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Stripe Rust of Wheat

This Agnote provides Victorian grain growers with information on the management of stripe rust in wheat.

Stripe rust in Victoria

Given favourable environmental conditions stripe rust can cause significant yield loss to susceptible varieties. However, farmers have shown that by planning to manage this disease they can effectively minimise its effects.

There have been two introductions of wheat stripe rust into Australia. These introductions may have entered Australia on clothing. The first introduction occurred in Victoria in 1979, and rapidly spread across eastern Australia. This original rust mutated and a number of pathotypes (also known as races or strains) developed, enabling the rust to attack more wheat varieties over time. This first introduction, even though wide spread in the east, did not move to Western Australia.

The second introduction of stripe rust into Australia occurred in Western Australia in 2002. In 2003, this pathotype was detected in eastern Australia. This second introduction, now known as the "WA" pathotype, quickly became dominant in eastern Australia. It was more aggressive than the previous pathotypes on a large number of wheat varieties. Its presence resulted in the resistance ratings of many wheat varieties being reviewed and down graded.

Since 2003 the "WA" pathotype has undergone several mutations. There are now four pathotypes of wheat stripe rust that are common in Victoria. They are the "WA", the "WA Yr17", the "Jackie" and now the "Jackie Yr27" pathotypes. These four pathotypes are all closely related, as three are mutations of the "WA" pathotype.

The "WA Yr17" pathotype is similar to the "WA" pathotype except it has the additional ability to attack wheat varieties with the "Yr17" (or VPM) resistance gene. The "Jackie" pathotype is similar to the "WA" pathotype, but it has the ability to also attack some triticale varieties. Finally, the "Jackie Yr27" pathotype (confirmed 2008) is similar to the "Jackie" pathotype, but can also attack wheat varieties with the Yr27 resistance gene.

What to look for

Stripe rust is easiest to identify in the morning. Examine leaves, especially the older leaves, low in the canopy and look for yellow stripes of pustules. These pustules are raised above the leaf surface and can be easily wiped off onto a white cloth or tissue leaving a yellow stain (Figure 1). Also watch for hot spots in the crop. Hot spots are 1-10 meters in diameter, and are generally well developed just before the disease becomes widespread in the crop.

Figure 1. Stripe rust on the MS - S variety Mitre (photo courtesy Colin Wellings).

Disease cycle

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 the summer on volunteer or self-sown plants to allow a new epidemic to develop in 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.

Stripe rust management

Given appropriate conditions and susceptible varieties stripe rust can cause significant loss to wheat yields. However, farmers have shown that by planning to manage this disease they can effectively minimise its effects.

The most appropriate stripe rust management strategy for a given farm will vary from one farm to another, from region to region, and from season to season. There has been much discussion regarding the merits of various approaches to stripe rust management, such as choice of seed or fertiliser fungicide treatment, versus reliance on fungicide sprays alone. Which ever strategy is used, provided it is implemented in a timely fashion, it will be effective. It is important that growers choose which strategy is most appropriate for their situation, and follow it.

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

- **Remove volunteers that support inoculum in the 6 weeks prior to sowing.**
- **Avoid very susceptible (VS) and susceptible (S) varieties by selecting more resistant varieties.**
- **Use a seed or fertiliser treatment to suppress early infection.**
- **Monitor crops during the growing season and apply a foliar fungicide early in the epidemic, if required.**

Each of these approaches is discussed in the following.

The green bridge

Stripe rust can only survive from one season to the next on living plants (mostly wheat, and to a lesser extent barley, triticale, barley grass, brome grass and phalaris). This is called the “green bridge”.

Stripe rust does not survive on seed, stubble or soil. Therefore, the more susceptible volunteer wheat plants growing during summer/autumn the greater the risk of a stripe rust epidemic.

The susceptibility of the volunteer wheat plants over summer influences the quantity of inoculum generated by the green bridge. If most varieties in a district are resistant there will be considerably less inoculum than if the majority of plants are susceptible or very susceptible.

It is critical that all volunteer wheat is removed either by spraying, cultivation or heavy grazing by the end of March. Particular care should be taken to destroy plants around sheds, and silos, as stripe rust often survives on these plants.

Variety selection

Selecting wheat varieties for rust resistance is an important part of rust management. Select varieties with the highest levels of rust resistance possible, keeping in mind other agronomic and disease traits of the variety. The actual disease response that occurs in the field will depend on many factors including the amount of inoculum carry over, the timing of the rust outbreak in the crop, and the pathotypes (races/strains) of stripe rust occurring in a region.

The resistance ratings to stripe rust presented in Table 1 are based on data collected from around Australia. For additional varieties refer to the current Agnote “Cereal Disease Guide 2009 (AG 1160)”.

