

BE ALERT: Is fungicide resistance coming to your vineyard?



Suzanne McKay
Barbara Hall
SARDI

Why do you think you may have resistance?

- Fungicide not working

Possible causes?

- Coverage
- Fungicide choice
- Correct rate
- Application timing
- Resistance

What is fungicide resistance?

Resistance = a stable, heritable trait that results in a reduction in sensitivity to a fungicide by a fungus

Practical resistance = label rates of a fungicide no longer provide commercially acceptable control of a disease

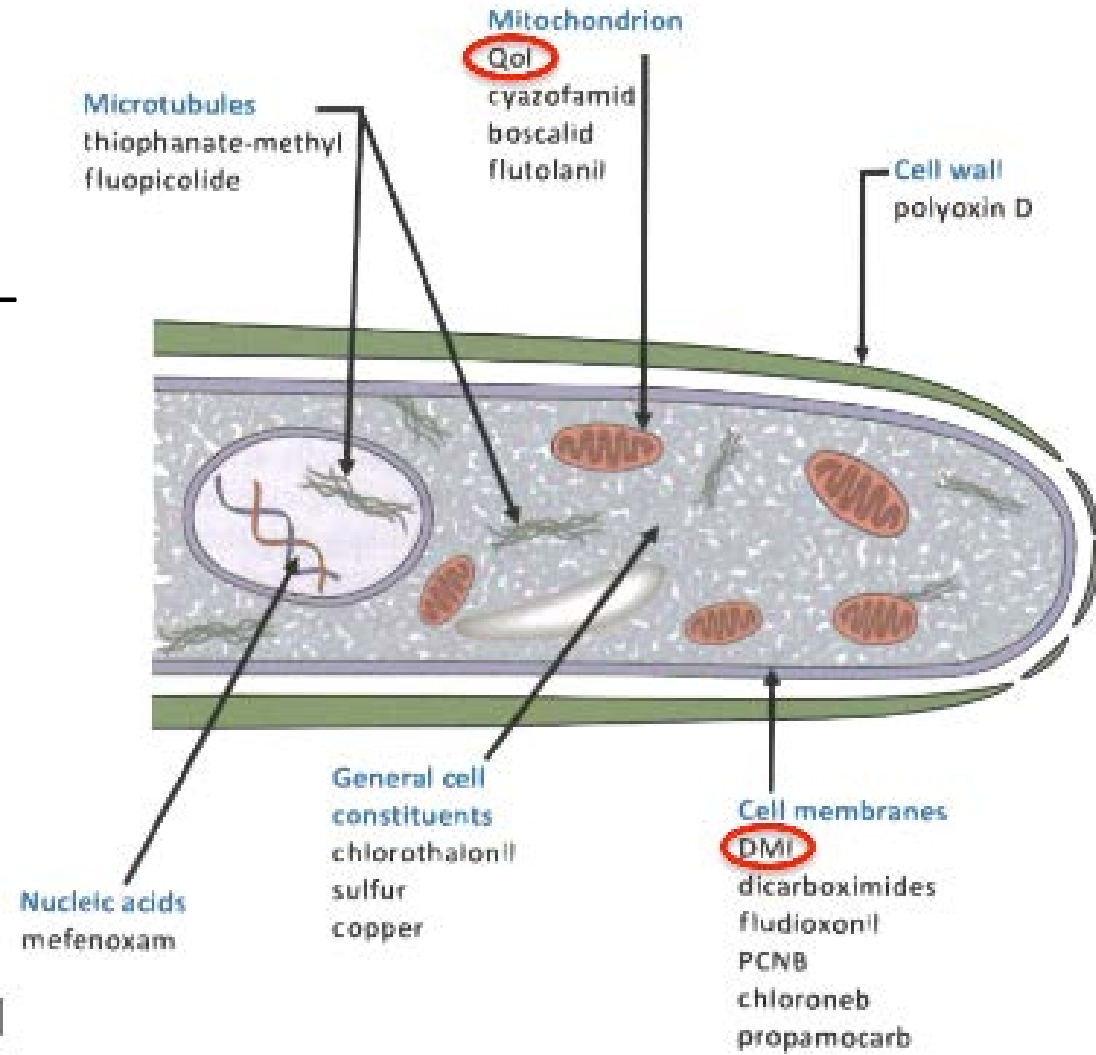
Time scale for development of resistance

