Fungicide Resistance Management Strategies

Developed by the CropLife Australia Fungicide Resistance Management Review Group and industry researchers

Valid as at 27 June 2019
## Index to crop and pest strategies

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<td>Septoria, Yellow spot, Powdery mildew</td>
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INTRODUCTION

1. 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.

2. WHAT CAN BE DONE TO PREVENT OR DELAY RESISTANCE?

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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.
2.6 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.

2.7 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.

3. 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.

4. 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

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

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

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

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

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.

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

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All previous versions of this strategy are now invalid. Phone: 02 62732733  Email: info@croplife.org.au  Website: www.croplife.org.au
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.

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, which should be used in accordance with the following resistance management strategies.
Crop(s): Almonds
Pest(s): Blossom Blight and Brown Rot

Resistance Management Strategy for:

- **Group 2** (Dicarboximide);
- **Group 3** Demethylation inhibitor (DMI);
- **Group 7** SDHI (Succinate dehydrogenase inhibitors);
- **Group 11** Qol (Quinone outside inhibitor);
- **Group 11+3** (Qol + DMI); and
- **Group 11+7** (Qol + 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, Group 7** or **Group 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. If applying **Group 7** or **Group 11** fungicides in mixtures, **DO NOT** apply more than two consecutive sprays before changing to another group.

6. Consecutive application includes from the end of one season to the start of the following season.

7. Rotate with products from **Groups M2, M3 and M4**.

8. The spray program should be considered and the strategy applied on a whole-orchard basis.
Crop(s): Almonds
Pest(s): Rust

Resistance Management Strategy for:

- **Group 3** Demethylation inhibitor (DMI);
- **Group 7** SDHI (Succinate dehydrogenase inhibitors);
- **Group 11** QoI (Quinone outside inhibitor);
- **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 1**.

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**, **Group 7** or **Group 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.
Crop(s):  Apples, Pears
Pest(s):  Apple and Pear Scab

Resistance Management Strategy for:

Group 3  Demethylation inhibitor (DMI);
Group 7  SDHI (Succinate dehydrogenase inhibitors);
Group 9  (Anilinopyrimidine);
Group 11  QoI (Quinone outside Inhibitor); 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.
Crop(s): Banana
Pest(s): Yellow sigatoka

Resistance Management Strategy for:

Group 3 Demethylation inhibitor (DMI);
Group 7 SDHI (Succinate dehydrogenase inhibitors);
Group 9 (Anilinopyrimidine); and
Group 11 Qol (Quinone outside Inhibitor);

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 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.

<table>
<thead>
<tr>
<th>Chemical Group</th>
<th>Max. number of Applications/year</th>
<th>Max. number of consecutive sprays</th>
<th>Restricted (no-spray) periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3</td>
<td>6 (&amp; no more than 2 of 3 sprays)</td>
<td>2</td>
<td>June to September inclusive</td>
</tr>
<tr>
<td>Group 7</td>
<td>4 (&amp; no more than 1 of 3 sprays)</td>
<td>Not allowed</td>
<td>June to September inclusive</td>
</tr>
<tr>
<td>Group 9</td>
<td>6 (&amp; no more than 2 of 4 sprays)</td>
<td>2</td>
<td>No restriction</td>
</tr>
<tr>
<td>Group 11</td>
<td>2 (&amp; no more than 1 of 3 sprays)</td>
<td>Not allowed</td>
<td>May to September inclusive</td>
</tr>
</tbody>
</table>

EVERYWHERE EXCEPT FAR NORTH QUEENSLAND
12. When using Group 3 fungicides, apply a maximum of two consecutive Group 3 sprays before changing to a fungicide of a different activity group.
13. DO NOT apply more than six Group 3 sprays in any 12 month period.

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14. **DO NOT** apply more than four **Group 7** or **11** sprays in any 12 month period.

15. **DO NOT** apply consecutive sprays of **Group 7** or **11** fungicides.

16. Apply a minimum of two sprays from a different activity group between sprays of a **Group 7** or **11** fungicide.

17. **DO NOT** apply more than six **Group 9** sprays in any 12 month period.

