



## Summary of Recommendations for Grapevine

11<sup>th</sup> of April, 2019

This document is automatically generated from the following FRAC Working Groups Recommendations. For further information please refer to the links in the list of the individual recommendations:

<b>Fungicide groups to control diseases caused by true fungi</b>	
Anilino-Pyrimidines (AP)	<a href="#">Link to all AP-Recommendations</a>
Aza-naphthalenes (AZN)	<a href="#">Link to all AZN-Recommendations</a>
Dicarboximide fungicides	<a href="#">Link to all Dicarb.-Recommendations</a>
MBC fungicides (Methyl Benzimidazole Carbamates) and NPC fungicides (N-phenyl carbamate)	<a href="#">Link to all MBC-Recommendations</a>
Sterol biosynthesis inhibitor (SBI) fungicides, Azoles	<a href="#">Link to all SBI-Recommendations</a>
Succinate dehydrogenase inhibitors (SDHI)	<a href="#">Link to all SDHI-Recommendations</a>
Quinone outside Inhibitors (QoI), Strobilurines	<a href="#">Link to all QoI-Recommendations</a>
<b>Fungicide groups to control diseases caused by oomycetes</b>	
Carboxylic Acid Amides (CAA)	<a href="#">Link to all CAA-Recommendations</a>
OxySterol Binding Protein Inhibition (OSBPI)	<a href="#">Link to all OSBPI-Recommendations</a>
PhenylAmide fungicides (PA)	<a href="#">Link to all PA-Recommendations</a>
Quinone outside Inhibitors (QoI), Strobilurines	<a href="#">Link to all QoI-Recommendations</a>

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## 1. Recommendations for diseases caused by true fungi

### General AP's Guidelines

Where different AP-containing products are used in one season, the cumulative number of applications with cyprodinil-, pyrimethanil- or mepanipyrim-containing products must not exceed the maxima as mentioned below.

For sound resistance management, good agricultural practices, including phytosanitary measures and crop protection, should be followed not only in commercial practice, but also in nurseries

### AP – Botrytis Guidelines

- Where up to three treatments are made per season, the number of applications of AP-containing products is limited to one.
- In situations where four to six Botrytis treatments are made per crop and season, a maximum of two applications with AP-containing products are recommended.
- In specific situations where seven or more Botrytis treatments are required per crop and season, a maximum of three applications with AP-containing products is recommended and not more than two consecutive applications.
- For specific crops and products, follow use recommendations of individual companies.

### AZN - Recommendations for grapes diseases

- Apply Group 13 fungicides preventatively.
- Group 13 fungicides must be applied in spray programs with fungicides of a different mode of action.
- Apply a maximum of 3 Group 13 fungicide containing sprays per season, solo or in mixture (co-formulations or tank mixes) with effective mixture partners from different cross-resistance groups.
- Do not exceed 2 consecutive applications of Group 13 fungicides per season.
- Always follow product specific label recommendations for resistance management.

### Dicarboxamides-> General Use Recommendations

Minimise the selection pressure by minimising the number of applications. As a guide, do not apply more than two to three per crop per season.

Restrict applications to those times when Botrytis infection pressure is high.

Maintain regular prolonged times without exposure to dicarboximides.

Where resistance is well established, use combinations to stabilise Botrytis control, but their application must follow the same rules as for dicarboximides alone.

Note that individual countries will now have their own, more detailed, use guidelines for specific crops.

### Methyl-Benzimidazole-Carbamates (MBC) - General Use Recommendations

There are no specific recommendations for benzimidazoles. Both mixtures and alternations are valid strategies to minimize the risk of resistance development. In case of tank-mixtures, the benzimidazole fungicide must be applied at its label dose together with the appropriate dose of

an effective, non-cross-resistant partner fungicide. Benzimidazole-based products must be integrated in a spray program containing fungicides having a different site of action and effective on the target pest. In order to reduce selection pressure, the total number of benzimidazole applications should not exceed that indicated on the product label. The exclusive use of benzimidazole fungicides must be avoided. Post-infection, curative treatments must be reserved for special situations where no alternatives are available.