- Mode of Action of fungicide
- Genetics of fungus- *target site*
- Fungus life cycle
 - generation time/reproduction*
- Fungicide applications
 - number*
 - timing*

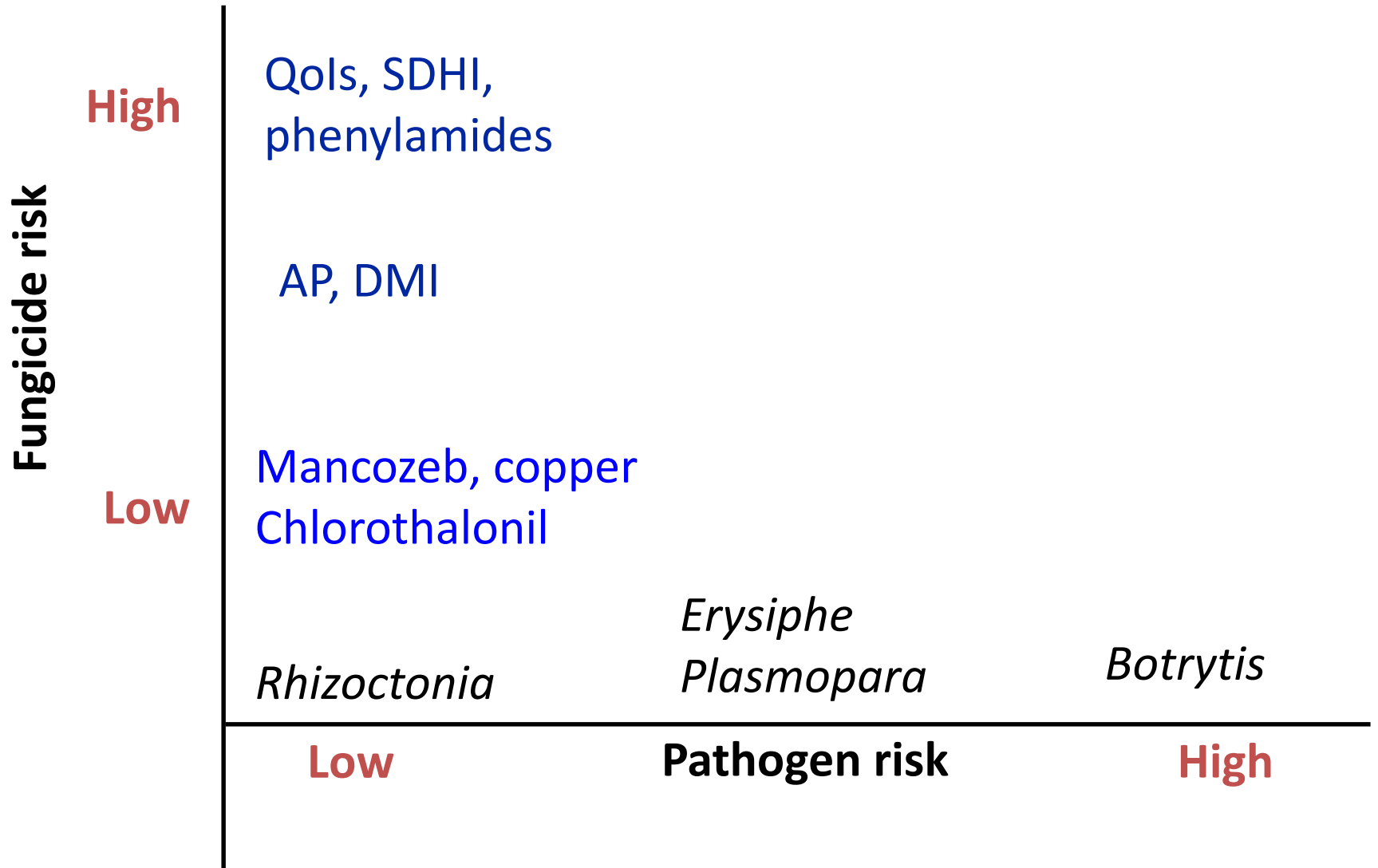
➤ **Difficult to predict development of resistance**