Varieties rated as Very Susceptible (VS) or Susceptible (S) to stripe rust should be avoided. In such varieties stripe rust is more difficult to manage, especially if the season is favourable for stripe rust. VS and S varieties have the potential to rapidly lose all leaf area to stripe rust. The build up of rust on these varieties can lead to infection of other crops in the district due to the large amount of spores they produce. If VS or S varieties are grown it is critical that seed or fertiliser is treated with a fungicide before sowing. Crops of VS to S varieties should be monitored regularly for the first sign of rust and a fungicide applied if necessary.

Table 1. Variety rating to stripe rust, leaf rust and stem rust

Wheat variety	Stem	Rust Stripe	Leaf
Annuello	R	MS-S	MR
Axe	MS	MR	MR
Barham	MR	MS-S[Yr17]	MR
Bolac	MR-MS	R-MR	MS
Camm	S	MS-S[Yr17]	S
Carinya	MR	MR-MS[Yr17]	MR
Catalina	MR	MR-MS	MR
Chara	MR-MS	MS-S	MS
Correll	MR-MS	MR	MS
Derrimut	R-MR	MS[Yr17]	R
EGA Gregory	MR-MS	MR	MR
GBA Ruby	MS	R-MR[Yr27#]	MR
Gladius	MR	MR-MS[Yr17]	MS
Guardian	MR	MS	MS
Kellalac	MS-S	MR-MS	S-VS
Lincoln	MR	R-MR	R-MR
Livingston	MR	R-MR	R-MR
Merinda	R-MR	R-MR[Yr27#]	MR
Mitre	R-MR	MS-S	MS
Peake	MR-MS	MR-MS	R
Sentinel	R	R-MR	R-MR
Ventura	R#	MS[Yr17]	MR-MS
Wyalkatchem	MS	MS-S	R
Yitpi	S	MR-MS	MS
Young	MR	MS[Yr17]	MR-MS

R= Resistant, MR = Moderately resistant, MS = Moderately susceptible, S = Susceptible, VS = Very susceptible

[Yr17] Has the stripe rust resistance gene *Yr*17 which is effective against the “WA”, “Jackie” and “Jackie Yr27” pathotypes, but ineffective against the “WA Yr17” pathotype, for which the expected field rating is shown.

[Yr27#] These lines have effective resistance against the “WA”, “WA Yr17” and “Jackie” pathotypes, but will be more susceptible to the “Jackie Yr27” pathotype. The degree of susceptibility is unknown.

Varieties rated as Moderately Resistant to Moderately Susceptible (MR-MS) or Moderately Susceptible (MS) generally have adult plant resistance (APR - see page 4). These varieties are unlikely to lose all their flag leaf to disease, but may need a fungicide spray if rust is detected early (before flag emergence).

Varieties rated Moderately Resistant (MR) would only show limited rust symptoms on their flag leaves under ideal rust conditions. Varieties rated as R are those with resistance which persists for the duration of the plant's life. Even varieties rated as MR and Resistant (R) should be monitored with a view to fungicide application as mutations in the rust can occur.

Seed / fertiliser fungicide treatments

Seed and fertiliser fungicide treatments play an important role in stripe rust management. In the Wimmera, Western, Central and North East districts all varieties with a stripe rust rating of MR-MS or lower should be treated with either a seed or fertiliser treatment to suppress early stripe rust. In the Mallee, growers should use a seed or fertiliser treatment that suppresses early infection in crops when there is a high carry over of inoculum on the green bridge.

These treatments will be most effective when adopted across a region as they will greatly reduce the inoculum levels in a district. The length of protection varies depending on the product selected. For a comprehensive list of products, see "Cereal Seed Treatments 2009" by H. Wallwork, SARDI.

Be aware that some seed treatments effective against stripe rust (e.g. products containing triadimenol and flutriafol) may reduce coleoptile length, and this should be considered at sowing time. Also note that fertiliser treatments do not control bunts and smuts, so a seed treatment still needs to be applied to the seed. Where crops are sown early for anticipated grazing benefits, issues such as withholding period will need to be considered.

Products containing triadimenol or triticonazole give suppression of stripe rust for about 4 weeks after sowing, and can help reduce early development of the disease in the crop. However, crops must continue to be monitored during the growing season with a view to fungicide application.

Longer season protection can be provided by applying fluquinconazole to seed, or flutriafol or triadimefon to fertiliser. These products can give protection up to flag leaf emergence or later in some cases. Often these products will reduce the need for follow up foliar sprays, however, crops should still be monitored with a view to foliar sprays if necessary.

Fungicide sprays

Effective fungicides for controlling stripe rust are available; but should be regarded as a support, and not a substitute, for growing resistant varieties.