### **SBI - General Recommendations:**

The SBI fungicides represent one of the most potent classes of fungicides available to the grower for the control of many economically important pathogens. It is in the best interest of all those involved in recommending and using these fungicides that they are utilised in such a way that their effectiveness is maintained

The working group concentrates its resources on the major crop/pathogen targets from the point of view of resistance risk. Inevitably many, still important pathogens are omitted. To help in making recommendations for crops and pathogens not directly covered, the following general recommendations can be made:

- Repeated application of SBI fungicides alone should not be used on the same crop in one season against a high-risk pathogen in areas of high disease pressure for that particular pathogen.
- For crop/pathogen situations where repeated spray applications (e.g. orchard crops/powdery mildew) are made during the season, alternation (block sprays or in sequence) or mixtures with an effective non cross-resistant fungicide are recommended (see [FRAC Code List](#)).
- Where alternation or the use of mixtures is not feasible because of a lack of effective or compatible non cross-resistant partner fungicides, then input of SBI's should be reserved for critical parts of the season or crop growth stage.
- If the performance of SBIs should decline and sensitivity testing has confirmed the presence of less sensitive isolates, SBIs should only be used in mixture or alternation with effective non cross-resistant partner fungicides.
- The introduction of new classes of chemistry offers opportunities for more effective resistance management. The use of different modes of action should be maximized for the most effective resistance management strategies.
- Users must adhere to the manufacturers' recommendations. In many cases, reports of "resistance" have, on investigation, been attributed to cutting recommended use rates, or to poorly timed applications.
- Fungicide input is only one aspect of crop management. Fungicide use does not replace the need for resistant crop varieties, good agronomic practice, plant hygiene/sanitation, etc.
- Exclusive frequency measurements of single cyp51 mutations are not sufficient to describe the sensitivity situation towards DMIs but can help to better understand the background of sensitivity shifts.

### **DMI - Grape - Powdery mildew (*Erysiphe necator*) Use Recommendations:**

- DMIs and amines should be used preventative and curative situations should be avoided.
- The existing strategy for effective disease control and resistance management continues to be successful and the use recommendation is a maximum of 4 applications per season per mode of action. The strategy includes the use of mixtures or alternation with non-cross resistant fungicides.

- To ensure that SBIs can remain the effective basis for control of *Erysiphe necator* in grape vine, their use should adhere to the full recommended rate (either alone or in mixture) at the recommended timing and application volume and an accurate treatment of each row

### **KRI – Botrytis Recommendations for the use of KRIs:**

- Use KRIs only protectively.

- Use KRIs only in strict alternation, no block application.

- Solo product as part of alternation programmes:

Spray programmes with a maximum of 3 treatments per season: max. 1 application with KRIs

Spray programmes with 4-5 treatments/season: max. 2 applications with KRIs

Spray programmes with 6 and more treatments: at the maximum one third of all Botryticide-applications

- Use in mixtures:

Both partners - if applied alone at the dose used in the mixture - must have sufficient activity against Botrytis. Not more than 50% of all Botryticide-treatments should be made with KRIs-containing mixtures.

For sound resistance management, good agricultural practices, including phytosanitary measures and crop protection, should be followed carefully.

### **General SDHI General Guidelines**

- Strategies for the management of SDHI fungicide resistance, in all crops, are based on the statements listed below. These statements serve as a fundamental guide for the development of local resistance management programs.

- Resistance management strategies have been designed in order to be proactive and to prevent or delay the development of resistance to SDHI fungicides.

- Fungicide programs must deliver effective disease management. Apply SDHI fungicide based products at effective rates and intervals according to manufacturers' recommendations.

- Effective disease management is a critical component to delay the build-up of resistant pathogen populations.

- The number of applications of SDHI fungicide based products within a total disease management program must be limited.

- When mixtures are used for SDHI fungicide resistance management, applied as tank mix or as a co-formulated mixture, the mixture partner:

- should provide satisfactory disease control when used alone on the target disease

- must have a different mode of action

- Mixtures of two or more SDHI fungicides can be applied to provide good biological efficacy; however, they do not provide an anti-resistance strategy and must be treated as a solo SDHI for resistance management. Each application of such a mixture when used in a spray program counts as one SDHI application.

- SDHI fungicides should be used preventively or at the early stages of disease development.

- Please refer to the "mixture document" ([link](#)) for more information on fungicide mixtures for resistance management.

- Species can carry different mutations which affect SDHIs. A few mutations can lead to different sensitivities depending on the chemical structure of the active ingredient.

- As SDHIs are cross-resistant, resistance management must be the same for all SDHIs.

- All monitoring and guideline related statements refer to the entire group of SDHIs

### **SDHI Guidelines – Grapes**

- Apply SDHI fungicides according to manufacturers' recommendations.

