Stripe rust management and varietal selection: 2004

Grant Hollaway, Rob Weppler DPI Horsham, Russell Eastwood AGT Horsham, Colin Wellings, University of Sydney

Summary

Stripe rust can be managed in 2004 using a combination of inoculum reduction (removal of volunteer cereals), varietal selection, seed or fertiliser treatment and crop monitoring with a view to fungicide application if necessary.

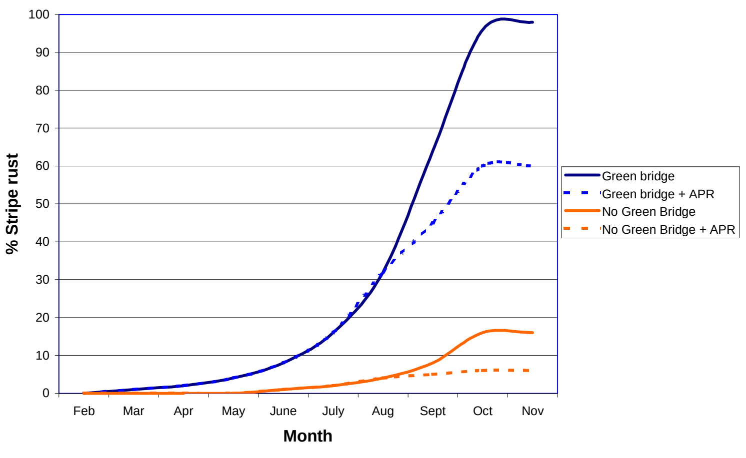
2003 in review

The 2003 growing season will be long remembered for the high level of stripe rust in wheat requiring fungicide applications in some cases. High rainfall in February led to wide growth of self sown wheat plants, providing a green bridge for rust to build up on prior to the sowing of new crops. Stripe rust was first seen and most severe in the Nhill district where February rainfall was greatest. Also in 2003 the "Western Australian strain" of stripe rust was detected in Victoria for the first time. Following the severe stripe rust outbreak in 2003 the ratings for some varieties have been revised.

The green bridge

Significant rainfall in the Wimmera in February (eg. > 100 mm at Nhill) resulted in germination and growth of wheat, which remained green until sowing in May. This provided a "green bridge" enabling rust to build up to higher levels than usual prior to sowing. The possible effect of this, on the epidemic later in the season is shown in Figure 1 compared to the typical levels of rust following a drier summer/autumn period where minimum rust build up occurs. This illustrates how a green bridge, as seen in 2003, can have a large effect on the levels of stripe rust later in the season.

Figure 1. Illustration of the effects of a green bridge and adult plant resistance (APR) on the development of stripe rust in wheat compared with a drier summer.



The susceptibility of the self sown wheat plants growing over summer can also influence the quantity of inoculum generated in a green bridge. If most varieties in a district are resistant there will be less inoculum produced than if the majority of self sown plants are susceptible.

Stripe rust strains in Victoria

The Western Australian Strain of Stripe Rust: The first introduction of stripe rust to Australia occurred in Victoria in 1979 and rapidly spread across eastern Australia. This stripe rust most likely came on a traveller's clothing from France. Through mutation the original introduction has developed a number of strains (also known as races) enabling it to become virulent on many wheat varieties over time. This original introduction, even though wide spread in Eastern Australia, did not spread to Western Australia.

The second introduction of wheat stripe rust to Australia was detected in Western Australia in 2002, and in 2003 this strain was detected in Victoria and other parts of eastern Australia. It is possible that the "Western Australian stripe rust" was introduced to that state on clothing from the USA and was then carried by wind or on clothing to eastern Australia.

Based on seedling reactions, the Western Australian strain of stripe rust did not contain any new virulence for the seedling resistance genes deployed in eastern Australia. The relative aggressiveness/virulence of the two stripe rust strains on the adult plant resistance genes deployed in our varieties has not yet been established.

In 2003 even though the "Western Australian strain" was the predominant strain detected in Victoria other strains including, the H45 and the VPM strains were also detected.

Resistance to stripe rust in wheat

In general there are two types of resistance to stripe rust deployed in Australian wheats; major gene resistance, and adult plant resistance. These resistance sources may be used either alone or in combination.

Major gene resistance is a race specific resistance which is very effective against some strains but ineffective against others. Typically when these major genes are first deployed they are completely effective, but through mutation of the rust these resistances are often short lived as they are overcome or "broken down" by the pathogen. An example of this is the acquisition of virulence toward the *Yr17* gene deployed in the variety Camm. When this variety was first released it was resistant to all strains of stripe rust present in Australia, however, when the rust mutated this resistance gene was overcome making this variety susceptible.