18. **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.

<table>
<thead>
<tr>
<th>Chemical Group</th>
<th>Max. number of applications/year</th>
<th>Max. number of consecutive sprays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3</td>
<td>6 (&amp; no more than 2 of 3 sprays)</td>
<td>2</td>
</tr>
<tr>
<td>Group 7</td>
<td>4 (&amp; no more than 1 of 3 sprays)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Group 9</td>
<td>6 (&amp; no more than 2 of 4 sprays)</td>
<td>2</td>
</tr>
<tr>
<td>Group 11</td>
<td>4 (&amp; no more than 1 of 3 sprays)</td>
<td>Not allowed</td>
</tr>
</tbody>
</table>
Crop(s): Barley
Pest(s): Powdery mildew

Resistance Management Strategy for:

**Group 3**
Demethylation Inhibitor (DMI);

**Group 5**
(Morpholines);

**Group 7**
SDHI (Succinate dehydrogenase inhibitors);

**Group 7 + 3**
(SDHI + DMI);

**Group 11 + 3**
(Quinone outside Inhibitor + DMI);

**Group 11 + 4**
(Quinone outside Inhibitor + PAA); and

**Group 13**
(Aza-naphthalene).

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 (11+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.
Crop(s): Barley
Pest(s): Scald and Net blotch

Resistance Management Strategy for:

- **Group 3**: Demethylation Inhibitor (DMI);
- **Group 7**: SDHI (Succinate dehydrogenase inhibitors);
- **Group 7 + 3**: (SDHI + DMI);
- **Group 11 + 3**: (Quinone outside Inhibitor + DMI); and
- **Group 11 + 4**: (Quinone outside Inhibitor + PAA).

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. 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.

6. **DO NOT** apply more than three applications containing **Group 3** fungicides per growing season. This total of three applications includes DMI’s 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.

7. Minimise use of **Group 3** fungicides which are known to have compromised resistance status.
Crop(s): Broccoli/Cauliflower

Pest(s): Downy Mildew

Resistance Management Strategy for:

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

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, 40, 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.
Crop(s): Broccoli/Cauliflower
Pest(s): White blister

Resistance Management Strategy for:

Group 4 (Phenylamide)
Group 11 QoI (Quinone outside inhibitor);
Group 21 (Quinone inside Inhibitors)
Group 28 + 43 (Carbamate plus 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. Apply no more than two applications of **Group 4** and **Group 11** fungicides per crop.

5. Apply no more than three applications of a **Group 21 or 28+43** fungicide in per crop.
Crop(s): Canola  
Pest(s): Blackleg  

Resistance Management Strategy for:

- **Group 3** Demethylation Inhibitor (DMI);  
- **Group 7** SDHI (Succinate dehydrogenase Inhibitor); and  
- **Group 7 + 3** (SDHI + DMI).

1. Fungicides should be used as preventatively as possible 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.

2. In high risk disease environments, integrated management approaches should be used to reduce fungicide resistance risk including 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 when targeting blackleg. Combinations of in furrow and seed treatment are counted as one application.

6. Minimise use of fungicides which are known to have compromised resistance status.

<table>
<thead>
<tr>
<th>Growth stage</th>
<th>Rotation options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed/in-furrow</td>
<td>3</td>
</tr>
<tr>
<td>Seedling</td>
<td>3, 7 or 7 + 3</td>
</tr>
</tbody>
</table>
Crop(s): Canola  
Pest(s): Sclerotinia

Resistance Management Strategy for:

- **Group 2** (Dicarboximide);
- **Group 3** Demethylation inhibitor (DMI);
- **Group 7** SDHI (Succinate dehydrogenase inhibitors);
- **Group 7 + 3** (SDHI = DMI); and
- **Group 11 + 3** (Quinone outside Inhibitor + DMI).

1. Fungicides should be used as protectant treatments, applied during flowering of the crop, prior to an infection period.