- When mixtures are used for SDHI fungicide resistance management, applied as tank mix or as a co-formulated mixture, the mixture partner:
  - should provide satisfactory disease control when used alone on the target disease
  - must have a different mode of action
  - Apply a max. of 3 SDHI-containing fungicides per year over all diseases, solo or in mixture with effective mixture partners from different cross-resistance groups but not more than 50% of the total number of applications.
  - A maximum of 4 SDHI fungicide applications may be used where 12 or more fungicide applications are made per crop.
  - If used solo, apply SDHI fungicides in strict alternation with fungicides from a different cross-resistance group.
  - If used in mixture, apply SDHI fungicides in a maximum of 2 consecutive applications.
  - Apply SDHI fungicides preventively.
  - For SDHI fungicide applications specifically targeted against grey mold, *Botrytis cinerea*, refer to the table below.

Total number of <i>Botrytis cinerea</i> spray applications per crop	1	2	3	4	5	6	>6
Maximum recommended Solo SDHI fungicide sprays <b>(apply in strict alternation)</b>	1	1	1	2	2	2	3
Max. recommended SDHI fungicide sprays in mixture <b>(apply a max. of 2 consecutive applications)</b>	1	1	2	2	2	3	3

### QoI - Guidelines for General Recommendations

Resistance management strategies have been further enhanced in order to be proactive and to prevent the occurrence of resistance to QoI fungicides developing in other areas and pathogens. Specific guidelines by crop follow the general guidelines given here.

- Fungicide programmes must deliver effective disease management. Apply QoI fungicide based products at effective rates and intervals according to manufacturers' recommendations. Effective disease management is a critical component to delay the build-up of resistant pathogen populations.
- The number of applications of QoI fungicide based products within a total disease management program must be limited whether applied solo or in mixtures with other fungicides. This limitation is inclusive to all QoI fungicides. Limitation of QoI fungicides within a spray programme provides time and space when the pathogen population is not influenced by QoI fungicide selection pressure.
- A consequence of limitation of QoI fungicide based products is the need to alternate them with effective fungicides from different cross-resistance groups (refer to the specific crop recommendations).
- QoI fungicides, containing only the solo product, should be used in single or block applications in alternation with fungicides from a different cross-resistance group. Specific recommendation on size of blocks is given for specific crops.

- QoI fungicides, applied as tank mix or as a co-formulated mixture with an effective mixture partner, should be used in single or block applications in alternation with fungicides from a different cross-resistance group. Specific recommendations on size of blocks are given for specific crops.
- Mixture partners for QoI fungicides should be chosen carefully to contribute to effective control of the targeted pathogen(s). The mixture partner must have a different mode of action, and in addition it may increase spectrum of activity or provide needed curative activity. Use of mixtures containing only QoI fungicides must not be considered as an anti-resistance measure. Where local regulations do not allow mixtures, then strict alternations with non-cross resistant fungicides (no block applications) are necessary.
- An effective partner for a QoI fungicide is one that provides satisfactory disease control when used alone on the target disease.
- QoI fungicides are very effective at preventing spore germination and should therefore be used at the early stages of disease development (preventive treatment).

**Guidelines for using QoI fungicides on vines - Powdery mildew (*Uncinula necator* / *Erysiphe necator*)**

Apply a maximum of 4 QoI fungicide containing sprays against any disease per vine crop, and a maximum of 33% of the total number of applications.

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Apply a maximum of 2 QoI fungicide containing sprays targeted against powdery mildew per vine crop, preferably in mixture (co-formulations or tank mixes) with effective mixture partners from different cross-resistance groups.
3. Apply QoI fungicides preventively.
4. QoI fungicides used solo should be used in strict alternation with fungicides from a different cross-resistance group.
5. Apply QoI fungicides used in mixture in a maximum of two consecutive applications in alternation with fungicides from a different cross-resistance group. In areas where resistance has been confirmed, apply QoI fungicides in strict alternation and in mixture with an effective partner.

## 2. Recommendations for diseases caused by oomycetes

### **CAA - Plasmopara viticola – Grape downy mildew (no general recommendations)**

Plasmopara viticola is classified by FRAC as a high risk pathogen. Long-term experience with CAA fungicides demonstrates that the resistance risk of Plasmopara viticola to this fungicide group is moderate and can be managed through appropriate use strategies.

Use Recommendations:

- Apply CAA fungicides preferably in a preventive manner
  - Apply a maximum of 50% of the total number of intended applications for disease control not exceeding a total of 4 CAA fungicide sprays during one crop cycle. In areas of high resistance the total number should not exceed a maximum of 3 applications during one crop cycle
  - Always apply CAA fungicides in mixture with effective partners such as multi-site or other non cross resistant fungicides
  - An effective partner for a CAA fungicide is one that provides satisfactory disease control when used alone at the mixture rate
  - Alternation with fungicides having other modes of action is recommended in spray programs
- For more detailed product recommendations refer to the use guidelines published by the respective CAA manufacturers.

