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INTRODUCTION

The CropLife Australia Fungicide Resistance Management Review Group (FRMRG) has drafted disease resistance management strategies in conjunction with growers, researchers and agronomists to minimise the development of resistance to fungicides. These strategies provide growers with guidelines for fungicide use (and other methods) for sustainable disease control.

WHAT IS FUNGICIDE RESISTANCE?

Resistance by fungal pathogens to fungicides usually evolves following the intensive use of fungicides for disease control. In any fungal population there are likely to be individuals that have some degree of natural resistance and which are less susceptible to fungicides, even before the chemicals are used. Resistance arises through the incorrect use of fungicides by selection of the resistant forms of fungi. Continued use of a fungicide or fungicide chemical group can result in a significant build-up of resistant individuals in the fungal population – to the point where that particular product, or other products from the same chemical group, is no longer effective. In some cases, removal of the selection pressure can result in the fungal population regaining its sensitivity to the fungicide group, but this is not always the case. The risk of fungicide resistance developing varies between different chemical groups and different fungal pathogens, such that specific strategies are recommended for those situations considered to carry the highest risk.

WHAT CAN BE DONE TO PREVENT OR DELAY RESISTANCE?

The most common approach to managing fungicide resistance is through responsible use of fungicides, of which the resistance management strategies presented in this document are good examples. In their most basic form, these strategies advocate rotation of fungicide products with a different chemical activity group to prevent over-use of any one product or activity group. More complex strategies safeguard against the development of cross-resistance or resistance to multiple chemical groups. In Australia, all fungicide products are labelled to identify which activity group they belong to. The activity group is indicated by a number (or letter/number combination) code on the product label.

Selecting the most effective or appropriate way to apply fungicides will make them work better and assist in delaying the development of resistance. A good understanding of the pathogen's life cycle and epidemiology will also help in the selection of the most appropriate application method. As a general rule, targeted applications to control a certain development stage or population level are most effective, whereas shotgun approaches like application of fungicides through irrigation systems could accelerate the development of resistance by exposing a large portion of the fungal population to sub-lethal rates. Particular attention should be given to label recommendations, rates and coverage. Adherence to suggested disease threshold levels is also good resistance management practice.

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The use of cultural practices or growing varieties of crops with a high degree of natural resistance to diseases – requiring fewer or less frequent fungicide applications.

Working with industry bodies such as the CropLife Australia Fungicide Resistance Management Review Group to establish resistance management strategies for minor crops and/or those crops for which no strategies exist. Of particular concern are permitted uses of fungicides, often in minor crops, where repeated use of a limited number of fungicide alternatives occurs. Although not explicitly stated on agricultural use permits, such permitted uses should also incorporate measures to prevent resistance.

In the event of tank mixing products and/or co-formulations, always follow the recommendation from the most recent Fungicide Resistance Management Strategies and apply the most stringent strategy applicable to the pathogen most at risk of developing resistance.

Certain environments are conducive to continuous infection and consistently high disease pressure. Examples of such environments are nurseries, tunnels, glasshouses and other structures of protected cultivation. Because protected cultivation usually requires multiple applications of fungicides at short intervals to control high disease incidence, these are often the origin of resistance to fungicides. Users of fungicides should be particularly mindful of the resistance risk under these conditions. Do not use a fungicide product to which resistance has been confirmed and stop using a product if resistance is suspected. When the fungicide in question no longer gives adequate control, stop using it temporarily and consult the supplier on its current resistance status.

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In the absence of an established resistance management strategy for a particular crop/disease situation, it is recommended that the use of fungicides from any given activity group (excluding Group M) be limited to a maximum of one-third of the total number of fungicide applications. The use of consecutive applications of fungicides from the same activity group should also be limited by alternating between products from different activity groups. The use of Group M fungicides is not limited, as these fungicides carry an inherently low risk of fungicide resistance developing.

ACTIVITY GROUP LABELLING IN AUSTRALIA

In order to help fungicide users to manage fungicide resistance, all fungicide products sold in Australia are classified according to the chemical activity group of their active constituent. The activity group must be indicated by a letter code on the product label. Australia was the first country to introduce compulsory activity group labelling on products. Since the introduction of activity group labelling in Australia, other countries have adopted activity group classification systems, however caution should be shown if cross-referencing activity groups between Australia and other countries, as there are some differences in classification.

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CHANGES TO ACTIVITY GROUPS

In 2008, CropLife Australia completely revised Australia's fungicide activity grouping system to bring it into line with the international Fungicide Resistance Action Committee (FRAC) activity group classification system. This was the first major revision of the Australian classification system since its introduction several years ago. Activity group codes have now been changed from letters to numbers (or letter/number combinations). For a complete list of all fungicide active constituents registered in Australia and their old and new activity groups, see the Fungicide Activity Group Table on the CropLife Australia website at www.croplife.org.au.

RESISTANCE RISK

Table 1: Plant pathogens accepted as showing a medium risk of development of resistance to fungicides.

FRAC Pathogen	Crop	Disease
<i>Bremia lactucae</i>	Lettuce	Downy mildew
<i>Gibberella fujikuroi</i> *	Rice	Bakanae
<i>Leptosphaera nodorum</i> (<i>Stagonospora nodorum</i>)	Wheat	Leaf spot
<i>Monilinia</i> spp.	Stone and pome fruit	Monilinia rots
<i>Mycosphaerella graminicola</i> (<i>Septoria tritici</i>)	Wheat	Septoria
<i>Mycosphaerella musicola</i>	Banana	Yellow Sigatoka (Leaf Spot)
<i>Peronospora</i> spp.	Various	Downy mildew
<i>Podosphaera leucotricha</i>	Apple	Powdery mildew
<i>Puccinia</i> spp.	Wheat/barley	Rusts
<i>Pyrenophora teres</i>	Barley	Net Blotch
<i>Pyrenophora tritici-repentis</i>	Wheat	Tan spot (yellow spot)
<i>Tapesia</i> spp.	Wheat/barley	Eyespot
<i>Erysiphe necator</i> *	Grapevine	Powdery mildew

*The EPPO Guideline lists these pathogens as high risk and baselines are normally requested

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Table 2: Plant pathogens accepted as showing a high risk of development of resistance to fungicides (adapted from EPPO, 2002).

FRAC Pathogen	Crop	Disease
<i>Botryotinia fuckeliana</i> (<i>Botrytis cinerea</i>)	Various, especially grapevine	Grey mould
<i>Erysiphe graminis</i>	Wheat / barley	Powdery mildew
<i>Mycosphaerella fijiensis</i>	Banana	Black sigatoka
<i>Phytophthora infestans</i>	Potato	Late blight
<i>Plasmopara viticola</i>	Grapevine	Downy mildew
<i>Pseudoperonospora cubensis</i> and related	Cucurbits	Downy mildew
<i>Pyricularia oryzae</i>	Rice	Rice blast
<i>Sphaerotheca fuliginea</i> and related	Cucurbits	Powdery mildew
<i>Venturia</i> spp.	Apple, pear	Scab

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Table 3: Plant pathogens for which resistance has been confirmed in Australian field conditions. Users are advised to at all times adhere to appropriate resistance management strategies.

