

FUNGICIDE RESISTANCE FACT SHEET

Understanding how fungicide resistance develops in cropping systems

KEY POINTS

- Reduced sensitivity or resistance involves loss of fungicide effectiveness against a specific pathogen under field conditions.
- Careful fungicide usage and management is essential for limiting fungicide resistance.
- Use all available management options to reduce disease pressure and reliance on fungicides for disease control.
- Avoid repeat usage of a fungicide to minimise resistance selection.

Photo: CGDM



Fungicide resistance is a serious issue that can affect crop yields in the short term, while impacting on the long-term viability of registered fungicides. Understanding how fungicide resistance develops, how it places additional pressure on other fungicides, and how fungicide use should be managed to minimise risk is vital for protecting future crop yields.

Reduced sensitivity or resistance to a fungicide occurs when a previously effective fungicide does not work optimally or fails to control a pathogen in the field.

Numerous cases of reduced sensitivity or resistance have already been identified in Australia, across all major crops and cropping regions. It is usually a preventable outcome resulting from over-reliance on a single fungicide or chemical actives from a single Mode of Action (MoA) group.

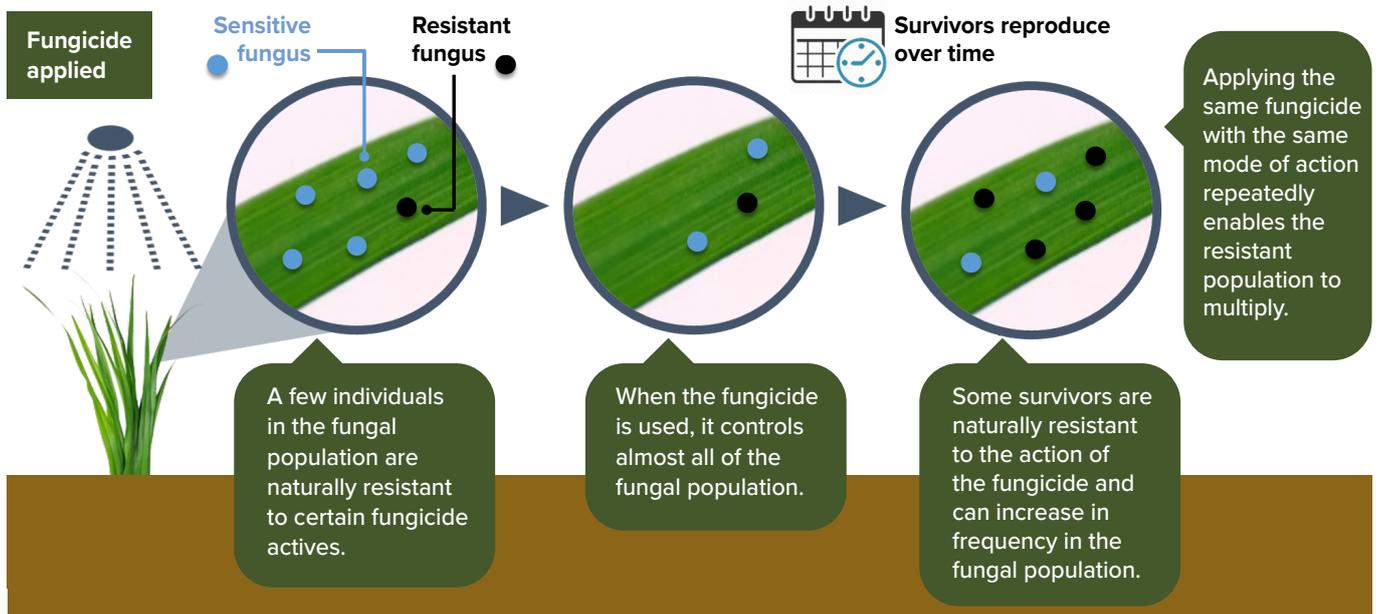
Any loss of fungicide effectiveness is almost always a regional problem. Spores released by resistant fungi can spread over a large area in a short time.

Misuse of fungicides and poor disease management practices on a single farm can have a widespread effect.