2. **DO NOT** apply more than two applications per flowering period of **Group 11** (or 11+3) or **Group 7** (or 7+3) containing products for the control of sclerotinia in canola.

3. **DO NOT** apply more than three applications containing **Group 2** or **Group 3** (or 11+3 or 7+3) fungicides per flowering period for the control of sclerotinia in canola.

**Note:** An application in the flowering period for the control of upper canopy infection (UCI) of blackleg should also be counted as an application for the control of sclerotinia, if conditions are conducive for sclerotinia infection or sclerotinia infection is already present.
Crop(s): Cucurbits
Pest(s): Downy Mildew

Resistance Management Strategy for:

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

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, 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 of a 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.
Crop(s): Cucurbits
Pest(s): Powdery Mildew

Resistance Management Strategy for:

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

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 (eg. 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:
   a. Tank mix systemic fungicides with a protectant fungicide **AND** use fungicides from at least two different systemic activity groups per crop.
   b. Alternate systemic fungicides with a protectant fungicide **AND** use fungicides from at least two different systemic activity groups per crop.
   c. Alternate systemic fungicides from at least three different activity groups per crop.
   d. Apply **Group 11** fungicides preventatively

4. Use a maximum of one **Group 11** containing spray out of every three fungicide applications.

5. **DO NOT** use consecutive applications of **Group 11** or **Group U6** fungicides.

6. **DO NOT** apply more than two **Group 11** (including **Group 11+7** or **Group U6**) products per crop.

7. **DO NOT** apply more than three **Group 7** or **Group 13** products per crop and no more than two consecutive applications per year.
Crop(s): Fruit (post-harvest treatment)

Pest(s): Post-harvest diseases

Resistance Management Strategy for:

- Group 2 (Dicarboximide) and other “systemic” fungicides;
- Group 3 Demethylation inhibitor (DMI);
- Group 3+12 (DMI + Phenylpyroles);
- Group 9 (Anilinopyrimidine);
- Group 11+12 (QoI + Phenylpyroles); and
- Group 12 (Phenylpyroles).

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.
Crop(s): Grape
Pest(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** (Quinone outside inhibitor, 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.

<table>
<thead>
<tr>
<th></th>
<th>Group 4</th>
<th>11</th>
<th>21 + M1</th>
<th>40</th>
<th>45 + 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. number of consecutive applications</td>
<td>2</td>
<td>none</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Max. number of solo sprays</td>
<td>none</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(50%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>none</td>
</tr>
<tr>
<td>Max. number of sprays per season</td>
<td>4-mix</td>
<td>2</td>
<td>3</td>
<td>4-mix</td>
<td>4-mix</td>
</tr>
<tr>
<td>(50%)</td>
<td></td>
<td></td>
<td></td>
<td>(50%)</td>
<td></td>
</tr>
<tr>
<td>Areas of higher agronomic risk</td>
<td>mix</td>
<td>mix</td>
<td>n/a</td>
<td>mix</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1Refer to point 6

6. **Group 40** – do not apply as the last spray of the season.
   **Group 40** – apply a maximum of 50% of the total number of downy sprays

7. **Group 11** – If applied alone, do not make consecutive applications.
   **Group 11** – apply a maximum of 2 sprays per season, including mixtures.

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Crop(s): Grape
Pest(s): Powdery Mildew

Resistance Management Strategy for:

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

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

<table>
<thead>
<tr>
<th></th>
<th>Group 3</th>
<th>Group 5</th>
<th>Group 7</th>
<th>Group 11</th>
<th>Group 11 + 3</th>
<th>Group 13</th>
<th>Group U6</th>
<th>Group 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of consecutive sprays when applied as the only fungicide</td>
<td>2</td>
<td>2</td>
<td>none</td>
<td>none</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum number of consecutive sprays when applied as a tank-mix or co-formulant</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum number of sprays per season</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

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 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.