FRAC Pathogen	Crop	Resistance confirmed against	FRAC Group	Disease
<i>Botrytis cinerea</i>	Strawberries	Iprodione	2	Grey mould
		Strobilurins	11	
		Pyrimethanil	9	
		Fenhexamid	17	
<i>Blumeria graminis</i> f.s.p. <i>hordei</i>	Barley	Triazoles	3	Powdery mildew
<i>Podosphaera xanthii</i>	Cucurbits	Buprimate	8	Powdery mildew
		Strobilurins	11	
		Triadimenol	3	
<i>Erysiphe necator</i>	Grapes	Strobilurins	11	Powdery mildew
<i>Venturia inaequalis</i>	Apples	Triazoles	3	Black spot
<i>Plasmopara viticola</i>	Grapes	Phenylamides	4	Downy mildew
		Strobilurins	11	
<i>Mycosphaerella musicola</i>	Bananas	Strobilurins	11	Yellow sigatoka

Pathogens with high resistance risk

In some cases, fungicides from additional fungicide activity groups may be available under permit for use in the above crop/pest situations. Details of such permits can be obtained from the Australian regulator's (APVMA) website: (www.apvma.gov.au). In the absence of a resistance management strategy for activity groups of products available under permit, or in the absence of restrictions contained within the permit, it is strongly advised that those products (excluding Group M fungicides) be used in alternation with registered products from other fungicide activity groups, which should be used in accordance with the following resistance management strategies.

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Pathogens with medium or unlisted resistance risk

In some cases, fungicides from additional fungicide activity groups may be available under permit for use in the above crop/pest situation. Details of such permits can be obtained from the Australian regulator's (APVMA) website: (www.apvma.gov.au). In the absence of a resistance management strategy for activity groups of products available under permit, it is advised that spray programs incorporating those products (excluding Group M fungicides) also incorporate registered products from other fungicide activity groups. Programs should be used in accordance with the following resistance management strategies.

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Crop(s): Almonds

Disease(s): Blossom Blight and Brown Rot

Resistance Management Strategy for:

Group 2	Dicarboximides;
Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 11	Quinone outside Inhibitor (QoI);
Group 11+3	QoI + DMI; and
Group 11+7	QoI + SDHI.

1. **Do not** apply consecutive sprays of products containing **Group 7**. Consecutive sprays include mixtures containing **Group 7**.
2. **Do not** apply consecutive sprays of products containing **Group 11**. Consecutive sprays include mixtures containing **Group 11**.
3. **Do not** apply more than three **Group 3, 7 or 11** sprays per season (including mixtures of **Group 11+3** and **Group 11+7**).
4. **Do not** apply more than three **Group 2** sprays in one season. Apply no more than two consecutive sprays before changing to another group.
5. Consecutive application includes from the end of one season to the start of the following season.
6. The spray program should be considered and the strategy applied on a whole-orchard basis.
7. No specific resistance management strategy has been developed for low-risk fungicides, including those in Group M and BM. These products should be included in a management strategy as rotation and mixing partners as per label recommendations.

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Crop(s): Almonds

Disease(s): Rust

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 11	Quinone outside Inhibitor (QoI);
Group 11+3	QoI + DMI; and
Group 11+7	QoI + SDHI.

1. **Do not** apply consecutive sprays of solo products containing **Group 7**. Consecutive sprays include mixtures containing **Group 7**.
2. **Do not** apply consecutive sprays of solo products containing **Group 11**. Consecutive sprays include mixtures containing **Group 11**.
3. **Do not** apply more than three **Group 3, 7** or **11** sprays per season (including mixtures of **Group 11+3** and **Group 11+7**).
4. If two consecutive sprays of **Group 3** or **Group 11+3** fungicides are used, then use the same number of sprays of an alternative group(s) before using another **Group 3**, including sprays in the following seasons.
5. If applying **Group 7** or **Group 11** fungicides in mixtures e.g. **Group 11+7**. **Do not** apply more than two consecutive sprays before changing to another group.
6. Rotate with products from **Groups M2, M3** and **M5**.
7. The spray program should be considered and the strategy applied on a whole-orchard basis.

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Crop(s): Apples, Pears

Disease(s): Apple and Pear Scab

Resistance Management Strategy for:

- Group 3** Demethylation Inhibitors (DMI);
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 9** Anilinopyrimidine;
- Group 11** Quinone outside Inhibitor (QoI); and
- Group U12** Cell membrane disruption fungicides.

1. To prevent or delay the onset of resistance to **Group 3** fungicides, **do not** apply more than four **Group 3** sprays alone per season.
2. If more sprays, are required apply a tank mix of a **Group 3** with a **Group 9** or suitable product from **Groups M** or **M1** to **M9**, or apply a registered product containing a combination of a **Group 3** and a **Group 9** fungicide.
3. **Do not** apply more than four sprays per season of **Group 9** fungicides (solo products).
4. **Do not** apply more than four sprays per season of products containing a combination of a **Group 9** and a **Group 3** fungicide and no more than two consecutive applications.
5. **Do not** apply more than three sprays per season of **Group 7** or **Group 11** fungicides. If two consecutive applications of **Group 7** or **Group 11** fungicides are used, then they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before a **Group 7** or **Group 11** fungicide is used again, either in the current or following season.
6. Where spray programs include solo **Group 9** products and combination products, the maximum cumulative number of applications is four per season and no more than two consecutive applications.
7. In locations where resistance has been reported use a **Group 9** only in mixture with a registered, alternative mode of action for which resistance is not known.
8. To prevent or delay the onset of resistance to **Group U12**, **do not** apply more than three consecutive sprays of **Group U12**, and no more than a total of six **Group U12** sprays per season.
9. If more sprays are required, tank mix **Group U12** with a protectant product at the registered rate.

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Crop(s): Banana

Disease(s): Yellow sigatoka

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 7+3	SDHI + DMI;
Group 9	Anilinopyrimidine; and
Group 11	Quinone outside Inhibitor (QoI).

FAR NORTH QUEENSLAND

1. De-leafing must be conducted in accordance with industry guidelines.
2. Apply a regular schedule of protectant sprays.
3. When disease potential is high, apply a maximum of two consecutive **Group 3** sprays before changing to a fungicide of a different activity group.
4. **Do not** apply more than six **Group 3** sprays in any 12-month period. **Do not** apply any **Group 3** sprays in the months of June, July, August and September.
5. **Do not** apply more than two **Group 11** sprays in any 12-month period. **Do not** apply **Group 11** sprays in the months of May, June, July, August and September.
6. **Do not** apply more than four **Group 7** sprays in any 12-month period. **Do not** apply **Group 7** sprays in the months of June, July, August and September.
7. **Group 7** or **11** fungicides should be applied in mixture with another fungicide from a different activity Group registered for the control of Yellow Sigatoka at the full registered rate.
8. **Do not** apply consecutive sprays of **Group 7** or **11** fungicides.
9. Apply a minimum of two sprays from a different activity group between sprays of a **Group 7** or **11** fungicide.
10. **Do not** apply more than six **Group 9** sprays in any 12-month period.
11. **Do not** apply more than two consecutive sprays of a **Group 9** fungicide before changing to a fungicide of a different activity group. When using consecutive applications of **Group 9** fungicides, follow with at least as many different activity group fungicides before resuming with a **Group 9** fungicide.

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Group	Maximum number of applications per year	Maximum number of consecutive sprays	Restricted (no-spray) periods
3	6 (& no more than 2 of 3 sprays)	2	June to September inclusive
7	4 (& no more than 1 of 3 sprays)	Not allowed	June to September inclusive
9	6 (& no more than 2 of 4 sprays)	2	No restriction
11	2 (& no more than 1 of 3 sprays)	Not allowed	May to September inclusive

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EVERYWHERE EXCEPT FAR NORTH QUEENSLAND

1. When using **Group 3** fungicides, apply a maximum of two consecutive **Group 3** sprays before changing to a fungicide of a different activity group.
2. **Do not** apply more than six **Group 3** sprays in any 12-month period.
3. **Do not** apply more than four **Group 7** or **11** sprays in any 12-month period.
4. **Do not** apply consecutive sprays of **Group 7** or **11** fungicides.
5. Apply a minimum of two sprays from a different activity group between sprays of a **Group 7** or **11** fungicide.
6. **Do not** apply more than six **Group 9** sprays in any 12-month period.
7. **Do not** apply more than two consecutive sprays of **Group 9** fungicides before changing to a fungicide of a different activity group. When using consecutive applications of **Group 9** fungicides, follow with at least as many different activity group fungicides before resuming with a **Group 9** fungicide.