The requirement for fungicide sprays will depend on the carry over of rust inoculum on the green bridge, the timing of the epidemic (in relation to crop growth stage) and the level of resistance in the variety. For example, in 2003, 2004 and 2008 where stripe rust was detected early (i.e. tillering to flag), a fungicide spray was required in many varieties to protect green leaf area until the onset of adult plant resistance, which starts around ear emergence. Varieties without effective APR may have required sprays beyond ear emergence. Sprays are generally more effective when applied early in an epidemic.

It is likely that the onset of a rust epidemic will be different in different years. The timing of the first occurrence in the crop may be different, and the area where it first occurs may also be different. It is, therefore, important that the decision to apply fungicides is made during the season, using available information, and is not based on previous experiences alone.

During the season crops should be monitored regularly (at least every 2 weeks) for the presence of stripe rust. The earlier that rust occurs within a crop the greater the potential loss, but the easier it is to control. If stripe rust is present before ear emergence, then crops must be sprayed before the level of infection reaches 1% leaf area affected (this is when approximately 35 leaves per 100 have stripe rust). It is better to spray sooner rather than later. When stripe rust is first detected at ear emergence, only the most susceptible (S and VS) crops may need spraying. After a fungicide application crops should continue to be monitored as fungicides only provide between 2 to 4 weeks protection.

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.

Early season protection vs. foliar sprays

There has been much discussion as to the relative merits of either applying or not applying early season seed or fertiliser treatments (with follow up fungicide spray if required) versus just relying on applications of foliar fungicides. Both approaches can effectively manage stripe rust, with similar costs to the grower, if used appropriately.

The disadvantage of early season protection is that expense is incurred before knowing if rust will be an issue, or the yield potential of the crop. The advantage of the early applied long season protection is that in the presence of rust the likelihood that a fungicide will be required before flag leaf emergence is reduced, minimising the need for timely fungicide applications during the season.

The disadvantage of the foliar spray option alone is that crops must be sprayed early in the rust epidemic, in a timely fashion, keeping in mind the difficulty of spraying during a period of continuous wet weather. The advantage of this approach is that expense is only incurred when, and if, stripe rust is an issue within the crop.

Both methods are effective if applied appropriately. To determine which approach is the most suitable growers need to consider rust carry over on the green bridge, variety selection, local conditions, and the ability to spray for stripe rust in a timely fashion.

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 that 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 in wheat 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 resistance that is widely used in Australian wheats. APR genes are often partial resistance genes that work by slowing down the rate of epidemic development. They do not stop the disease progress completely.

There are a number of APR genes used in commercial wheats. The relative effectiveness of APR genes can be influenced by factors such as:

- Temperature (they often working better at higher temperatures).
- Crop nitrogen status (there may be a delayed onset in high nitrogen status crops).
- The variety that they are deployed in.
- The number of APR genes present (their effects are often additive).
- Sometimes the pathotypes of stripe rust present.

Even though APR genes are widely used in Australian wheat varieties they are often not well understood. Some APR genes may also be pathotype specific and therefore prone to being overcome by new pathotypes of stripe rust. Other APR genes are regarded as "durable" and, therefore, less likely to be overcome.

In general, APR becomes effective at around ear emergence and works best if rust levels are not excessive in the crop at this time. In varieties that have APR as their only source of resistance it may be important to protect the earlier growth stages of the crop with seed or fertiliser treatments and/or fungicide sprays. In general, varieties rated as MS with effective APR will rarely lose all their flag leaf to disease, whereas varieties rated as S and VS are at risk of losing 100% of their leaf area to disease.

Many cultivars with APR can be very susceptible as young plants. Growers using such varieties must plan to protect their crops from stripe rust before the onset of effective APR to minimise rust build up. The level of susceptibility of young crops will vary from one variety to another. This early susceptibility of young crops can result in build up of rust in some years.

Stripe rust management: summary

- Monitor all wheat crops weekly and know how to identify stripe rust.
- Stripe rust is better managed by applying sprays early in the epidemic.
- After booting the need for fungicide sprays will depend on a number of factors including varietal resistance, level of stripe rust infection, crop yield potential and anticipated climatic conditions.

Further references

More detailed information can be obtained from the DPI Information Note Series: www.dpi.vic.gov.au/notes Click on Crops & Pastures > Cereals >

Cereal Diseases Guide- 2009 (AG 1160).

Cereal Foliar Fungicides - 2007 (AG 1190).

Victorian Winter Crop Summary (2009).

Wallwork H (2000) Cereal Leaf and Stem Diseases.

Wallwork H (1999) Cereal Disease: The Ute Guide.

Wallwork H (SARDI) Cereal Seed Treatments 2008.

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