6. Group 11 – 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.
Crop(s): Grape
Pest(s): Grey Mould (Botrytis Bunch Rot)

Resistance Management Strategy for:
Group 2 (Dicarboximide);
Group 7 SDHI (Succinate dehydrogenase inhibitors);
Group 9 (Anilinopyrimidine) and combinations of Group 9 (Anilinopyrimidine) and
Group 12 (Phenylpyrroles);
Group 11 Qol (Quinone outside Inhibitor) and combinations of Group 11 and Group 3
(Demethylation inhibitor (DMI));
Group 17 (Hydroxyanilide)

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.

<table>
<thead>
<tr>
<th>Total number of Botrytis targeting sprays</th>
<th>Maximum recommended number of sprays which can contain group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5+</td>
<td>2</td>
</tr>
</tbody>
</table>

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 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.
Crop(s): Lettuce
Pest(s): Botrytis & Sclerotinia

Resistance Management Strategy for:

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

1. Apply Group 2 fungicide as a seedling drench soon after emergence.
2. Apply a protectant fungicide as a high volume foliar spray before planting out, then a Group 2 fungicide immediately after planting.
3. Maintain a cover with protectant fungicide sprays at 7-10 day intervals.
4. If weather conditions favour Botrytis infection, tank mix the protectant with a Group 2 fungicide.
5. DO NOT apply Group 2 fungicides more than four times per season, irrespective of the target disease.
6. DO NOT apply more the two Group 9 or Group 12 fungicides per crop.
7. DO NOT apply more than three Group 7 or Group 11 fungicides per crop and no more than two consecutive sprays per crop.
Crop(s): Lettuce
Pest(s): Downy Mildew

Resistance Management Strategy for:

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

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.
Crop(s): Macadamia
Pest(s): Husk Spot

Resistance Management Strategy for:

Group 1 Methyl Benzimidazole Carbamates;
Group 3 Demethylation inhibitor (DMI);
Group 7 SDHI (Succinate dehydrogenase inhibitors);
Group 11 QoI (Quinone outside Inhibitors) fungicides; 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 actions.

<table>
<thead>
<tr>
<th>Maximum number of consecutive sprays when applied alone</th>
<th>Group 1</th>
<th>Group 3</th>
<th>Group 7</th>
<th>Group 11</th>
<th>Group 7 + 11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

| 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 the Group 7 and Group 11 applies to co-formulated products.

3. The spray program should be considered and the strategy applied on a whole-orchard basis.
Crop(s): Onion (Allium spp.)

Pest(s): Downy Mildew

Resistance Management Strategy for:

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

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.
Crop(s): Ornamentals  
Pest(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.
Crop(s): Passionfruit
Pest(s): Alternaria sp.

Resistance Management Strategy for:

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

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.
Crop(s): Peanut
Pest(s): Leaf Spots, Rust, Net Blotch

Resistance Management Strategy for:

Group 3  Demethylation inhibitor (DMI);  Group 11  QoI (Quinone outside Inhibitor); 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.
Crop(s): Poppies  
Pest(s): Downy Mildew

Resistance Management Strategy for:

Group 4 (Phenylamide);  
Group 11 QoI (Quinone outside Inhibitor);  
Group 28+43 (Carbamate plus Benzamide);  
Group 40 (Carboxylic acid amide); and  
Group 49 OSBP (Oxysterol binding protein inhibitor) fungicides  
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 Group 49+11) product if it will be the last fungicide applied to the crop.
Crop(s): Potato
Pest(s): Late Blight (Irish Blight)

Resistance Management Strategy for:

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

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.
Crop(s): Potato

Pest(s): Target Spot (Early Blight)

Resistance Management Strategy for:

Group 2 (Dicarboximide);
Group 3 Demethylation inhibitor (DMI);
Group 7 SDHI (Succinate dehydrogenase inhibitors);
Group 9 (Anilinopyrimidine);
Group 11 Qol (Quinone outside Inhibitor); and
Group 11 + 3 (Qol + DMI) treat as a Group 11 fungicide for resistance management purposes.

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.
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 inhibitor (DMI) + Quinone outside Inhibitor);
- *Group 7 (SDHI (Succinate dehydrogenase inhibitors));
- Group 7+3 (SDHI + DMI);
- Group M3 (dithiocarbamate); and
- *Group M4 (phthalimide) fungicides

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.