When a major resistance gene is "broken down" the level of resistance in a variety will depend on the other genes also present in that variety.

Adult plant resistance (APR) is a partial resistance which becomes effective at different times depending on the variety. The effectiveness of the APR is reduced in crops high in nitrogen and varies with variety and is often more effective at warmer temperatures. This form of resistance is widely used in Australian wheats. There are a number of APR resistance genes used in our wheats, and their effectiveness depends on the gene used and the number of APR genes present as their effects are often additive.

Some APR genes are strain specific and therefore prone to being overcome by new strains of stripe rust. Other APR genes are regarded as "durable" and therefore less likely to be overcome.

These partial APR genes work by slowing down the rate of epidemic development. They do not stop the disease progress completely.

Varietal responses for 2004

Based on the high disease pressure from stripe rust experienced in 2003 and the occurrence of the 'Western Australian strain' in Victoria it has become necessary to revise the disease ratings for many of our varieties. For additional varieties refer to the "Cereal Disease Guide 2004" (www.dpi.vic.gov.au/notes). Table 1 lists the old and revised disease ratings using data from the 2003 growing season. Listed also are the stripe rust resistance genes present in the varieties and some additional comments.

When selecting varieties it is important to select the highest levels of resistance possible. The actual disease response that occurs in the field will depend on many factors including inoculum carry over and the strains of stripe rust occurring in a particular location. Avoiding the most susceptible varieties will be very important in reducing the levels of rust inoculum in the environment.

Seed treatments

Seed treatments are an important part of a stripe rust management strategy. In areas and seasons where there is a green bridge to enable carry over of inoculum and when susceptible varieties are grown growers should consider using a seed treatment that suppresses early infection in crops. There are a number of seed and fertiliser treatments available to suppress early stripe rust infection (See "Cereal seed treatments 2004" by H. Wallwork SARDI).

Table 1. Revised varietal rating to stripe rust following the 2003 season and the stripe rust resistance genes postulated to be present in each variety

Cultivar	Yr genes	Notes	Previous rating	Revised rating
Annuello	APR	Yr18 + ?	R-MR	MS
Camm	Yr17	Yr17 (ineffective) + minor Unidentified gene	S	S
Chara	Yr7 APR	Yr 7 (ineffective) + Yr18 or YrCK	R	MS
Diamondbird	Yr7 APR	Yr 7 (ineffective) + ?	MR	MS
Frame	APR	Unidentified APR	MR-MS	MR-MS
Goldmark	Yr6 APR	Yr6 (ineffective) ?	MR	MS*
Goroke	APR	Yr18	MR	MR-MS*
H45	Yr7 APR	Yr7 (ineffective) + an APR which has little benefit in the field	MS-S	VS
Janz	APR	Yr18 + unidentified gene	MR	MR-MS
Clearfield JNZ	APR	Yr18		MS*
Kellalac	YrA APR	YrA (ineffective) ?	MR	MR-MS
Lorikeet	APR	Yr18	MR	MS
Meering	APR	Yr18	MR	MS
Mira	APR	Unidentified APR (may have Yr27?)	MR	MR
Mitre	Yr6 APR	Yr6 (ineffective) + Yr18	MR	MS-S
Ouyen	?	Probably Yr18 + ?	MR	MR-MS
Pugsley	Yr17 APR	Yr17 (ineffective) + minor unidentified gene	MS-S	MS
Rosella	YrA APR	YrA (ineffective) + Yr18	MR	MR-MS
Silverstar	Yr7, APR	Probably Yr18	MR	MS-S
Wyalkatchem			S	S
Yitpi	APR	Unidentified APR	MR	MR-MS

APR – Adult Plant Resistance, * – Based on limited data.

Fungicide sprays

Effective fungicides for controlling stripe rust are available see Agnote "Cereal foliar fungicides 2004" (www.dpi.vic.gov.au/notes), but should be regarded as a support and not a substitute for growing varieties with some resistance.

The requirement for fungicide sprays will depend on inoculum carry over, timing of the epidemic and level of resistance in the variety. In 2003, where stripe rust was detected early, a fungicide spray was required in varieties such as Mitre to protect the flag leaf until the onset of adult plant resistance around ear emergence. More susceptible varieties, such as H45, would have required a second spray 4 weeks after the first. Sprays are generally more effective when applied early on in an epidemic.

Important: In 2004 crops should be monitored regularly for the presence of stripe rust. The flag leaf should be kept disease free. If rust is easily detected (≥35% of leaves have stripe rust present), and the variety is rated susceptible or very susceptible (S or VS) spray immediately while moderately susceptible crops should be sprayed at flag leaf emergence. If an S or VS variety required spraying prior to flag leaf emergence, a second spray may be necessary.
There is often an apparent increase in stripe rust for a few days after spraying. This is caused by the development of symptoms of infections that occurred just before spraying. Control becomes apparent within a week of spraying and the period of protection is normally about four weeks.