Group	Maximum number of applications per year	Maximum number of consecutive sprays	Restricted (no-spray) periods
3	6 (& no more than 2 of 3 sprays)	2	6 (& no more than 2 of 3 sprays)
7	4 (& no more than 1 of 3 sprays)	Not allowed	4 (& no more than 1 of 3 sprays)
9	6 (& no more than 2 of 4 sprays)	2	6 (& no more than 2 of 4 sprays)
11	4 (& no more than 1 of 3 sprays)	Not allowed	4 (& no more than 1 of 3 sprays)

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Crop(s): Barley

Disease(s): Powdery Mildew

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 5	Morpholines;
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 7+3	SDHI + DMI;
Group 11+3	Quinone outside Inhibitor (QoI) + DMI; ;
Group 11+4	QoI + Phenylamide; ;
Group 13	Aza-naphthalene; and
Group 11+7+3	QoI + SDHI + DMI

1. Fungicides should be used preventatively or at first sign of disease. If disease is established within the canopy, fungicides may not produce optimal results and there is high chance of selection for fungicide resistance. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk including the removal of stubble, control of green bridge volunteers and the use of resistant varieties. Monitor if conditions favour disease development and reapply an appropriate fungicide from 21 to 28 days after first application. Use the higher label rate ranges where conditions favour disease development.
2. **Do not** apply more than two applications per growing season of **Group 3, 5, 7 (7+3, 11+7+3), 11 (11+3, 11+7+3 or 11+4) or 13** containing products. This includes in-furrow or seed treatments that have activity on powdery mildew. Combinations of in-furrow and seed treatment are counted as one application.
3. Use **Group 13** products in mixture with an effective partner or alternate with fungicides of a different activity group. Always apply in mixture with a curative fungicide where disease is established. Where applied alone, only use as a protectant (preventative) treatment.
4. **Do not** apply consecutive applications of **Group 11** containing products. This includes in-furrow i.e. If a **Group 11+4** fungicide has been used in-furrow at planting, the first foliar fungicide spray must not contain a **Group 11** fungicide.
5. If a **Group 7** seed treatment has been used with foliar activity (as determined by label claims), the first foliar fungicide applied must not contain a **Group 7** fungicide.
6. **Group 7** foliar fungicides must always be in a co-formulation or in mixture with a registered mixing partner with a different mode of action, with no known resistance.
7. Minimise use of **Group 3** fungicides which are known to have compromised efficacy due to resistance.

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Crop(s): Barley

Disease(s): Scald and Net Blotch

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 7+3	SDHI + DMI;
Group 11+3	Quinone outside Inhibitor (QoI) + DMI;
Group 11+4	QoI + Phenylamide;
Group 11+7+3	QoI + SDHI + DMI.

1. Fungicides should be used as protectant treatments – where no more than 5% leaf area infection evident anywhere in the canopy. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk, which may include:
 - removal of stubble,
 - crop rotation (**avoid** barley on barley),
 - control of green bridge volunteers; and
 - use of tolerant and resistant varieties.
2. **Do not** apply more than one application of a **Group 7** seed treatment with foliar activity in any two consecutive growing seasons.
3. **Do not** apply more than two applications per growing season of **Group 11** or **7** containing products. 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.
4. **Do not** apply consecutive applications of **Group 11** containing products. This includes in-furrow i.e. if a **Group 11+4** or **11+3+7** fungicide has been used in-furrow at planting, the first foliar fungicide spray must not contain a **Group 11** fungicide.
5. If a **Group 7** seed treatment has been used with foliar activity (as determined by label claims), the first foliar fungicide applied should not contain a **Group 7** fungicide.
6. If a **Group 7** fungicide is being applied as a foliar spray, it must be in a co-formulation or in mixture with a registered mixing partner with a different mode of action, with no known resistance.
7. **Do not** apply more than three applications containing **Group 3** fungicides per growing season. This total of three applications includes DMIs applied as **Group 11+3** or **Group 11+7+3** co-formulations and in-furrow or seed treatments that have activity on foliar

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diseases. Combinations of in-furrow and seed treatments are counted as one application.

8. Minimise use of **Group 3** fungicides which are known to have compromised resistance status.

NET BLOTCH ON YORKE PENINSULA, SOUTH AUSTRALIA

1. Minimise use of **Group 7** fungicides with foliar activity where resistance has been confirmed.
2. Minimise the use of **Group 7** fungicides (seed treatments and foliar sprays) to high-risk crop varieties.
3. **Group 7** fungicides **should not** comprise more than 50% of the total number of fungicide applications targeting this disease, which includes seed treatments with foliar activity and foliar sprays per season.

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Crop(s): Broccoli/Cauliflower

Disease(s): White Blister

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitors (QoI);
- Group 21** Quinone inside Inhibitors; and
- Group 28+43** Carbamate + Benzamide.

1. Apply fungicides from **Group 4, 11, 21** or **28+43** in a preventative strategy when conditions favour disease development. Applications made within the nursery count towards the total number of applications allowed per crop.
2. Always apply **Group 4** in mixtures for foliar applications. Apply no more than two consecutive sprays of products containing **Group 4** actives.
3. Apply no more than two consecutive sprays of fungicides containing **Group 11** or **21**. Consecutive sprays should only be adopted if these groups are applied in mixture with an alternative mode of action fungicide. **Group 11** or **21** fungicides should be applied in strict alternation with other fungicide groups if being applied without mix partners.
4. **Do not** apply more than two applications of **Group 4** and **Group 11** fungicides per crop.
5. **Do not** apply more than three applications of a **Group 21** or **28+43** fungicide per crop.

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Crop(s): Broccoli/Cauliflower

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitor (QoI);
- Group 21** Quinone inside Inhibitor; and
- Group 49** Oxysterol binding protein inhibitor (OSBP).

1. Applications made within the nursery count towards the total number of applications allowed per crop. It is recommended that disease control is started early and maintain a regular program using a fungicide from groups other than **Group 4, 11, 21** or **49**.
2. When conditions favour disease development, **do not** wait for disease to appear, but apply two consecutive sprays of a **Group 4, 11, 21** or **49** product at the interval recommended on the label. Then resume the program of sprays using products from a different group to the **Group 4, 11, 21** or **49** products just applied.
3. **Do not** apply more than three sprays of a **Group 4, 11, 21** or **49** product or 33% of the total number of fungicide sprays per season, whichever is more restrictive.
4. Apply **Group 4** and **49** fungicides preventatively and only in mixtures with effective protectant fungicides from a different group.
5. **Do not** use a **Group 49** product if it will be the last fungicide applied to the crop.
6. Continue alternation of fungicides between successive crops. **Do not** make more than (6) six total applications of a **Group 49** product per year on the same area targeting the same disease.

