Fungicide Resistance Management Strategies

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COMMONWEALTH OF AUSTRALIA
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Overview

• How are fungicides classified?

• Review some of the major fungicides used in Australian Viticulture plus examples of resistance

• Resistance management

Consider anti-resistance strategies
Why be concerned about fungicide resistance?

- Plant pathogens grouped according to how likely they can develop resistance.
- Botrytis and Downy mildew are considered high risk
- Powdery mildew considered high to medium risk
Classification of fungicides

• There are several ways but mode of action / chemical grouping is the most useful

• In Australia we use a series of numbers (1 to 40) to signify / group different fungicides.
Non-specific inhibitors

• Fungicides that attack several cellular target sites, e.g. –SH groups

• Non-systemic, lack eradicative properties

• Low risk of resistance

• Activity groups M to M9
Non-specific inhibitors (2)

- Early examples of fungicides such as Bordeaux Mixture
- Generally inorganic compounds such as Cu & S sprays
- Chlorothalonil (Bravo) and Captan are examples
Benzimidazoles – Group 1

• First truly systemic fungicides developed in the 1960’s.

• Widely used indiscriminately following their introduction

• Benomyl is an example

• Resistance rapidly developed
Benomyl resistance

- Monogenic resistance
- Repeated use of the fungicide in the one season with no mixtures
- Resistance is stable
Dicarboximides – group 2

• Introduced in response to benomyl resistance in Botrytis

• Iprodione (Rovral) introduced 1974

• Mode of action unclear

• Weakly systemic
Dicarboximide resistance

1978 - German vineyards reported Botrytis resistance.

Resistance is now widespread but unlike benonyl resistance can be managed.
Phenylamides – group 4

• Example Metalaxyl (Ridomil)
• Inhibit RNA synthesis
• Acropetally systemic
• Active against Downy mildew
Features of Ridomil resistance

• Product used singularly

• Disease pressure was high

• Product used curatively

Now use Ridomil Plus (metalaxyl and copper) - An anti-resistance strategy
Sterol Biosynthesis Inhibitors – Group 3

- Inhibit different steps in the sterol biosynthetic pathway, e.g. demethylation (DMIs)

- Powdery mildew on grapes - resistance hasn’t been a major problem

Alternate with other activity groups - An anti-resistance strategy
Anilinopyrimidines - e.g. Scala

Inhibit secretion of cell wall degrading enzymes
Scala Resistance – Group 9

• Easy to obtain in the lab

• Limited reports of field resistance, largely from France & Switzerland.

• Diminished sensitivity of some Aus isolates

Distinguish between lab and field resistance
Strobilurins Group 11

• Analogues of Strobilurin A from a fungus

• Interfere with fungal respiration (quinone outside inhibitors QoIs)

• Examples include Amistar and Cabrio

• No resistance recorded in grapes

Alternate with other activity groups - An anti-resistance strategy
Phenylpyrroles (Group 12)

• Analogues of Pyrolnitrin isolated from a soil bacterium

• Fludioxonil (Group 12) is sold in Australia with cyprodinil (Group 9) as a mixture (Switch)

Two modes of action (mixtures)
An anti-resistance strategy
Q. How does resistance develop?

Mutation of the pathogen genome in the presence of a selection pressure.
Types of fungicide resistance

Cross resistance
Double resistance
Negative cross resistance
Monogenic vs. polygenic

Implications for resistance management???
Resistance management

• Understand life cycle of the fungus and only apply when necessary

• Monitor the population in the vineyard

• Use mixtures, alternate products and limit use

Minimise selection pressure - An anti-resistance strategy
Alternatives to fungicides

- Biological control agents
- Cultural control e.g. canopy management
- Disease resistant / tolerant varieties e.g. loose bunch structure

Fungicides as apart of an IPM program
- An anti-resistance strategy
Latest information on what you can apply and when

- AWRI web site

  (Click on resistance management)
Fungicide Resistance Management Strategies
Developed by the CropLife Australia Fungicide Resistance Management Review Group and industry researchers
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CropLife Web site
http://www.croplifeaustralia.org.au

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

Resistance Management Strategy for:

- Group 4 (Phenylamide);
- Group 11 (Quinone outside Inhibitor); and
- Group 40 (Dimethomorph) fungicides

1. Start disease control sprays when the vine shoots are approximately 20cm long and continue spraying at intervals of 7-21 days using a protectant or non-phenylamide fungicide.

Be informed and up to date –
An anti-resistance strategy

4. DO NOT apply more than three sprays per season of Group 11 fungicides. If two or three 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.
Thank you