2003 Fungicide trials

Three stripe rust management trials were conducted in 2003. One trial was a yellow leaf spot trial (cv. Yitpi at Horsham) which was infected with stripe rust while two trials were in crops of Mitre at Horsham and Marnoo.

In general the dry finish and frost were more limiting to yield than disease. Therefore, both grain yield and percentage leaf area affected (%LAA) should be considered when comparing effectiveness of treatments.

The best reduction in stripe rust severity was achieved with an application at GS39 (flag leaf emergence), while a single application at GS56 at Horsham also gave good reductions in disease severity in these trials (Table 2).

Yitpi treated with a single application of propiconazole (Bumper®) at GS39 had good control of stripe rust, but no significant improvement in yield. The yield response from two and three applications was due to yellow leaf spot control early in the season (this trial was sown into stubble infected with yellow leaf spot) and stripe rust control later in the season. Where more than one disease is present it is important to select the most appropriate fungicide for all of the diseases present.

At Marnoo, a single application of tebuconazole (Folicur®) at GS39 or GS56 gave an economic advantage, but an application at GS64 did not. Delaying the application past GS39 reduced the benefit. At Horsham, a single application at GS56 gave yield advantages from 8 to 22%.

Table 2. The percentage leaf area affected (%LAA) with stripe rust on the top two leaves and grain yield of wheat treated with foliar fungicides at different growth stages in 2003

	Yitpi (MR-MS) Horsham		**Mitre (MS-S) Horsham**				**Mitre (MS-S) Marnoo**	
Fungicide:	Bumper (250mL/ha)		Triad (1000mL/ha)		Folicur (290mL/ha)		Folicur (290mL/ha)	
Application Timing	%LAA (GS 73)	Yield (t/ha)	%LAA (GS 69)	Yield (t/ha)	%LAA (GS 69)	Yield (t/ha)	%LAA (GS 64)	Yield (t/ha)
Nil	13.4	3.0	19	2.7	19	2.7	17.0	1.8
GS 31	7.9	3.1						
GS 39	0.6	3.1					0.8	2.1
GS 55-58	4.3	3.1	3	2.9	4	3.1	16.4	2.1
GS 64							10	1.8
GS 31+39	0.3	3.3						
GS 31+39+58	0	3.3						
LSD (0.05)	**3.11**	**0.21**	**6.37**	**0.21**	**6.37**	**0.21**	**11.21**	**NS**
LSD (0.10)								**0.24**

Life cycle

The stripe rust fungus requires living host plants on which to grow and produce spores. The main host is wheat, but it can infect some varieties of barley, triticale and some species of barley grass, and to a lesser extent brome grass and phalaris. Rust is not seed borne.

The fungus is dispersed as wind-blown spores which produce new infections. This cycle is repeated many times during the cropping season, causing epidemics to develop. Conditions suitable for epidemic development occur from April to December in Victoria and stripe rust can be expected in crops by September in most years.

The fungus requires temperatures of less than 18°C (optimum 6-12°C), with a minimum of three hours of leaf-wetness (for example, dew) for new infections to occur. Once an infection is established the fungus can survive short periods of temperatures as high as 40°C.

Sufficient rust survives summer on volunteer or self-sown plants to allow a new epidemic to develop the following season. Only one infected leaf per 30 ha of regrowth needs to survive the summer to produce severe epidemics.

Stripe rust can also infect the developing head reducing grain number and size. Chemical control of head infection is not considered to be effective.

Recommendations for 2004

The following management strategies are recommended to minimise the impact of stripe rust in 2004:

- Remove volunteers that support inoculum in the 6 weeks up to sowing.
- Select more resistant varieties.
- Consider using a seed treatment to suppress early infection.
- Monitor crops during the growing season and apply a foliar fungicide early in the epidemic if required.
- Remember to also manage other diseases of cereals.

More information

www.nre.vic.gov.au/notes (click on Crops and Pastures, Cereals)
Weppler and Hollaway, *Cereal foliar fungicides 2004*
Hollaway G (2004) *Cereal Disease Guide 2004*
Wallwork H (2000) *Cereal Leaf and Stem Diseases*.
Wallwork H (1999) *Cereal Disease: The Ute Guide*.
Wallwork H *Cereal seed treatments 2004*
Victorian Winter Crop Summary (2004).

Thanks to Wendy Bedggood for preparing this Note and Hugh Wallwork for comments.