MANAGING FUNGICIDE RESISTANCE

FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Septoria tritici blotch

KEY POINTS

- Fungicide resistance and reduced sensitivity in the STB pathogen has been widely reported worldwide.
- Group 11 (QoI) fungicides are considered to be at high risk and resistance was detected in South Australia in 2021.
- Multiple cases of reduced sensitivity to Group 3 (DMI) fungicides have been detected across the southern growing region.
- Careful use and rotation of available fungicides will lessen the spread of resistance in STB.
- Agronomic practices that minimise disease pressure reduce the need to apply fungicides.
- Good management will help protect the long-term efficacy of current fungicides.

Photo: Nick Poole.

Septoria tritici blotch.

Septoria tritici blotch (STB) is caused by the fungal pathogen *Zymoseptoria tritici.* It is an important disease of wheat, particularly in high rainfall areas of the southern growing region, where it can cause yield losses of around 40 per cent under very conducive conditions.

There have been several cases of STB developing full resistance to fungicides globally and they must be used with care in Australia to protect their continued effectiveness.

Group 11 (QoI) fungicides are considered to be at highest risk of resistance development, and a gene known to indicate resistance to Group 11 fungicides was detected in STB samples from Millicent, SA, during 2021.

Group 3 (DMI) fungicides are also considered to be very vulnerable and reduced effectiveness has been reported from several Australian wheat growing districts in the past.

In Europe there have been cases of reduced sensitivity affecting Group 7 (SDHI) performance and this group is described as having a moderate to high risk of resistance development.

Fungicide resistance

Zymoseptoria tritici has developed resistance to fungicides in most wheat growing areas of the world since the 1980s. The pathogen is now completely resistant to the Group 11 (QoI) strobilurins azoxystrobin and pyraclostrobin (contained in Amistar Xtra® and Opera®) in the United Kingdom, Europe and New Zealand. There are also several reports of reduced effectiveness to Group 3 (DMI) triazoles (Baycor® and Jockey®).

These international examples indicate the pathogen is capable of evolving fungicide resistance traits independently in multiple locations.

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Considerable care is needed to ensure the continued effectiveness of the fungicides registered for STB in Australian cropping.

Resistance to Group 11 (QoI) strobilurin fungicides (e.g. Radial®, Veritas®, Topnotch®, etc) was detected in STB samples from Millicent, SA in July 2021. This resistance was linked to the G143A gene mutation, which is also associated with QoI resistance in wheat powdery mildew.

There is a strong possibility that more cases of this Group 11 resistance could be detected in the southern growing region.

Reduced sensitivity to the Group 3 DMI fungicides, including cyproconazole, epoxiconazole (Soprano®, etc.), flutriafol (Bayonet®, Impact®, Pollux®, etc.), propiconazole (Propimax®, Fitness®, etc.), tebuconazole (Laguna®, Orius®, Rebuke®, Folicur® etc.), and triadimenol (Baytan®, etc.) has been detected in New South Wales, SA, Tasmania and Victoria.

This reduced sensitivity was first detected in isolates collected from Victoria and Tasmania in 2011, then from NSW and SA in 2014.

The haplotype with the greatest impact on Group 3 efficacy, the G1 mutant, has since been widely detected in STB populations across NSW, Victoria, SA and Tasmania. It was most frequently found in Tasmania.

While epoxiconazole, propiconazole and fluquinconazole have all been linked to examples of reduced sensitivity, they will still control the disease in the field. However there have been detectable changes in the field performance of flutriafol, cyproconazole and tebuconazole.

Group 7 (SDHI) fungicides still offer effective control of STB in Australia. However, the risk of STB developing SDHI resistance means use of this MoA group must also be carefully managed.

Fungicide resistance terminology

When a pathogen is effectively controlled by a fungicide, it is defined as sensitive to that fungicide. As fungicide resistance develops, that sensitive status can change to:

- **REDUCED SENSITIVITY**

  When a fungicide application does not work optimally but does not completely fail.