How fungicide resistance develops

A fungicide can lose effectiveness when naturally resistant strains of a particular pathogen begin to dominate the overall population within a crop. Each time the compromised fungicide is applied, the sensitive population is reduced while the resistant strains are not. With repeated applications, the sensitive population level stays relatively flat while the resistant examples continue to multiply until they become the dominant strain.

HOW DOES FUNGICIDE RESISTANCE DEVELOP?



Resistance can vary greatly according to the specific combination of host plant, pathogen, and fungicide group – which means management strategies need to be tailored to each scenario.

Key drivers of fungicide resistance

The key drivers of fungicide resistance are **disease pressure** and **fungicide use**.

Disease pressure can be increased by:

- Season-to-season pathogen carry-over via stubble or a 'green bridge'
- Planting susceptible cultivars
- Weather – usually high rainfall or humidity
- Poor agronomic practices, such as lack of crop rotation
- Poor hygiene practices

Fungicide use – especially repetitive, excessive or unnecessary use of the same MoA group – helps promote the selection of resistant pathogen strains.

Resistance is generally more prevalent in areas with higher disease pressure, where fungicides often need to be applied more frequently.



Photo: GRDC

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.

The danger of a fungicide resistance ‘domino effect’

The immediate impact of fungicide resistance is clear – the uncontrolled disease spreads widely through the crop despite application of the compromised fungicide at the maximum label rate.

In such cases, the resistant pathogen can often be successfully controlled through applications of an alternative fungicide product containing chemical actives from a different Mode of Action group.

However, there is a risk of a domino effect, where the failure of one fungicide places additional pressure on the remaining options.

With a limited number of fungicides approved for use on each crop/disease pairing, the loss of one fungicide reduces the number of products that can be included in rotation for ongoing protection. The pathogen is therefore exposed to these remaining products more frequently, which increases the selection pressure on any strains with resistance to those.

In some cases, such as the net blotches of barley or Septoria tritici blotch of wheat, where two of the three currently registered MoA groups are already subject to resistance or reduced sensitivity, the loss of each fungicide increases the use, and therefore the vulnerability, of the remaining options.

Manage fungicide use to minimise risk

Good agronomic practices and the strategic use of fungicides are essential to help minimise the risk fungicide resistance poses to grain production.

Good agronomic practices help to minimise disease pressure and, therefore, the need to apply fungicides. Strategic fungicide use helps ensure resistant strains are not selected in the fungal population.

Photo: CCDM.



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

Strategic fungicide use

4. Spray only if necessary and apply strategically

Every application of a fungicide can help select a resistant strain within the pathogen population. So it is vital to only spray when the risk or presence of disease warrants it. Avoid applying fungicide on a calendar-based schedule or as a precaution when spraying herbicide or fertiliser. The best practice is to apply fungicide preventatively, at the first sign of disease if conditions are conducive for disease development.

5. Rotate and mix fungicides and Mode of Action Groups

Growers should avoid applying the same fungicide twice in a row and should apply mixtures with different modes of action whenever possible. This includes fungicides used as seed treatments and in-furrow applications, and not just foliar sprays.

Generally, using the same MoA group more than twice in the same season should be avoided. However, some crop-chemical combinations should be limited to one application per season. AFREN has produced a range of materials that provide specific advice for managing fungicides with specific crops and diseases. (See Useful Resources on page 5)

Fungicide resistance management.

Start with a strong foundation of less susceptible plant varieties, supported by integrated disease management, along with strategic use of fungicides.

Good agronomic practices

1. Avoid susceptible crop varieties

Be aware of the potential pathogens in your paddock and select resistant cultivars where possible. Crop genetic resistance reduces the need to control pathogens with fungicides. Awareness of previous problems and knowledge of carry-over risks in your rotation program can all help identify fungal threats.

Consult your agronomist and refer to the current GRDC Crop Sowing Guide for your region to identify available cultivars with the required resistance traits.

2. Rotate crops

It has been known for thousands of years that planting crops in rotation is good farming practice. Rotating crops provides a dynamic host environment that fungal pathogens have difficulty

adapting to. This can help limit the build-up of disease pressure from year to year.