Mechanisms of resistance

Altered target site – prevents fungicide from accessing the target site




Fungicide / target site risk

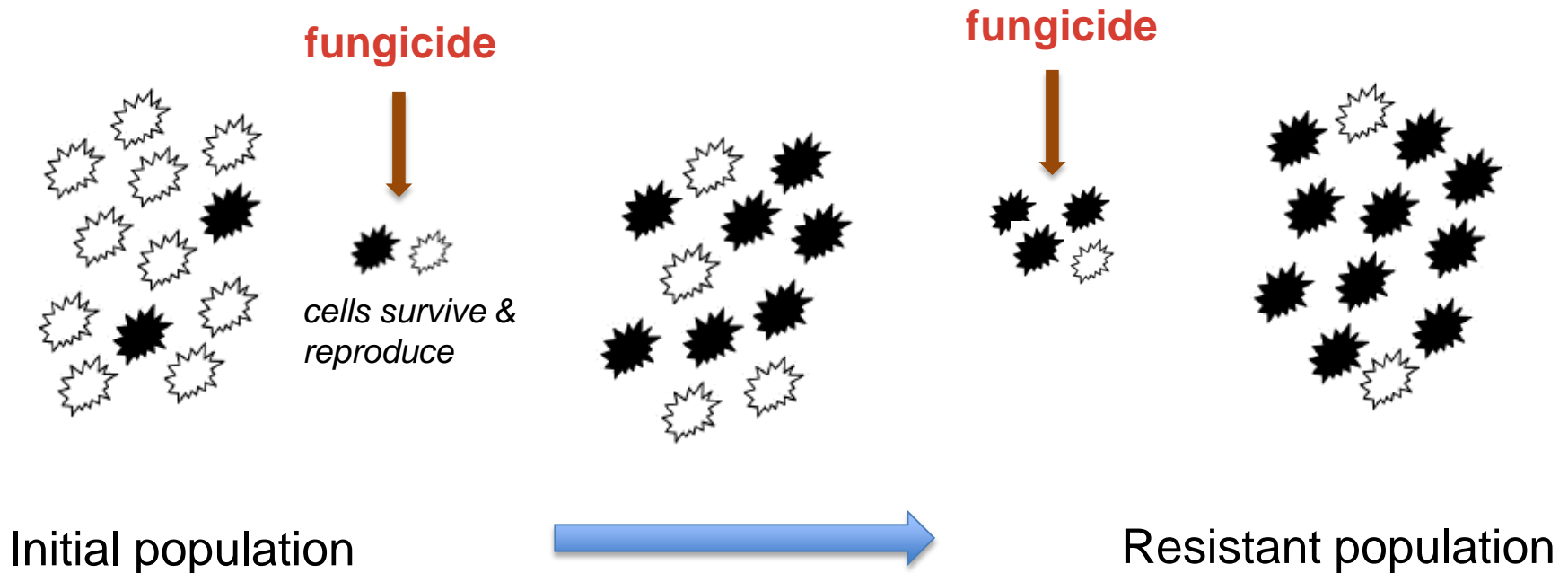


How does resistance develop?

DNA mutations affect fungicide activity

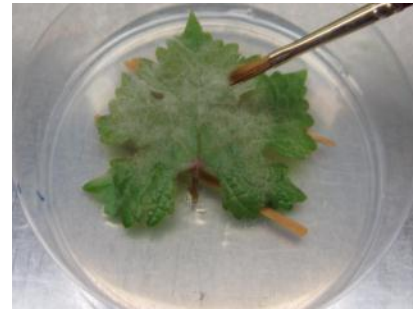
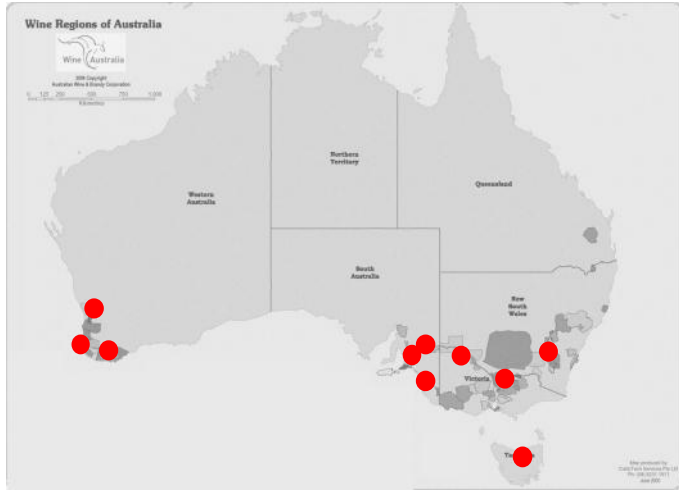
 Sensitive: no mutation