  This may not be noticeable at field level, or the grower may find previously experienced levels of control require higher chemical concentrations up to the maximum label rate. Reduced sensitivity must be confirmed through specialised laboratory testing.

- **RESISTANCE**

  When a fungicide fails to provide disease control in the field at the maximum label rate.

  Resistance must be confirmed by laboratory testing and be clearly linked to a loss of control when using the fungicide correctly in the field.

- **LAB DETECTION**

  A measurable loss of sensitivity can often be detected in laboratory *in vitro* tests before or independent of any loss of fungicide efficacy in the field. Laboratory testing can indicate a high risk of resistance or reduced sensitivity developing in the field.

Managing fungicide resistance

It is important to recognise that fungicide use, and the development of fungicide resistance, is a numbers game. That is, as the pathogen population increases, so does the likelihood and frequency of naturally resistant strains being present.

A compromised fungicide will only control susceptible individuals while resistant strains within the population continue to flourish.

As a result, it is best to use fungicides against a small pathogen population. That way, only a small number of resistant individuals will be present to survive the fungicide application and they will remain vulnerable to other competitive pressures in the agri-ecosystem.

Keeping the pathogen population low can be achieved by taking all possible agronomic steps to minimise disease pressure (see *Non-chemical controls* below) and by applying fungicide at the first sign of infection once the crop has reached its key growth stages.

Fungicide usage recommendations for wheat

Planning of fungicide rotations needs to consider all fungal pathogens that may be present in the crop. Otherwise the fungicide treatment for one pathogen may encourage resistance in another.

Careful fungicide use will reduce the risk of fungicide resistance developing in STB in Australia and help ensure the longevity of the available chemical protections.

Advice to wheat growers includes:

- **Minimise** use of the **Group 3** fungicides that are known to have compromised resistance.
- **Rotate Group 3** actives within and across seasons. In other words, do not use the same Group 3 active ingredient twice in succession.
- **Avoid** more than three applications of fungicides containing any **Group 3** active in the one growing season.

- **Group 11** containing fungicides should always be used mixed with a Group 3 DMI (if not already formulated). This **Group 11 + 3** mixture should be rotated with effective **Group 3** or **Group 3 + 7** mixtures, taking care that the active ingredients in these rotational products are different to those used in mixture for the Group 11 application.
- **Group 11** containing fungicides should always be used as a preventative rather than a curative control.
- Avoid applying more than one application per season of **Group 7** or **Group 11** containing products, whether solo or in mixtures. This includes foliar sprays as well as in-furrow or seed treatments that have activity on foliar diseases. Combinations of in-furrow and seed treatment are counted as one application.

Finally, it is always important to follow the AFREN 'Fungicide Resistance Five' recommendations for fungicide use. These guidelines can be applied to all crops and pathogens, regardless of their formal fungicide resistance status, to reduce the chances of resistance developing.

The Fungicide Resistance Five!

1. **Avoid susceptible crop varieties**
2. **Rotate crops – use time & distance to reduce disease carry-over**
3. **Use non-chemical control methods to reduce disease pressure**
4. **Spray only if necessary & apply strategically**
5. **Rotate & mix fungicides / MoA groups**

Non-chemical controls

Septoria tritici blotch is favoured by susceptible host varieties growing in cool, moist conditions (15° to 20°C, with frequent rain events followed by 48 hours of leaf wetness or high relative humidity). It is more common in early sown crops and in wet springs and causes the greatest yield loss when it infects the upper three leaves of the plant.

Yield loss can range from 20 per cent in typical seasons to around 40 per cent in very conducive conditions.

Zymoseptoria tritici survives on wheat stubble. Spores are both wind-borne and dispersed by rain splash.