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Crop(s): Canola

Disease(s): Blackleg and Sclerotinia

Resistance Management Strategy for:

Group 2	Dicarboxamides;
Group 3	Demethylation inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitor (SDHI);
Group 7+3	SDHI + DMI; and
Group 11+3	Quinone outside Inhibitor + DMI

1. Fungicides should be used primarily as a preventative or at first sign of disease. If disease is established within the canopy, fungicides may not produce optimal results and there is very strong potential to select for fungicide resistance. Sclerotinia targeted applications should be applied during flowering of the crop, prior to an infection period. Application of fungicides for Sclerotinia may put selection pressure on the blackleg population.
2. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk. This includes growing canola at least 500 m from previous seasons canola stubble, the use of resistant varieties, using alternative fungicide modes of action and stubble management such as knocking down and/or strategic burning.
3. The risk of developing resistance to fungicides can be reduced by incorporating different modes of action into blackleg management programs as either mixtures, co-formulations or rotations.
4. If a **Group 7** seed treatment has been used with foliar activity on blackleg (as determined by label claims), the seedling fungicide application at 4-6 leaf stage targeting blackleg should not contain a **Group 7** fungicide.
5. **Do not** apply more than two applications containing **Group 7** fungicides per growing season. Combinations of in furrow and seed treatment are counted as one application.
6. **Do not** apply more than two consecutive applications of a **Group 3** fungicide
7. Minimise use of fungicides which are known to have compromised resistance status.
8. If seasonal conditions require a second fungicide application at 50% flowering after a 20% flowering timing, the second application should be from a different Group.

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Application stage (Disease being controlled)		Rotation options for different fungicide active groups											
Seed dressing & in-furrow (Blackleg)		None	None	None	None	3	3	3	3	7	7	7+3	7+3
Seedling foliar (Blackleg)		None	3	7	7+3	None	3	7	7+3	None	3	None	3
20-50% flowering (Sclerotinia) Choose only one option from this section	1	None	None	None	None	None	None	None	None	None	None	None	None
	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3		3		3	3	3	
	4	7+3	7+3	7+3	7+3	7+3		7+3		7+3	7+3	7+3	
	5	11+3	11+3	11+3	11+3	11+3		11+3		11+3	11+3	11+3	

If a second application at 50% flowering required:

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	Application at 20% flowering			
	2	3	7+3	11+3
Rotation options for 50% flowering second application	3	2	2	2
	7+3			
	11+3			

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Crop(s): Cucurbits

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitor (QoI);
- Group 28+43** Carbamate + Benzamide;
- Group 40** Carboxylic acid amide;
- Group 49** Oxysterol binding protein inhibitor (OSBP);
- Group 49+11** OSBP + QoI;

1. Applications made within the nursery count towards the total number of applications allowed per crop. It is recommended that disease control is started early and maintain a regular program using a fungicide from groups other than **Groups 4, 11, 28+43, 40, 49** or **49+11**.
2. When conditions favour disease development, **do not** wait for disease to appear, but apply two consecutive sprays of a **Group 4, 11, 28+43, 49** or **49+11** fungicide, at the interval recommended on the label, or a single spray of a **Group 11** fungicide. Then resume the program of sprays using products from a different group to the **Group 4, 11, 28+43, 49** or **49+11** fungicide just applied.
3. **Do not** apply more than four sprays of a **Group 4** or **Group 40** product per season.
4. **Do not** apply more than three sprays of a **Group 49** containing product. **Group 49** containing sprays should not consist of more than 33% of the total number of fungicide sprays per crop. **Group 49+11** sprays count as both a **Group 49** and a **Group 11** spray.
5. **Do not** apply more than two sprays of **Group 28+43** or **11** containing fungicides (including **49+11**) per crop.
6. Apply **Group 4, 11** and **49** (including **49+11**) fungicides preventatively.
7. Apply **Group 4** and **49** fungicides only in mixtures or co-formulations with a registered fungicide from a different mode of action group with no known resistance.
8. Continue alternation of fungicides between successive crops. **Do not** make more than (6) six total applications of a **Group 49** product per year on the same area targeting the same disease.

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Crop(s): Cucurbits

Disease(s): Powdery Mildew

Resistance Management Strategy for:

Group 3	Demethylation inhibitor (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 8	Hydroxy-(2-amino-)pyrimidine;
Group 11	Quinone outside Inhibitor (QoI);
Group 11+7	QoI + SDHI;
Group 13	aza-naphthalenes;
Group U6	Phenyl-acetamide; and
Group 50	Actin inhibitors;

1. Start disease control early. **Do not** wait for powdery mildew to appear before spraying but start as soon as practicable after crop emergence.
2. Use protectant sprays in early crop growth. Apply protectant sprays up to the fruit set stage of the crop if the disease normally occurs during this period. If this schedule is interrupted (e.g. by rain) use a tank mix of protectant plus systemic before recommencing the protectant program.
3. After fruit set, use systemic fungicides in one or more of the following ways:
4. Tank mix systemic fungicides with a protectant fungicide **and** use fungicides from at least two different systemic activity groups per crop.
5. Alternate systemic fungicides with a protectant fungicide **and** use fungicides from at least two different systemic activity groups per crop.
6. Alternate systemic fungicides from at least three different activity groups per crop.
7. Apply **Group 11** fungicides preventatively.
8. Use a maximum of one **Group 11** containing spray out of every three fungicide applications.
9. **Do not** use consecutive applications of **Group 11** or **Group U6** fungicides.
10. **Do not** apply more than two **Group 11** (including 11+7) or **Group U6** products per crop.
11. **Do not** apply more than three **Group 7** or **Group 13** products per crop and no more than two consecutive applications per year.

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Crop(s): Fruit (post-harvest treatment)

Disease(s): Post-harvest diseases

Resistance Management Strategy for:

- Group 2** Dicarboximide and other "systemic" fungicides;
- Group 3** Demethylation inhibitors (DMI);
- Group 3+12** DMI + Phenylpyrroles;
- Group 9** Anilinopyrimidine;
- Group 11+12** Quinone outside Inhibitors (QoI) + Phenylpyrroles; and
- Group 12** Phenylpyrroles.

1. For the last pre-harvest spray, use a fungicide with a different activity group to the fungicide planned for use as a post-harvest treatment.
2. Where alternatives are available, rotate to use as many different activity groups as possible.
3. **Do not** dispose of unused dip solutions as a spray to crops or orchards.
4. **Do not** dispose of unused dip solutions within or near the crop or orchard area.

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Crop(s): Grape

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitor;
- Group 21** Quinone inside Inhibitor;
- Group 40** Carboxylic acid amide; and
- Group 45** QoI, stigmatellin binding type fungicides.

1. Apply all these fungicides preventatively. **Group 4** fungicides should be applied before the first sign of oilspots or as soon as possible after an infection period.
2. Mixtures - co-formulations or tank mixes with label rate of alternative mode of action.
3. Apply a maximum of two consecutive applications of any one group.
4. Start preventative disease control sprays using **non-Group 4** protectant fungicides, typically when shoots are 10-20cm long. Continue spraying at intervals of 7-21 days depending on disease pressure, label directions and rate of vine growth.
5. Limit the use of **Group 4** fungicides to periods when conditions favour disease development. Always apply **Group 4** fungicides in mixtures.

	Group				
	4	11	21+M1	40	45+40
Maximum number of consecutive applications	2	none	2	2	2
Maximum number of solo sprays	None	2	3	2 (50%)	None
Maximum number of sprays per season	4-mix	2	3	4-mix (50%*)	4-mix
Areas of higher agronomic risk	mix	mix	N/A	mix	N/A

*Refer to Point 6

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6. **Group 40:**

- do not apply as the last spray of the season.
- apply a maximum of 50% of the total number of downy sprays.

