

Fungicides and Fungicide Resistance



National Vegetable
Extension Network

T A S M A N I A

Vegetable crop diseases are often caused by fungi. Examples of foliar diseases caused by fungi include: downy mildew, powdery mildew and white blister. Examples of soilborne fungal diseases include: clubroot and diseases caused by *Pythium*, *Fusarium*, *Rhizoctonia*, *Sclerotinia* and *Sclerotium* species.

Fungicide resistance occurs when a fungicide or active-ingredient that was once effective, becomes no longer effective. It can occur when reduced rates of fungicides are used or when fungicides are over-used.

Fungicide Resistance: Detection & Management

If a spray application leaves a number of naturally resistant individuals alive, repeated application of the same fungicide/active-ingredient/group will give a competitive advantage to the resistant strains. The sensitive strains are controlled

but the resistant strains continue to multiply. With repeated application of the same fungicide / group, the resistant strains will dominate the population (Figure 1).

It can be difficult to know if a disease control failure has been caused by fungicide resistance. Some laboratories can test for fungicide resistance. Contact your local agronomist or VegNET officer for information about these tests.

Fungicide resistance can be very expensive due to crop losses as well as the investment in fungicides. It can also become an area wide issue, with resistant organisms spreading between crops and between farms.

Examples of fungal organisms that can develop resistance to fungicides include: *Botrytis cinerea*, *Sclerotinia fructicola*, *Bremia lactucae*, *Phytophthora infestans*, *Peronospora destructor*. Table 1 lists vegetable diseases with known resistance development in Australia.

QUALITATIVE RESISTANCE BUILD-UP

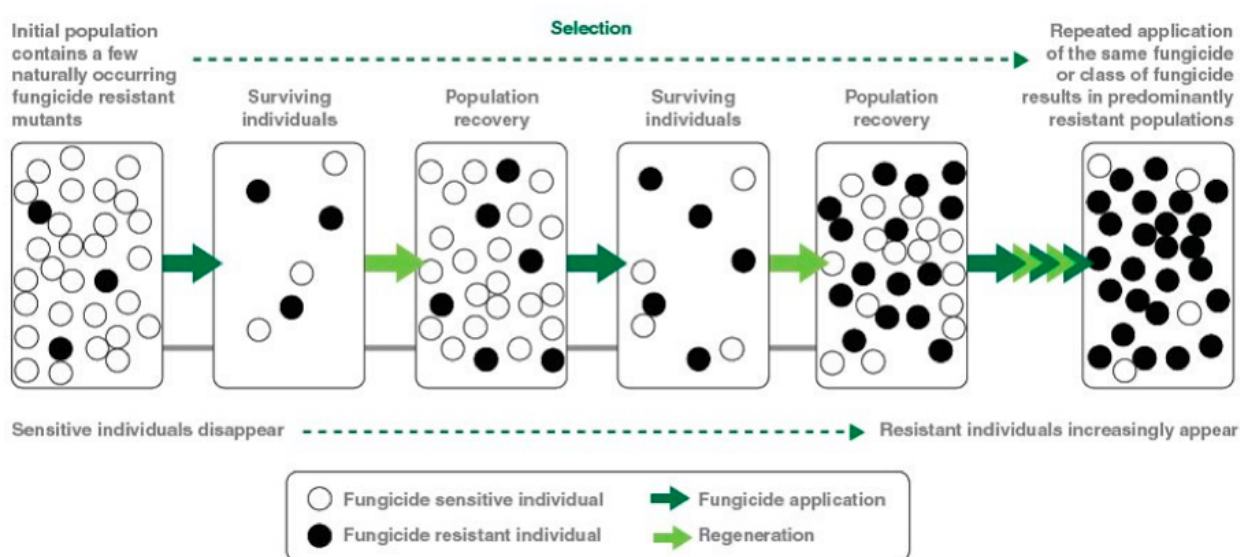


Figure 1. The development of fungicide resistance (Hewitt, 1998).

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Table 1 - Resistance risk (Sourced from: CropLife Australia Website)

CROP	PATHOGEN	DISEASE	RESISTANCE DEVELOPMENT IN AUST.
Lettuce	Bremia lactucae	Downy mildew	Medium risk
Various	Peranospora spp	Downy mildew	Medium risk
Various	Botryotinia fuckeliana (Botrytis cinerea)	Grey mould	High risk
Potato	Phytophthora infestans	Late blight	High risk
Cucurbits	Pseudoperonospora cubensis and related	Downy mildew	High risk
Strawberries	Botrytis cinerea	Grey Mould	Confirmed against: Iprodione (group 2) Strobilurins (group 11) Strobilurins (group 9) Fenhexamid (group 17)
Cucurbits	Podosphaera xanthii	Powdery mildew	Confirmed against: Buprimate (group 8) Strobilurins (group 11) Triadimenol (group 3)

There are important management practices that can be used to lower the risk of both fungal infections in crops, and the development of fungal resistance.