*Note currently only available under temporary permit. Always check that permits are valid prior to use.
Crop(s): Stone Fruit
Pest(s): Blossom Blight and Brown Rot

Resistance Management Strategy for:

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

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 application made 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.

<table>
<thead>
<tr>
<th>Group</th>
<th>2</th>
<th>3</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>7+11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum number of consecutive sprays when applied alone</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Maximum number of consecutive sprays when applied in mix with a different mode of action</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Maximum number of sprays per season</strong></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

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 strategy applied on a whole-orchard basis.
Crop(s): Strawberry
Pest(s): Grey Mould (Botrytis)

Resistance Management Strategy for

- **Group 2** (Dicarboximide);
- **Group 7** SDHI (Succinate dehydrogenase inhibitors);
- **Group 9** (Anilinopyrimidine);
- **Group 9+12** (Anilinopyrimidine + Phenylpyrroles); and
- **Group 17** (Hydroxyanilide) fungicides

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.
Crop(s): Strawberry
Pest(s): Powdery Mildew

Resistance Management Strategy for:

Group 3  Demethylation inhibitor (DMI);
Group 7  SDHI (Succinate dehydrogenase inhibitors); and
Group 11  QoI (Quinone outside Inhibitor) fungicides

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 Group 11 fungicide.

2. DO NOT apply more than four Group 3 sprays per season. DO NOT apply more than two consecutive sprays of Group 3 fungicides, including from one season to the next.

3. If applying Group 7 fungicides, DO NOT apply more than two consecutive sprays before changing to another group.

4. 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. Apply Group 11 fungicides preventively. DO NOT apply consecutive sprays of Group 11 fungicides, including from one season to the next.

6. 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.

7. DO NOT use Group 3 fungicides curatively.
Crop(s): Strawberry runner production.

Pest(s): Powdery mildew (*Podosphaera aphanus*)

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.

*Note currently only available under temporary permit. Always check that permits are valid prior to use*
Crop(s): Tomato
Pest(s): Grey Mould

Resistance Management Strategy for:

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

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.
Crop(s): Tomato  
Pest(s): Powdery Mildew

Resistance Management Strategy for:

- **Group 3**: Demethylation inhibitor (DMI);
- **Group 11 + 3**: QoI (Quinone outside Inhibitor) + (DMI);
- **Group 7**: SDHI (Succinate dehydrogenase inhibitors); 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.
Crop(s): Tomato

Pest(s): Target Spot (Early Blight)

Resistance Management Strategy for:

Group 2 (Dicarboximide);
Group 3 Demethylation inhibitor (DMI);
Group 7 SDHI (Succinate dehydrogenase inhibitors);
Group 9 (Anilinopyrimidine);
Group 11 QoI (Quinone outside Inhibitor) fungicides; 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.
Crop(s): Turf

Pest(s): Various Diseases

Resistance Management Strategy for:

Group 1  (Benzimidazole);
Group 2  (Dicarboxamide);
Group 3  Demethylation Inhibitor (DMI);
Group 4  (Phenylamide);
Group 7  SDHI (Succinate dehydrogenase inhibitors);
Group 7 + 11  SDHI + (QoI) Quinone outside Inhibitor;
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 Inhibitors);
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 (ie 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.
Crop(s): Wheat
Pest(s): Septoria, Yellow spot, Powdery Mildew

Resistance Management Strategy for:

Group 3: Demethylation inhibitor (DMI);
Group 7: Succinate dehydrogenase Inhibitor;
Group 7 + 3: (Succinate dehydrogenase Inhibitor + DMI);
Group 11 + 3: (Quinone outside Inhibitor + DMI) and
Group 11 + 4: (Quinone outside Inhibitor + PAA)

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. 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.

6. **DO NOT** apply more than three applications containing Group 3 fungicides per growing season. This total of three applications includes DMI’s 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 treatment are counted as one application.

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