7. **Group 11:**

- if applied alone, do not make consecutive applications.
- apply a maximum of 2 sprays per season, including mixtures.

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Crop(s): Grape

Disease(s): Grey Mould (*Botrytis Bunch Rot*)

Resistance Management Strategy for:

- Group 2** Dicarmoximide;
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 9** Anilinopyrimidine;
- Group 9+12** Anilinopyrimidine + Phenylpyrroles;
- Group 12** Phenylpyrroles;
- Group 11** Quinone outside Inhibitor (QoI);
- Group 11+3** QoI + Demethylation inhibitors (DMI); and
- Group 17** Hydroxylanilide.

1. Apply all these fungicides as protectants before the first sign of disease.
2. Consecutive applications include from the end of one season to the start of the next.
3. Varying the number of fungicides applied targeting *Botrytis* changes the relative resistance risk to any one fungicide group. When three or fewer sprays are applied, it is recommended that three different groups of fungicides are used (see table below). When four sprays are applied, try to use 3 or 4 different groups of fungicide.

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		Maximum recommended number of sprays which can contain				
		Group:				
		2	7	9 (Incl. 9+12)	11 (Incl. 11+3)	17
Total number of <i>Botrytis</i> targeting sprays	1	1	1	1	1	1
	2	1	1	1	1	1
	3	1	1	1	1	1
	4	2	2	2	2	2
	5+	2	2	2	2	2

4. If a **Group 11** or **7** fungicide is used solo, it should only be used in strict alternation with fungicides from a different mode of action group.
5. **Do not** apply more than two consecutive sprays from the same fungicide group, for any **Group**

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- 2, 7, 9** (including combinations with **Group 12**) **11+3** or **17** fungicide, including from the end of one season to the start of the following season.
6. If two consecutive applications of **Group 11+3** fungicides are used, then they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before a **Group 11** (including combinations with **Group 3**) fungicide is used again, either in the current or following season.
 7. If resistance to a fungicide group has been detected, only use that fungicide group in mixtures or in strict alternation with fungicides from a different cross resistance group. A fungicide group that has been applied as the final application of the season should not be the first fungicide in the following season.
 8. No specific resistance management strategy has been developed for low-risk fungicides, including those in Group M and BM. These products should be included in a management strategy as per label recommendations.

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Crop(s): Grape

Disease(s): Powdery Mildew

Resistance Management Strategy for:

- Group 3** Demethylation inhibitors (DMI);
- Group 5** Amines (morpholines);
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 11** Quinone outside inhibitors (QoI);
- Group 11+3** QoI + DMI (refer to **Group 11** in table)
- Group 13** Aza-naphthalenes;
- Group U6** Phenyl-acetamide; and
- Group 50** Actin disruptors (aryl-phenyl-ketone).

1. Apply all these fungicides preventatively.
2. Consecutive applications include from the end of one season to the start of the next.
3. Mixtures - co-formulations or tank mixes with label rate of alternative mode of action.

	Group						
	3	5	7	11	13	U6	50
Maximum number of consecutive sprays when applied as the only fungicide	2	2	None	None	2	2	2
Maximum number of consecutive sprays when applied as a tank-mix or co-formulant	2	2	2	2	2	2	2
Maximum number of sprays per season	3	3	3	2	3	2	4

4. Medium to high risk fungicides (**Group 7** and **11**) if used consecutively should be applied in a mixture or co-formulation with a registered, alternative mode of action for which resistance is not known – where these fungicides have been routinely used for many seasons, field research indicates there is an increased risk of powdery mildew resistance. To ensure effective powdery

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mildew control in these circumstances, either use alternative modes of action or apply in mixtures.

5. **Group 11:**

- if applied alone, as the only fungicide, do not make consecutive applications, apply a maximum of 2 sprays per season.
- if applied with another fungicide, can be used consecutively except where they have been used routinely for many seasons, apply a maximum of 2 sprays per season.

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Crop(s): Lettuce

Disease(s): Botrytis and Sclerotinia

Resistance Management Strategy for:

Group 2	Dicarboximide;
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 9	anilinopyrimidine;
Group 11	Quinone outside inhibitor (QoI); and
Group 9+12	anilinopyrimidine + phenylpyrroles.

1. Maintain a cover with protectant fungicide sprays at 7-10 day intervals from planting.
2. **Do not** apply **Group 2** fungicides more than four times per season, irrespective of the target disease.
3. **Do not** apply more than two fungicides containing **Group 9** per crop (including **Group 9+12**).
4. **Do not** apply more than three **Group 7** or **Group 11** fungicides per crop and no more than two consecutive sprays per crop. If a Group 7 or 11 fungicide has been used solo it should be in strict alternation with other modes of action. If used in a mixture, no more than two consecutive sprays per crop. This includes the treatment at the end of one crop and the start of the next as consecutive.

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Crop(s): Lettuce

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 28+43** Carbamate + Benzamide;
- Group 40** Carboxylic acid amide;
- Group 49** Oxysterol binding protein inhibitor (OSBP); and
- Group 49+11** OSBP + Quinone outside Inhibitor (QoI).

1. Applications made within the nursery count towards the total number of applications allowed per crop. It is recommended that disease control is started early and maintain a regular program using a fungicide from groups other than **Group 4, 40, 49** (or **49+11**) or **28+43**.
2. When conditions favour disease development, **do not** wait for disease to appear, but apply two consecutive sprays of a **Group 4, 40, 49, 49+11** or **28+43** product at the interval recommended on the label. Then resume the program of sprays using an alternative fungicide group to what was just applied.
3. **Do not** apply more than four sprays of a **Group 4** or **40** product per season.
4. **Group 49** including **Group 49+11** fungicides should only consist of a maximum of 33% of the total fungicide sprays per season targeting downy mildew. **Do not** apply more than three sprays of a **Group 49** containing product including **Group 49+11** sprays. **Group 49+11** sprays count as both a **Group 49** and a **Group 11** spray.
5. **Do not** apply more than three sprays of a **Group 28+43** product per crop.
6. Apply **Group 4** and **49** (or **49+11**) fungicides preventatively and only in mixtures or coformulations with a registered fungicide from a different mode of action group, with no known resistance.
7. Continue alternation of fungicide modes of action between successive crops. **Do not** make more than (6) six total applications of a **Group 49** product per year on the same area targeting the same disease.

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Crop(s): Macadamia

Disease(s): Husk Spot

Resistance Management Strategy for:

- Group 1** Methyl Benzimidazole Carbamates;
- Group 3** Demethylation Inhibitor (DMI);
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 11** Quinone outside Inhibitors (QoI); and
- Group 7+11** SDHI + QoI.

1. If applying **Group 1, 3, 7** or **11** fungicides, **do not** apply more than two consecutive sprays (including from one season to the next) of fungicides from the same group before changing to another group. This applies for fungicides sprayed alone or in tank mix with another mode of action.

	Group 1	Group 3	Group 7	Group 11	Group 7+11
Maximum number of consecutive sprays when applied alone	None	None	None	None	1
Maximum number of consecutive sprays when applied in mix with a different mode of action	2	2	2	2	2
Maximum number of sprays per season	2	2	2	2	2

2. The limit of two sprays per season for **Group 7** and **11** applies to co-formulated products.
3. The spray program should be considered and the strategy applied on a whole-orchard basis.

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Crop(s): Onion

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 28+43** Carbamate plus Benzamide;
- Group 40** Carboxylic acid amide;
- Group 49** Oxysterol binding protein inhibitor (OSBP); and
- Group 49+11** OSBP + Quinone outside Inhibitor (QoI).