Know your crop

- Which pathogens are likely to affect this crop?
- How resistant is this variety to fungal pathogens? Using resistant varieties is one of the most powerful tools for avoiding fungal disease.
- When is fungal disease likely to occur in the life-cycle of the crop?
- Careful monitoring of conditions and crop health are important for preventative action and early response.
- Integrated Crop Protection (ICP) strategies, such as crop rotations, changing watering times, weed control, soil health, avoiding plant stress and fertiliser choice can reduce the risk of fungal disease. For example:
 - Minchinton (2012) found that watering broccoli at 4am compared with 8pm reduced the incidence of white blister.
 - using calcium nitrate fertilisers instead of ammonium or potassium-based fertilisers can reduce the susceptibility of plants to downy mildew and anthracnose.

Know your pathogen

- Have you correctly identified the pathogen in your crop? If in doubt, samples should be sent for testing (correct handling and packaging of samples is very important).

- What conditions are favourable for the development of fungal pathogens? e.g. moisture, air flow and temperature.
- What is the life-cycle of the pathogen, its location, site of infection and how does it cause your crop damage?
- What is the risk of resistance development in this pathogen (see resources section for where to find this information)?

Know your fungicide

- Rotation of fungicide **mode of action/activity groups** is a vital tool for avoiding resistance. The guidelines for when to change group should be carefully followed.
- Do not exceed the maximum number of applications for fungicide groups per season/crop.
- The disease must be correctly identified so that the right fungicides can be selected.
- Follow the label, the correct application rate is important when applying the fungicide. Follow all instructions very carefully and double check your maths. **It's important to get this right - so it's worth getting it checked.**
- Keep good records – all of the above steps are supported by accurate farm records. There are many free or low-cost apps and software, or a memo book can be just as effective.
- Monitor all fungicides for effectiveness (to help inform which fungicide to select in the future).

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What can you do?

1. Minimise inoculum levels:

- Use recommended rates when applying fungicides
- Use recommended application intervals. Avoid long intervals between applications of preventative fungicides (i.e. don't allow inoculum to build up)
- Know which pathogens are more likely to develop resistance (table 1)

2. Reduce selection pressure:

- Limit disease pressure e.g. through management of irrigation, nutrition, soil and crop health.
- Optimise spray coverage. Refer to 'Spray Application' factsheet available on the Soil Wealth and Integrated Crop Protection website: <http://www.soilwealth.com.au>
- Rotate fungicides with different modes of action
- Consider tank mixes

Factors contributing to success of fungicide applications

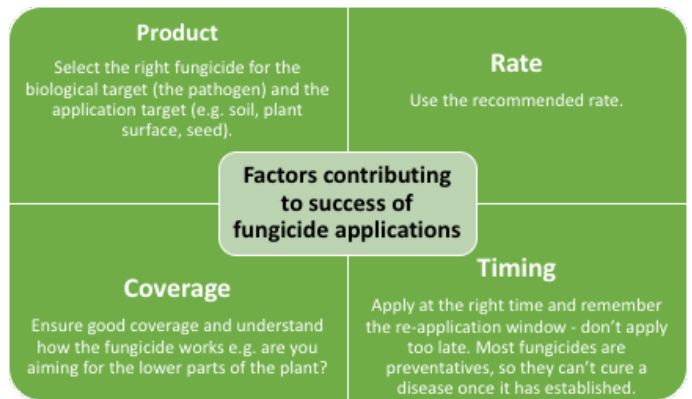


Figure 2: Factors contributing to success of fungicide applications (Adapted from Syngenta presentation (2018)).

Management of fungicide resistance is important to prolong the usefulness and effectiveness of fungicide products. Fungicide remains an important tool for the vegetable industry and it is in our interest to have a range of highly effective fungicides into the future.

Resources

CropLife Australia, Fungicide Resistance Management Strategies document at croplife.org.au

The Fungicide Resistance Action Committee (FRAC) site, is an excellent collection of information and resources.

References and further reading

Akem, C., Jovivich, E. 2013 Project VG07127: Intergrated management of foliar diseases in vegetable crops, QLD Department of Agriculture, Fisheries and Forestry.

Hailstones, D., Hall, B., Tesoriero, L., Forsyth, L. 2011 Project VG07119: Identification and monitoring of resistance in vegetable crops in Australia, Department of Primary Industries.

Hewitt, HG. 1998 Fungicides in Crop Protection. CAB International, Wallingford, UK.

Minchinton, E. 2005 Project VG01045: Disease management strategies for downy mildew on spring onions and white blister on radish, VIC Department of Primary Industries.

Minchinton, E. 2012 Project VG07070: Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildews and white blister, VIC Department of Primary Industries.

O'Brien, R.G. 1993 Project VG114: The management of fungicide resistance in horticulture crops, QLD Department of Primary Industries.

Dal Santo & Holding 2009 VG07109: Development of effective pesticide strategies compatible with IPM management used on farm