 Resistant: naturally occurring mutation

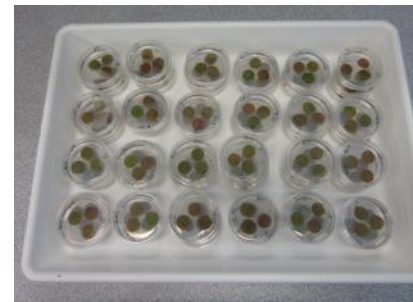


Testing for resistance

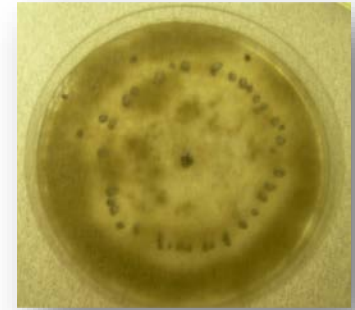
Methods



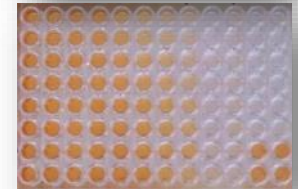
Powdery & downy



Lab tests for sensitivity



Botrytis



**Sensitive
OR
Resistant?**



DNA

- Adenine
- Thymine
- Cytosine
- Guanine
- Phosphate backbone


+

Detect mutation(s)

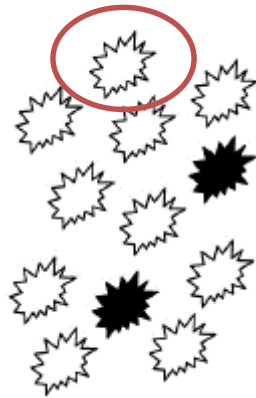
Caveat.....

Lab results on small numbers of samples cannot be directly equated to field performance