### **OSBPI General Use Recommendations**

Fungicide programs must deliver effective disease management. Apply OSBPIs at effective rates and intervals according to manufacturers' recommendations. Effective disease management is a critical component to delay the build-up of resistant pathogen populations. Apply OSBPIs only preventatively and in mixtures with

effective fungicides from different cross-resistance groups. The mixture partner should give effective control of the target disease(s) at the rate and interval selected.

Foliar exposure to OSBPI products should not exceed thirty-three percent (33%) of the total period of protection needed per crop.

The number of foliar applications of OSBPI products within a total disease management program must be limited as follows:

### **OSBPI Grape Use Recommendations**

Make no more than two (2) applications per season.

### **Phenylamides > General Use Recommendations**

The general use recommendations for phenylamide-based products have remained unchanged since 1997. The key (“umbrella”) guidelines for product use are as follows (they have to be adapted to local requirements and resistance levels):

The phenylamides should be used on a preventive and not curative or eradicated basis.

For foliar applications, the phenylamides should be used in a pre-packed mixture containing an unrelated effective partner and used in a sound management program. Where residual partners are used, it is recommended to use between three quarters and full recommended rates. The phenylamide dosage in the mixture depends on its intrinsic activity and is defined by the respective company.

The phenylamides should not be used as soil treatments against foliar diseases. When solo formulations are made available for soil use, strategies must be implemented which prevent any

possibilities for foliar applications. For seed treatment, mixtures rather than straight phenylamides should be used whenever possible.

The number of phenylamide applications should be limited (two to four consecutive applications per crop and year). The application intervals should not exceed 14 days and may be shorter in cases of high disease pressure. If rates and application intervals are reduced, the total amount of the phenylamide fungicide used per season should not exceed that of the full rate, and the total exposure time should remain the same. The rate of the mixing partners should remain the same for both intervals.

Phenylamide sprays are recommended early season or during the period of active vegetative growth of the crop. The farmer should switch to non-phenylamide products not later than the normal standard application interval of the non-phenylamide product.

### **QoI - Guidelines for General Recommendations**

Resistance management strategies have been further enhanced in order to be proactive and to prevent the occurrence of resistance to QoI fungicides developing in other areas and pathogens. Specific guidelines by crop follow the general guidelines given here.

- Fungicide programmes must deliver effective disease management. Apply QoI fungicide based products at effective rates and intervals according to manufacturers' recommendations. Effective disease management is a critical component to delay the build-up of resistant pathogen populations.
- The number of applications of QoI fungicide based products within a total disease management program must be limited whether applied solo or in mixtures with other fungicides. This limitation is inclusive to all QoI fungicides. Limitation of QoI fungicides within a spray programme provides time and space when the pathogen population is not influenced by QoI fungicide selection pressure.
- A consequence of limitation of QoI fungicide based products is the need to alternate them with effective fungicides from different cross-resistance groups (refer to the specific crop recommendations).
- QoI fungicides, containing only the solo product, should be used in single or block applications in alternation with fungicides from a different cross-resistance group. Specific recommendation on size of blocks is given for specific crops.
- QoI fungicides, applied as tank mix or as a co-formulated mixture with an effective mixture partner, should be used in single or block applications in alternation with fungicides from a different cross-resistance group. Specific recommendations on size of blocks are given for specific crops.
- Mixture partners for QoI fungicides should be chosen carefully to contribute to effective control of the targeted pathogen(s). The mixture partner must have a different mode of action, and in addition it may increase spectrum of activity or provide needed curative activity. Use of mixtures containing only QoI fungicides must not be considered as an anti-resistance measure. Where local regulations do not allow mixtures, then strict alternations with non-cross resistant fungicides (no block applications) are necessary.
- An effective partner for a QoI fungicide is one that provides satisfactory disease control when used alone on the target disease.
- QoI fungicides are very effective at preventing spore germination and should therefore be used at the early stages of disease development (preventive treatment).

### **Guidelines for using QoI fungicides on vines - Downy mildew (*Plasmopara viticola*)**

Apply a maximum of 4 QoI fungicide containing sprays against any disease per vine crop, and a maximum of 33% of the total number of applications.

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Apply QoI fungicides preventively.
3. Apply a maximum of 3 QoI fungicide containing sprays targeted against downy mildew per vine crop, only in mixture with effective partners from different cross-resistance groups.