to rust diseases and avoid varieties that are highly susceptible. Check disease resistance ratings in the latest *Crop Variety Sowing Guide*.

Table 2. Wheat variety resistance ratings and potential maximum yield loss due to leaf rust and stripe rust

Resistance rating	Definition	Potential yield loss (%) Leaf rust	Stripe rust
2 – very susceptible	Early high disease build-up; can promote epidemic development	40	80
3 – susceptible	High disease build-up	30	60
4 – moderately susceptible	Develops disease less quickly and so reduces loss risk	20	40
5 – intermediate	Some partial resistance; losses depend on disease pressure	15	30
6 – moderately resistant	High partial resistance; generally few losses	5	15
7 – resistant	Highly effective resistance; no or slight losses	<5	5
8 – highly resistant	Complete resistance	0	0

Avoid early infection

Destroy green bridge well in advance of seeding

The overlap of summer volunteer or autumn sown susceptible wheat with conventional wheat plantings in winter is a crucial factor in establishing early severe infection of stripe or leaf rust. Destroy self-sown wheat (particularly the most susceptible varieties) at young stages well in advance of seeding as occurrence of rain leading into a cropping season increases susceptible regrowth and allows very early sowing opportunities.

Early season fungicide protection is important in high risk situations

For susceptible to intermediate varieties, if there is an increased risk of localised rust carryover associated with green bridge cereals in your region, use fungicide at seeding or spray fungicide at stem elongation to prevent early infection.

Risk of early infection can not be assessed until autumn. If possible, delay general seed treatment of susceptible to intermediate varieties until autumn to determine the risk of rust associated with high early rainfall and regional green bridge cereals. If early infection develops, it will be significantly lower in crops that have been treated with fungicide at seeding and the disease will be easier to manage in spring if follow-up spraying is required.

Highly effective options include long-acting seed dressings (approximately $9 to $21/ha) or in-furrow fungicides (approximately $7 to $21/ha) that can provide protection until around flag leaf emergence stage depending on rate of application and disease pressure. Expenditure decisions (including product choice) should be made according to risk and yield potential. See Farmnote No. 10/04 *Cereal seed dressing and in-furrow fungicides 2004–2005*.

Foliar fungicides can also protect from early infection

In the absence of fungicide at seeding, crops at high risk of early infection (in areas of high rust activity) can be treated with a foliar fungicide spray at first node (Z31) (approximately $12 to $18/ha) to protect the crop from early infection until around flag leaf emergence (see Figure 1). This preventative strategy is applicable to varieties with CVT ratings 2–6 and can be used instead of fungicide at seeding. This can delay and sometimes avoid costs if the disease risk does not eventuate. However, an early spray will only protect the leaves which are emerged at the time of the foliar application.

Control late infection in susceptible to intermediate varieties with fungicide

Fungicide retards disease development for about three to six weeks after application, depending on product and rate. These diseases can be controlled effectively and economically if fungicide is applied shortly after infection commences but follow-up application will probably be required in long season environments or on very susceptible varieties.

If crops have not received early fungicide protection, commence monitoring for stripe or leaf rust at early stem elongation (first node stage, Z31 Figure 1) and apply fungicide at the first sign of infection, according to Table 3.

If crops have received early fungicide protection, commence monitoring for stripe or leaf rust at early to full flag leaf emergence (Z37 to Z39 Figure 1) and apply fungicide at the first sign of infection, according to Table 3.

When taken up by the leaf, the fungicide can stop development of early infections but more established infections can continue such that rust pustules may persist for several days after fungicide application.

Foliar fungicide guidelines

Fungicide timing

- Apply fungicide as soon as possible after the first detection of stripe or leaf rust for the most efficient fungicide control.
- Economic responses are reduced with later fungicide application. Use Table 3 as a guide.
- Spraying after crop flowering is normally not economic for stripe or leaf rusts.
- Optimising control of stripe rust on leaves is important to reduce risk of infection of heads. Apply fungicide at or before crop heading.

Fungicide rate

Use high rates of fungicide if application is delayed or if infection is advanced at the time of detection.

Table 3. Apply fungicide in response to the first sign of stripe or leaf rust at different crop growth stages according to variety response for the particular disease.

Crop stage at first sign of stripe rust or leaf rust infection Variety resistance rating	Before Z39 (pre flag leaf)*	Z39 to Z49 (full flag to late booting)	Z55 to Z59 (mid to late heading)	Z65 to Z69 (mid to late flowering)
2 – very susceptible	stripe or leaf**	stripe or leaf**	stripe or leaf	n/a
3 – susceptible	stripe or leaf**	stripe or leaf**	stripe or leaf	n/a
4 – moderately susceptible	stripe or leaf	stripe or leaf	stripe or leaf	n/a
5 – intermediate	stripe or leaf	stripe	n/a	n/a
6 – moderately resistant	stripe	n/a	n/a	n/a

* in the absence of early season fungicide protection, for example, seed dressing or in-furrow fungicide
** higher rates of fungicide are more profitable for more susceptible varieties
n/a spraying is generally not applicable for stripe rust or leaf rust.