1. Start disease control early and maintain a regular program using a fungicide from groups other than **Group 4, 40** or **49** (or **49+11**).
2. When conditions favour disease development, **do not** wait for disease to appear, but apply two consecutive sprays of a **Group 4, 28+43, 40, 49** (or **49+11**) product at the interval recommended on the label. Then resume the program of sprays using products from a different mode of action group to the **Group 4, 28+43, 40, 49** or **49+11** products just applied.
3. **Do not** apply more than four sprays of a **Group 4** or **40** product per season.
4. **Do not** apply more than three sprays of a **Group 28+43** or **49** (or **49+11**) product per crop. **Group 49** (or **49+11**) containing sprays should not consist of more than 33% of the total number of fungicide sprays per crop.
5. Apply **Group 4, 40** and **49** (including **49+11**) fungicides preventatively. Apply solo products of **Group 4** and **49** fungicides only in mixtures with a registered fungicide from a different mode of action group, with no known resistance.
6. Apply **Group 4** and **49** (or **49+11**) fungicides preventatively and only in mixtures with a registered fungicide from a different mode of action group, with no known resistance.
7. Continue alternation of fungicides between successive crops. **Do not** make more than (6) six total applications of a **Group 49** (or **49+11**) product per year on the same area targeting the same disease.

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Crop(s): **Ornamentals**

Disease(s): **Grey Mould**

Resistance Management Strategy for:

Group 2 Dicarboximide; and
Group 9 Anilinopyrimidine.

1. If three or fewer Botrytis fungicide sprays are applied per crop, use only one spray containing a **Group 9** fungicide. If four to six sprays are applied per crop, use a maximum of two sprays containing **Group 9** fungicides. If seven or more sprays are applied per crop use a maximum of three sprays containing **Group 9** fungicides.
2. Avoid applying more than two successive sprays of a **Group 9** fungicide, including from the end of one season to the next.
3. **Do not** apply more than two consecutive sprays of a **Group 2** fungicide.

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Crop(s): Passionfruit

Disease(s): Alternata Spot (*Alternaria* spp.)

Resistance Management Strategy for:

Group 2 Dicarboximide (acronym); and
Group 11 Quinone outside Inhibitors (QoI).

1. Maintain a protective cover with a protectant fungicide such as mancozeb.
2. Limit the use of **Group 2** to strategic periods, i.e. before, during and after extended wet periods.
3. Always tank mix the **Group 2** fungicide with a protectant such as mancozeb.
4. **Do not** apply more than four **Group 2** sprays in a season.
5. The total number of **Group 11** sprays should be no more than one-third of the total number of fungicide sprays per season.
6. **Do not** apply more than two consecutive applications of a **Group 11** spray.
7. If two consecutive applications of a **Group 11** spray are applied, they must be followed by at least the same number of sprays from an alternative chemical group.

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Crop(s): Peanut

Disease(s): Leaf Spot, Rust, Net Blotch

Resistance Management Strategy for:

Group 3 Demethylation inhibitors (DMI);
Group 11 Quinone outside Inhibitor (QoI); and
Group 3+11 DMI + QoI.

1. **Do not** apply more than three consecutive **Group 3** sprays alone, before changing to a fungicide of a different activity group.
2. Apply a maximum of five **Group 3** sprays per season.
3. **Do not** apply **Group 11** products as more than 50% of the total number of sprays in any one season, up to a maximum of three sprays of **Group 11**.
4. **Do not** apply more than two consecutive applications of a **Group 11** spray.
5. If two consecutive applications of a **Group 11** spray are applied, they must be followed by at least the same number of sprays from an alternative chemical group.

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Crop(s): Poppies

Disease(s): Downy Mildew

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitor (QoI);
- Group 28+43** Carbamate plus Benzamide;
- Group 40** Carboxylic acid amide;
- Group 49** Oxysterol binding protein inhibitor (OSBP); and
- Group 49+11** OSBP + QoI.

1. Start disease control early and maintain a regular protectant program. Fungicide applications need to start before the 6-leaf stage for early season control to be effective.
2. When conditions favour disease development (high humidity, still weather, overcast skies), prior to visible disease symptoms (white downy growth on the underside of lower leaves followed by brown angular lesions) apply a single spray of a **Group 49** fungicide, or up to two consecutive sprays of a **Group 4, 11, 40** or **28+43** product (including mixtures containing **Group 4, 11** or **40**), at the interval recommended on the label. Then resume the program of sprays using products from a different group to the **Group 4, 11, 40, 49** or **28+43** products just applied.
3. **Do not** apply more than two sprays per season of a product containing a **Group 4, 11, 40** or **49+11** fungicide. **Group 49** containing sprays should not exceed 33% of the of the total number of fungicide sprays per season.
4. **Do not** apply more than three sprays of a **Group 28+43** product per crop.
5. Apply **Group 11** and **Group 49+11** fungicides preventatively.
6. Apply **Group 4** and **49** fungicides preventatively and only in mixtures with an effective protectant fungicide from a different mode of action group.
7. **Do not** use a **Group 49** (or **49+11**) product if it will be the last fungicide applied to the crop.

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Crop(s): Potato

Disease(s): Late Blight (Irish Blight)

Resistance Management Strategy for:

- Group 4** Phenylamide;
- Group 11** Quinone outside Inhibitor (QoI);
- Group 21** Cyazofamid;
- Group 28+43** Carbamate plus Benzamide; and
- Group 40** Carboxylic acid amide.

1. Start disease control early and maintain a regular program using a fungicide from groups other than **Group 4, 11** or **40**.
2. When conditions favour disease development, **do not** wait for disease to appear, but apply two consecutive sprays of a **Group 4, 11, 40** or **28+43** fungicide at the interval recommended on the label. Then resume the program of sprays using products from a different group to the **Group 4, 11, 40** or **28+43** fungicides just applied.
3. **Do not** apply more than four sprays of a **Group 4** or **40** fungicides per season.
4. **Do not** apply more than two sprays of a **Group 28+43** product per crop.
5. Apply **Group 11** fungicides preventively. The total number of **Group 11** fungicide applications per season should not exceed one third of the total number of fungicide applications per crop. No more than two consecutive **Group 11** sprays should be applied. If consecutive applications of **Group 11** fungicides are used, then they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before a **Group 11** fungicide is used again, either in the current or following season.

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Crop(s): Potato

Disease(s): Target Spot (Early Blight)

Resistance Management Strategy for:

Group 2	Dicarboximide;
Group 3	Demethylation inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 9	Anilinopyrimidine (acronym);
Group 11	Quinone outside Inhibitor (QoI); and
Group 11+3	QoI + DMI (treat as Group 11).

1. Limit the use of **Group 2, 3, 9** or **11** fungicides to periods when conditions favour disease development.
2. **Do not** apply more than six **Group 2** sprays in one season. Apply no more than two consecutive sprays of a **Group 2** fungicide.
3. **Do not** apply more than six **Group 3** sprays in a season. Apply no more than two consecutive sprays of a **Group 3** fungicide alone.
4. If three or fewer fungicide sprays for target spot are applied per crop, use only one spray containing a **Group 7** fungicide. If four to six sprays are applied per crop, use a maximum of two sprays containing **Group 7** fungicides. If seven or more sprays are applied per crop use a maximum of three sprays containing **Group 7** fungicides. If used solo, apply **Group 7** fungicides in strict alternation with fungicides from a different cross resistance group. If fungicides containing **Group 7** are used in mixture, apply a maximum of 2 consecutive applications.
5. If three or fewer fungicide sprays for target spot are applied per crop, use only one spray containing a **Group 9** fungicide. If four to six sprays are applied per crop, use a maximum of two sprays containing **Group 9** fungicides. If seven or more sprays are applied per crop use a maximum of three sprays containing **Group 9** fungicides.
6. Apply no more than two consecutive sprays containing a **Group 9** fungicide.
7. Apply **Group 11** containing fungicides preventively. **Do not** apply more than three foliar applications of a **Group 11** containing fungicide per crop, no more than two consecutive **Group 11** sprays per crop. If consecutive applications of **Group 11** containing fungicides are used, then they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before a **Group 11** containing fungicide is used again, either in the current or following season.
8. When using a **Group 11** fungicide in-furrow at planting, use a fungicide from a different group as the first foliar spray.