3. Use non-chemical control methods to reduce disease pressure

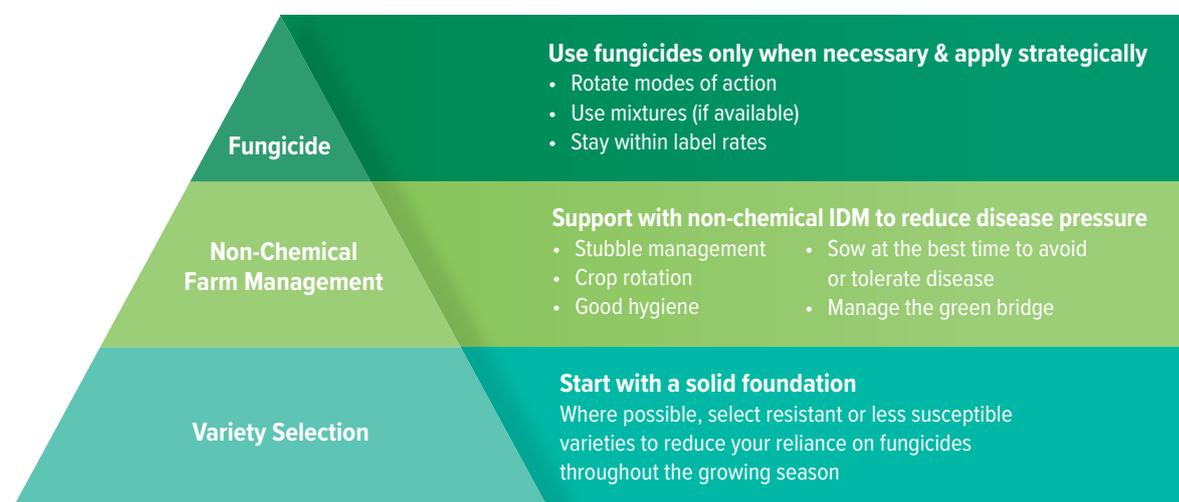
There is a range of farm hygiene and management practices that can help to reduce fungal disease pressure and, therefore, reliance on fungicides.

Most fungal pathogens require plant matter to survive from one season to the next. Eliminating this 'green bridge' and any infected stubble between plantings can help reduce disease carry-over.

Avoiding early sowing can help limit emergent plants' exposure to seasonal conditions that favour fungal spread.

Changing time of sowing between seasons can also help reduce disease pressure by changing the crop's exposure to the pathogen from year to year.

FUNGICIDE RESISTANCE MANAGEMENT



FREQUENTLY ASKED QUESTIONS

How does fungicide resistance develop?

Fungicide resistance occurs when fungicide resistant strains of a pathogen dominate the whole pathogen population. Fungicide resistant strains are 'selected for' by applications of the fungicide. That is, the non-resistant strains are controlled by the fungicide allowing the resistant strains to proliferate.

For more on the causes and effects of fungicide resistance, read the 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 fails to provide adequate control of the disease, or if the lower range of application rates on the label 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 rates, crop growth stage and notes of any evidence of a disease being present.

What should I look for?

It is important to inspect the crop 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 resistance experts in your region.

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DISCLAIMER While every effort has been made to ensure the scientific accuracy and currency of all information and recommendations, our understanding of fungicide resistance is constantly developing and readers are advised to seek further information regarding fungicide resistance from the [AFREN](#), [CCDM Fungicide Resistance Group](#) and [CropLife Australia](#) websites.

Not all active constituents/products in each MoA group are registered for use on the target pathogens indicated in each region. It is the responsibility of growers and advisers to ensure that the fungicide is registered, or that permits are current, for the target pathogen, crop and region.

Current information on registered fungicides can be found on the [APVMA](#) website.

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USEFUL RESOURCES

Australian Fungicide Resistance Extension Network (AFREN)

Dedicated site for the latest Fungicide Resistance information, reference materials, case studies, grower survey and news.
afren.com.au

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#management-guide

Fungicide Resistance Fact Sheets

A range of fact sheets offering advice for fungicide management in wheat, barley, canola and pulse crops; and for managing fungicide resistance in specific crop diseases where resistance issues have been identified in Australia.
afren.com.au/resources#factsheets

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.

MORE INFORMATION

Australian Fungicide Resistance Extension Network (afren.com.au)

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