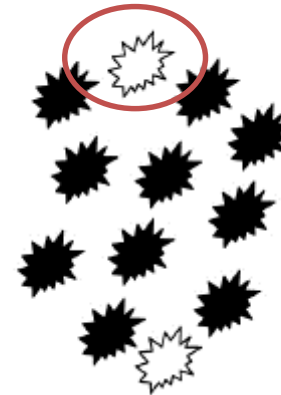
Resistance detection

 Sensitive: no mutation

 Resistant: naturally occurring mutation



Sensitive population



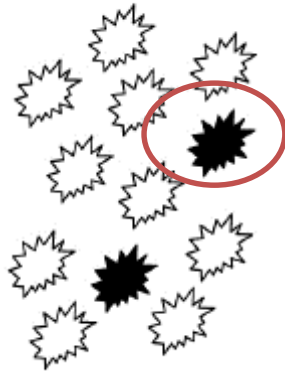
Resistant population

One test may only detect sensitive: not representative of population

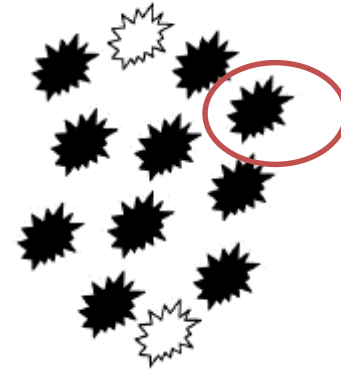
Resistance detection

 Sensitive: no mutation

 Resistant: naturally occurring mutation



Sensitive population



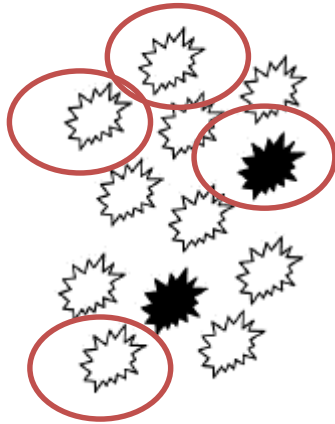
Resistant population

One test may only detect resistant: not representative of population

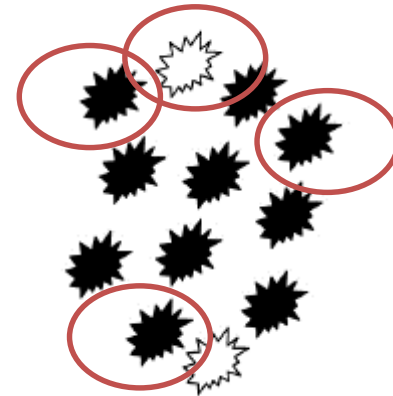
Resistance detection

 Sensitive: no mutation

 Resistant: naturally occurring mutation



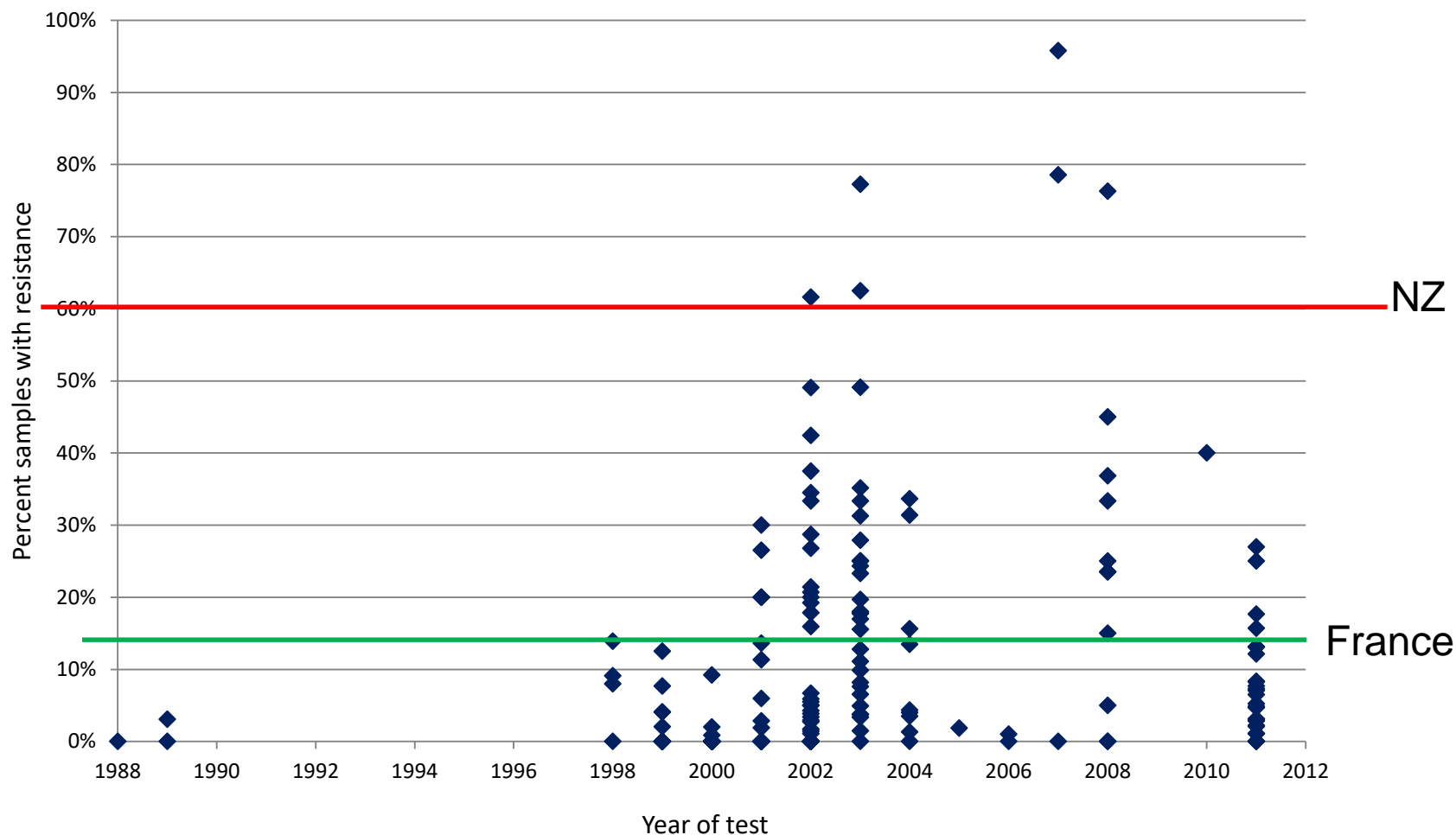
Sensitive population



Resistant population

Multiple tests are needed to be representative of population

Botrytis - dicarboximide



Results of where field performance is affected vary:

France: 15% of 100 bunches resistant, have reduced field performance

NZ suggest needs to be 60%

What's new with powdery mildew?