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Crop(s): Pulse crops

Disease(s): Grey Mould (*Botrytis*) and ascochyta

Resistance Management Strategy for:

Group 1	Methyl Benzimidazole Carbamates;
Group 2	dicarboximide;
Group 3+11	Demethylation inhibitors (DMI) + Quinone outside Inhibitor (QoI);
Group 7*	Succinate dehydrogenase inhibitors (SDHI);
Group 7+3	SDHI + DMI;
Group M3	dithiocarbamate; and
Group M4*	phthalimide.

1. **Do not** apply more than two **Group 1, 2, 3+11, 7+3, M3** or **M4** sprays in one season (including seed treatment).
2. **Do not** apply more than two consecutive **Group 1** or **M3** sprays, including from season to season and seed treatments. The final foliar spray of the previous season should be considered when planning which fungicide group to use in seed treatments and the first foliar application.
3. If a **Group 7** containing fungicide is used as a seed treatment, the first foliar fungicide used must not contain a **Group 7** fungicide.

* Currently only available under temporary permit. Always check that permits are valid prior to use.

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Crop(s): Stone Fruit

Disease(s): Blossom Blight (*Monilinia laxa*), Brown Rot (*M. fructicola*)

Resistance Management Strategy for:

- Group 2** Dicarboximide;
- Group 3** Demethylation inhibitors (DMI);
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 9** Anilinopyrimidine; and
- Group 11** Quinone outside Inhibitor (QoI).

1. If applying **Group 2, 3, 7, 11** or **7+11** fungicides, **do not** apply more than two consecutive sprays of fungicides from the same group before changing to another group, this includes the last application made in-field from one season to the next.
2. **Do not** apply more than three sprays of a **Group 7, 9, 11** or **7+11** fungicide per season.
3. If consecutive sprays of fungicides from the same chemical group are applied, they must be followed by at least the same number of sprays from an alternative chemical group, before returning to the original group.

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	Group					
	2	3	7	9	11	7+11
Maximum number of consecutive sprays when applied alone	2	2	2	2	2	2
Maximum number of consecutive sprays when applied in mix with a different mode of action	2	2	2	2	2	2
Maximum number of sprays per season	3	3	3	3	3	3

4. A post-harvest treatment should also be counted as an application.
5. The last blossom blight spray and the first pre-harvest brown rot spray should be regarded as consecutive applications.
6. The spray program should be considered and the resistance management strategy applied on a whole-orchard basis.

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7. No specific resistance management strategy has been developed for low-risk fungicides, including those in Group M and BM. These products should be included in a management strategy as per label recommendations.

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Crop(s): Strawberry

Disease(s): Grey Mould (*Botrytis*)

Resistance Management Strategy for:

Group 2	Dicarboximide;
Group 7	Succinate dehydrogenase inhibitors (acronym);
Group 9	Anilinopyrimidine;
Group 9+12	Phenylpyrroles; and
Group 17	Hydroxyanilide.

1. Apply a program of protectant fungicides during flowering. If conditions favour disease development during this period, use a **Group 2, 9, 12** or **17** fungicide.
2. **Do not** apply more than two successive sprays of **Group 2, 9, 12** or **17** fungicides.
3. If applying **Group 7** fungicides, **do not** apply more than two consecutive sprays before changing to another group. **Do not** apply more than three **Group 7** sprays per season. If consecutive sprays are used, then use the same number of sprays of an alternative group before using another **Group 7**, including sprays in consecutive seasons.
4. If three or fewer *Botrytis* fungicide sprays are applied per crop, use only one spray containing a **Group 9** fungicide. If four to six sprays are applied per crop use a maximum of two sprays containing **Group 9** fungicides. If seven or more sprays are applied per crop use a maximum of three sprays containing **Group 9** fungicides.
5. If three or fewer *Botrytis* fungicide sprays are applied per crop, use only one spray containing a **Group 12** fungicide. If four to six sprays are applied per crop use a maximum of two sprays containing **Group 12** fungicides. If seven or more sprays are applied per crop use a maximum of three sprays containing **Group 12** fungicides.

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Crop(s): Strawberry

Disease(s): Powdery Mildew

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 11	Quinone outside Inhibitor (QoI); and
Group U6	Phenyl-acetamide.

1. Apply a program of protectant fungicides from early crop establishment and maintain a regular spray program throughout the crop growing cycle. If weather conditions favour powdery mildew development, use a **Group 3** or **11** fungicide.
2. **Do not** apply more than four **Group 3** sprays per season.
3. **Do not** apply more than two consecutive sprays of **Group 3** fungicides, including from one season to the next.
4. If applying **Group 7** fungicides, **do not** apply more than two consecutive sprays before changing to another group.
5. **Do not** apply more than three **Group 7** sprays per season. If consecutive sprays are used, then use the same number of sprays of an alternative group before using another **Group 7**, including sprays in consecutive seasons.
6. Apply **Group 11** fungicides preventively.
7. **Do not** apply consecutive sprays of **Group 11** fungicides, including from one season to the next.
8. If three or fewer powdery mildew fungicide sprays are applied per crop, use only one spray containing a **Group 11** fungicide. If four to six sprays are applied per crop, use no more than two sprays containing a **Group 11** fungicide. If seven or more sprays are applied per crop use a maximum of three sprays containing a **Group 11** fungicide. **Do not** apply more than three **Group 11** sprays per season.
9. **Do not** use **Group 3** fungicides curatively.

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Crop(s): Strawberry runner production

Disease(s): Powdery Mildew

Resistance Management Strategy for:

- Group U6*** thiazolidine;
- Group 8*** hydroxy-(2-amino-) pyrimidines; and
- Group 13*** azanaphthalenes.

1. Strawberry runner growers should also refer to the resistance management strategy for strawberry – powdery mildew, as it applies equally to strawberry runner growers. This strategy is for the additional range of compounds available to strawberry runner producers under permit.
2. Fungicides from **Group U6, 8** and **13** are available for use on strawberry runner crops under individual permits from the APVMA.
3. Each permit states “**Do not** apply to fruit producing strawberry plants.”
4. Apply a maximum of two (2) **Group U6** sprays per season.
5. Apply a maximum of four (4) **Group 8** or **13** sprays per season.
6. Refer to individual permits for information relating to spray interval etc.

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* *Currently only available under temporary permit. Always check that permits are valid prior to use.*

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Crop(s): Tomato

Disease(s): Grey Mould

Resistance Management Strategy for:

Group 2 Dicarboximide; and
Group 7 Succinate dehydrogenase inhibitors (SDHI).

1. Tank mix **Group 2** fungicides with a protectant such as chlorothalonil. Avoid applying two **Group 2** fungicides in succession, unless tank mixed with a protectant.
2. **Do not** apply more than four **Group 2** sprays in a season.
3. If applying **Group 7** fungicides, **do not** apply more than two consecutive sprays before changing to another group. **Do not** apply more than three **Group 7** sprays per season. If consecutive sprays are used, then use the same number of sprays of an alternative group before using another **Group 7**, including sprays in consecutive seasons.