Use high rates of fungicide for longer duration of protection, for example, when seasonal conditions favouring infection are likely to persist or for more susceptible varieties.

Cost should be tuned to crop yield potential. Use standard rates for 1 t/ha to 2.5 t/ha and higher rates for higher yields or in long season environments.

Product choice

Discriminating between different fungicides is less important than considerations of timing and rate. Selection of fungicide can be influenced by opportunities to control other diseases such as yellow spot and septoria nodorum blotch that may occur in the crop, and by cost.

Application

Ground and aerial application methods are equally effective in controlling disease and choice will depend on timeliness and cost of application. Aerial application can cover a large area in a short time without crop damage. Ground application has lower direct costs but is slower and results in some crop damage from the wheels of the spraying equipment.

Spray volumes of 50 L/ha for ground spraying and 20 L/ha for aerial spraying are adequate but in high disease conditions, higher spray volumes will be beneficial. Unless specified by the manufacturer, spray adjuvants do not improve fungicide efficiency but follow the manufacturer's advice. Make the best use of aerial application with appropriate droplet size and spray oils to reduce evaporation.

Fungicide control of stripe rust head infection

Stripe rust can infect florets from heading to flowering, infecting the inside of the glume. Although spores may adhere to seed, they rarely induce grain discolouration and do not become seed borne. It can be expected that head infection will produce shrivelled grain so screenings will be expected to increase with severe infections. It is important to optimise control of stripe rust on leaves to reduce the risk of infection of heads by applying fungicide at or before crop heading.

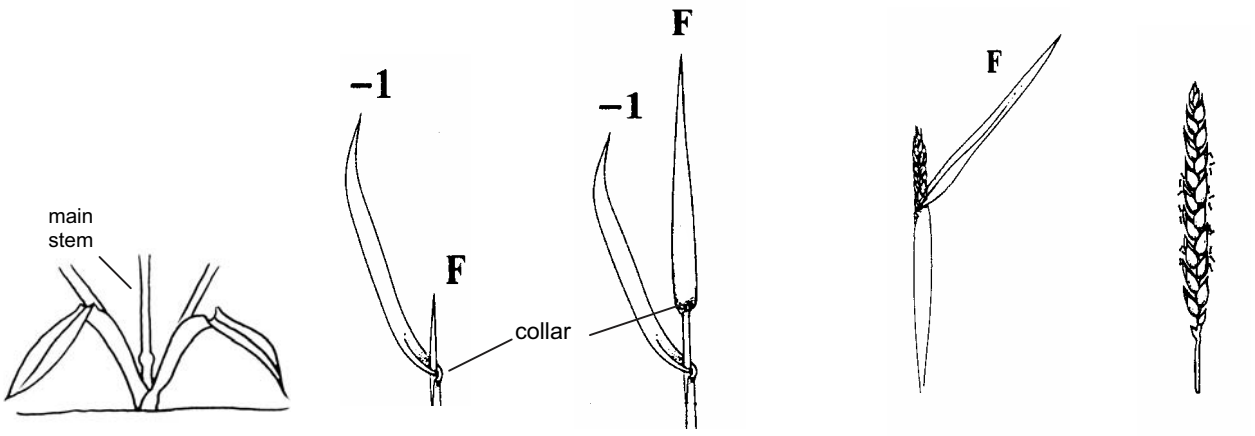
Further reading

Bulletin No. 4539 *Identifying wheat leaf diseases*. Department of Agriculture, Western Australia (2001).

Bulletin No. 4655 *The Crop Variety Sowing Guide 2005*. Department of Agriculture, Western Australia (2005).

Farmnote No. 10/04 *Cereal seed dressing and in-furrow fungicides 2004–2005.* Department of Agriculture, Western Australia (2004).

Farmnote No. 73/04 *Managing stem rust of wheat*. Department of Agriculture, Western Australia (2004).



First node (early jointing Z31)

The first node swelling can be felt near the base of the main stem when leaf sheaths are peeled back and no node swellings can be felt further up.

Before full flag leaf emergence (late jointing up to Z37)

The fully emerged leaf (-1) is not the flag leaf because another leaf, possibly the flag (F) is emerging at the collar.

Full flag leaf (Z39)

The fully emerged leaf (F) has no more leaves emerging from the collar and therefore it is the flag leaf. The leaf below is confirmed as the flag-1 leaf.

Early heading (Z51)

The head is beginning to emerge from the boot.

Flowering (Z65)

After head emergence pollen sacks protrude from the head indicating that flowering is underway.

Figure1. Wheat growth stages (as Zadocks decimal growth stages) for fungicidal control of stripe and leaf rusts.

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