- Testing of Talendo
 - Field trial with apparent failure : possibility of reduced sensitivity but unlikely to be resistant
 - Also tested against Legend – all sensitive
- SDHI base line testing (commercial) – all sensitive

Powdery mildew fungicides

FRAC group	Activity group	Product examples	Active ingredient
QoIs (Quinone outside Inhibitors)	11	Amistar® Cabrio® Flint®	azoxystrobin pyraclostrobin trifloxystrobin
Demethylation Inhibitors -DMIs	3	Topas® Mycloss® Domark® Bayfidan® Triadimefon® Digger® Viva® Orius®, Folicur®	penconazole myclobutanil tetraconazole triadimenol triadimefon difenoconazole* hexaconazole tebuconazole
Morpholines, SBI Class II	5	Prosper®	spiroxamine
SDHI*	7	Filan® coded product	boscalid -
Aza-naphthalenes*	13	Legend® Talendo®	quinoxifen* proquinazid
Phenyl-acetamide	U6	Flute®	cyflufenamid
Aryl-phenyl-ketone	U8	Vivando® Kusabi®	metrafenone pyriofenone

Red = resistance detected or assumed

Green = not detected

Black = not tested

Purple = possible - more testing needed

* Limited samples tested

What's new with downy mildew?

Yarra Valley: metalaxyl and pyraclostrobin resistance confirmed (including in abandoned vineyard)

King Valley: metalaxyl resistance confirmed, pyraclostrobin not detected but two samples slightly higher EC_{50}

Hunter Valley: metalaxyl resistance confirmed, pyraclostrobin suspected

More work will start 2019/20 with additional funding from WA

Metalaxyl resistant isolates wanted for AWRI work

Downy mildew- fungicides

FRAC group	Activity group	Product examples	Active ingredient
PhenylAmides	4	Ridomil®	metalaxyl
QoIs (Quinone outside Inhibitors)	11	Amistar® Cabrio®	azoxystrobin pyraclostrobin
Carboxylic acid amides	40	Acrobat® Revus®*	dimethomorph mandipropamid*
Phosphonates	33	Aliette® Foli-R-Fos®	fosetyl-aluminium phosphorous acid

Red = resistance detected or assumed

Green = not detected

Black = not tested

Purple = possible - more testing needed

* Limited samples tested

What's new with Botrytis?

- Retesting fludioxonil with lower discriminatory dose – have found some potentially less sensitive isolates
- SDHI base line testing (commercial) – all sensitive

Botrytis fungicides

FRAC group	Activity group	Product examples	Active ingredient
Dicarboximides	2	Rovral®	iprodione
SDHI	7	Filan® coded new product* coded new product	boscalid - -
Anilino-Pyrimidines	9	Scala® Solaris®, Switch®	pyrimethanil cyprodonil
Qols	11	Amistar®	azoxystrobin
PhenylPyrroles	12	Switch®	fludioxonil
SBI Class III	17	Teldor® Prolectus®	fenhexamid fenpyrazamine

Red = resistance detected

Green = not detected

Black = not tested

Purple = possible - more testing needed

* Initial showed suspect resistance, repeat testing showed not resistant, but less susceptible

Where are we now with testing?

Botrytis:

- Relationship between lab test and field performance known for older fungicides
- Good relationship between phenotypic and genotypic tests
- Potential for in field testing eg LAMP assays, dPCR
- Commercial testing available (plate assays)

Powdery mildew:

- Phenotypic tests work but laborious and sample size needed unknown
- Relationship between phenotypic and genotypic tests not clear
- Commercial testing not available

Downy mildew:

- Phenotypic tests work but consistency of results an issue
- Metalaxyl has no known mutation
- Commercial testing not available

Manage poor performance

- Good coverage
- Fungicide choice
 - Correct rate
 - Timing
- Manage resistance risk

Managing resistance risk

Always follow resistance management guidelines

Rotate or mix different modes of action

Use label rates

Limit total number of applications per fungicide group

Educate yourself about fungicide activity, modes of action, resistance groups & management practices

Start a fungicide program with a multi-site MOA to reduce populations – **DO NOT** use single-site MOA to control well-established infections



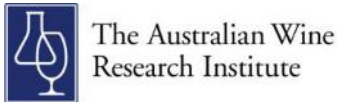
Agrochemicals registered for use in Australian viticulture
AN EQUINOX AGROCHEMICALS AUSTRALIA
18/19



Thanks to Wine Australia, growers & viticulturists



Project team & industry collaborators



Industry reference group



Vitisolutions



SARDI