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Crop(s): Tomato

Disease(s): Powdery Mildew

Resistance Management Strategy for:

- Group 3** Demethylation inhibitor (DMI);
- Group 11+3** Quinone outside Inhibitor (QoI) + DMI;
- Group 7** Succinate dehydrogenase inhibitors (SDHI); and
- Group 13** aza-naphthalenes.

1. Apply fungicides before disease becomes established.
2. **Do not** apply more than four sprays of a **Group 3** containing fungicide per crop.
3. If applying a **Group 7, 11** (or **11+3**) or **13** containing fungicides, **do not** apply more than two consecutive sprays before changing to another group. **Do not** apply more than three applications containing a **Group 7, 11** (or **11+3**) or **13** fungicide per season. If consecutive sprays are used, then use the same number of sprays of an alternative group before using another **Group 7, 11** (or **11+3**) or **13**, which includes sprays from consecutive seasons.

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Crop(s): Tomato

Disease(s): Target Spot (Early Blight)

Resistance Management Strategy for:

Group 2	Dicarboximide;
Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase inhibitors (SDHI);
Group 9	Anilinopyrimidine;
Group 11	Quinone outside Inhibitor (QoI); and
Group 11+3	QoI + DMI.

1. Limit the use of **Group 2, 3, 9** or **11** fungicides to periods when conditions favour disease development.
2. **Do not** apply more than four **Group 2** sprays in one season. Apply no more than two consecutive sprays of a **Group 2** fungicide.
3. **Do not** apply more than six **Group 3** sprays in a season. Apply no more than two consecutive sprays of a **Group 3** fungicide alone.
4. If applying **Group 7** fungicides, **do not** apply more than two consecutive sprays before changing to another group. **Do not** apply more than three **Group 7** sprays per season. If consecutive sprays are used, then use the same number of sprays of an alternative group before using another **Group 7**, including sprays in consecutive seasons.
5. If three or fewer fungicide sprays for target spot are applied per crop, use only one spray containing a **Group 9** fungicide. If four to six sprays are applied per crop, use a maximum of two sprays containing **Group 9** fungicides. If seven or more sprays are applied per crop, use a maximum of three sprays containing **Group 9** fungicides.
6. Apply no more than two consecutive sprays containing a **Group 9** fungicide.
7. Apply **Group 11** fungicides preventively. **Do not** apply more than six sprays, or one third of the total sprays (whichever is lower) from **Group 11** fungicides. **Do not** apply more than two consecutive sprays of **Group 11** fungicides. If consecutive applications of **Group 11** fungicides are used, then they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before a **Group 11** fungicide is used again, either in the current or following season.

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Crop(s): Turf

Disease(s): Various

Resistance Management Strategy for:

Group 1	Benzimidazole;
Group 2	Dicarboxamide;
Group 3	Demethylation Inhibitor (DMI);
Group 4	Phenylamides;
Group 7	Succinate Dehydrogenase Inhibitor (SDHI);
Group 7 + 11	SDHI + Quinone outside Inhibitor (QoI);
Group 11	QoI;
Group 11 + 2	QoI + dicarboxamide;
Group 11 + 3	QoI + DMI;
Group 12	Phenylpyrroles;
Group 14	chlorophenyls and nitroanilines;
Group 21	Quinone inside Inhibitor;
Group 28	Carbamate; and
Group 33	Phosphonate.

1. Fungicide groups that are classified as medium to high risk for fungicide resistance development; **Groups 1, 2, 4, 7, 11** and **21** should be rotated as a key feature to reduce the development of resistance.
2. **Do not** apply consecutive sprays of fungicides from the same activity group, unless mixed with a registered fungicide from a different mode of action group with no known resistance.
3. If consecutive sprays are done of fungicides from a high-risk fungicide group (i.e. **Group 1, 2, 4, 7, 11** or **21**) they must be followed by at least the same number of applications of fungicide(s) from a different group(s) before the same high-risk fungicide is used again.

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Crop(s): **Wheat**

Disease(s): **Septoria Blotch**

Resistance Management Strategy for:

- Group 3** Demethylation Inhibitors (DMI);
- Group 7** Succinate dehydrogenase inhibitors (SDHI);
- Group 3+7** DMI + SDHI; and
- Group 11+3** Quinone outside Inhibitor (QoI) + DMI.

12. Fungicides should be used as protectant treatments – where there is no more than 5% leaf area infection evident anywhere in the canopy. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk, which may include:
 - removal or burning of stubble,
 - crop rotation (**avoid** wheat on wheat),
 - control of green bridge volunteers; and
 - use of tolerant and resistant varieties.
13. **Do not** apply more than one application of a **Group 7** seed treatment with foliar activity in any two consecutive growing seasons.
14. **Do not** apply more than two applications per growing season of **Group 11** or **7** containing products. 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.
15. If a **Group 7** seed treatment has been used with foliar activity (as determined by label claims), the first foliar fungicide applied must not contain a **Group 7** fungicide.
16. If a **Group 7** fungicide is being applied as a foliar spray, it must be in a co-formulation or in mixture with a registered mixing partner with a different mode of action, with no known resistance.
17. **Do not** apply more than three applications containing **Group 3** fungicides per growing season. This total of three applications includes DMIs applied as **Group 11+3** co-formulations and in-furrow or seed treatments that have activity on foliar diseases. Combinations of in-furrow and seed treatments are counted as one application.
18. Minimise use of **Group 3** fungicides which are known to have compromised resistance status.

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Crop(s): **Wheat**

Disease(s): **Yellow Spot, Powdery Mildew**

Resistance Management Strategy for:

Group 3	Demethylation Inhibitors (DMI);
Group 7	Succinate dehydrogenase Inhibitor (SDHI);
Group 7+3	SDHI + DMI;
Group 11+3	Quinone outside Inhibitor (QoI) + DMI;
Group 11+4	QoI + Phenylamide; and
Group 11+7+3	QoI + SDHI + DMI.

1. Fungicides should be used as protectant treatments – where no more than 5% leaf area infection evident anywhere in the canopy. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk including the removal of stubble, control of green bridge volunteers and the use of tolerant and resistant varieties.
2. **Do not** apply more than two applications per growing season of **Group 11** or **7** containing products. This includes in-furrow or seed treatments that have activity on foliar diseases. Combinations of in-furrow and seed treatment are counted as one application.
3. **Do not** apply consecutive applications of **Group 11** containing products. This includes in-furrow i.e. If a **Group 11+4** fungicide has been used in-furrow at planting, the first foliar fungicide spray must not contain a **Group 11** fungicide.
4. If a **Group 7** seed treatment has been used with foliar activity (as determined by label claims), the first foliar fungicide applied should not contain a **Group 7** fungicide.
5. **Do not** apply more than one application of a **Group 7** seed treatment with foliar activity in any two consecutive growing seasons.
6. If a **Group 7** fungicide is being applied as a foliar spray, it must be in a co-formulation or in mixture with a registered mixing partner with a different mode of action, with no known resistance.
7. **Do not** apply more than three applications containing **Group 3** fungicides per growing season. This total of three applications includes DMIs applied as **Group 11+3** or **Group 11+7+3** co-formulations and in-furrow or seed treatments that have activity on foliar diseases. Combinations of in furrow and seed treatment are counted as one application.
8. Minimise use of **Group 3** fungicides which are known to have compromised resistance status.

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