Management practices to help reduce disease pressure and spread include:

- **Planting less susceptible wheat varieties.**
  Any level of genetic resistance to STB will help slow the rate of pathogen and disease development within a crop. This, in turn, reduces the reliance on fungicides to manage the disease. Avoid growing S and VS wheat varieties in disease-prone areas.
- **Practicing good crop rotation and stubble management.**
  A program of crop rotation creates a dynamic host environment that helps reduce inoculum levels from year to year. Wheat should not be planted into wheat stubble.

  Rotating non-susceptible wheat varieties can also provide a more dynamic host environment, forcing the pathogen to adapt rather than prosper.
- **Avoiding early sowing.**
  Sowing later can help delay plant growth until after the initial warm and damp period of late autumn to early winter that favours STB. This is important as infection of young plants can lead to increased losses at maturity. Later sown crops also tend to develop smaller canopies, which are less conducive to powdery mildew infection. However, delayed sowing can have an associated yield penalty in some environments and growers need to consider their risks.
- **Encouraging air circulation.**
  If crops need to be sown early for a long season in cool climates, grazing of the vegetative plants by livestock can reduce and open up the canopy. This will help encourage air circulation through the crop and lower the relative humidity. Strategies such as wider row spacings and reduced plant populations (without compromising yield potential) can also be beneficial.
- **Taking region-wide action.**
  STB has developed widespread fungicide resistance rapidly overseas. It is worth talking with neighbours and working together for integrated, area-wide fungicide resistance management practices.

Photo: Andrew Milgate, NSW DPI.

Septoria tritici blotch.

FREQUENTLY ASKED QUESTIONS

How does fungicide resistance develop?

Fungicide resistance occurs when naturally resistant strains of a pathogen come to dominate the pathogen population in a paddock or region. These naturally occurring strains are 'selected for' by applications of the fungicide. That is, the non-resistant population is controlled by the fungicide while the resistant population is not. With repeated control applications, the resistant individuals come to dominate the overall population and benefit from reduced competition.

For more on the causes and effects of fungicide resistance, read the GRDC/ AFREN Fact Sheet 'How Fungicide Resistance Develops'.

How do I know if I have a fungicide resistant disease in my crop?

If a fungicide application at the registered rate fails to exhibit full control of the disease, or if the application rate for a fungicide must be steadily increased from application to application, there is cause for concern.

You should keep an accurate record of every fungicide application – including dates, times, weather conditions, application and water rates, crop growth stage and notes on any evidence of a disease being present.

What should I look for?

It is important to inspect the crop within a two to three week window after every fungicide application, to confirm whether the expected level of control has been achieved.

If the disease is still present or increasing, review records of the application for reasons why it may have failed. If there is no obvious cause, consult an expert and consider having samples of the infected crop tested for fungicide resistance.

Who do I contact?

Contact your agronomist or adviser and have them review the crop and your fungicide application records. If they suspect fungicide resistance, they will be able to arrange further investigation, sample collection and lab analysis.

Alternatively, you can visit the AFREN website 'About' page for details of fungicide resistant experts in your region.

USEFUL RESOURCES

Australian Fungicide Resistance Extension Network (AFREN)
Dedicated site for the latest Fungicide Resistance information, reference materials, case studies, grower survey and news.
grdc.com.au/afren

AFREN Fungicide Resistance Information Guide
Comprehensive guide to fungicide resistance issues, instances and management – including details of fungicide Mode of Action groups, chemical actives and diseases by crop. Prepared by AFREN and published by the GRDC.
afren.com.au/resources#FRManagementGuide

GRDC Fungicide Resistance In Wheat Fact Sheet

GRDC Fungicides In Australia Fact Sheet

GRDC How Fungicide Resistance Develops Fact Sheet
afren.com.au/resources/#fact-sheets

GRDC Septoria tritici blotch Fact Sheet
grdc.com.au/septoria-tritici-blotch-in-wheat

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MORE INFORMATION

Australian Fungicide Resistance Extension Network
afren.com.au

REFERENCES

The content in this Fact Sheet is based on the content and sources included in the AFREN Guide **Fungicide Resistance Management in Australian Grain Crops.**
See 'Useful Resources' above.

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