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Table Grape Information Day, Kronenburg, 19 Aug 2022

Powdery mildew management in grapes



Francois Halleen and Minette Havenga

Grapevine powdery mildew (witroes)

Eryisphe necator

Obligate biotroph (verpligte patogeen)

Require green tissue to survive

Leaves

Canes

Berries

Huge economic losses

Lower quality and quantity of grapes

Cost associated with fungicides

Leaf symptoms

Young leaves are distorted

Initially, yellow to green blotches

Ash-grey to white powder

Asexual conidial spores

Source: Jones et al. (2014)

Cane symptoms

Oily grey blotches on green shoots

Red-brown to black patches

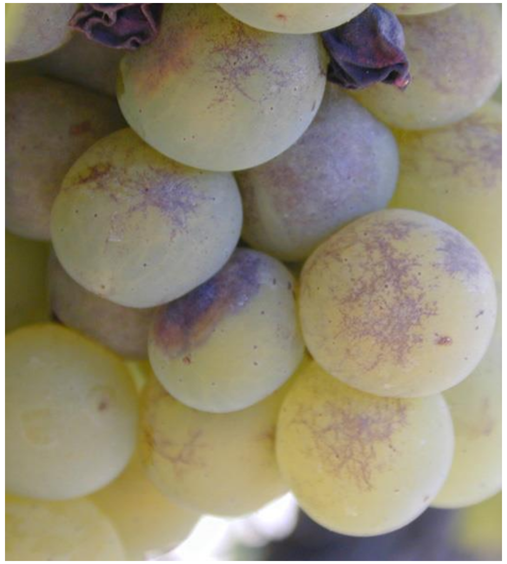
Mature irregularly

Shoots are stunted and dieback

Berry symptoms

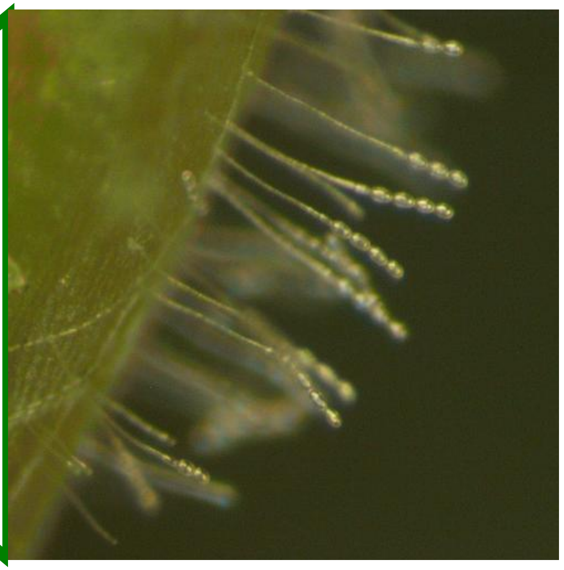
Young berries

Scarred



Cracked

Asexual conidia



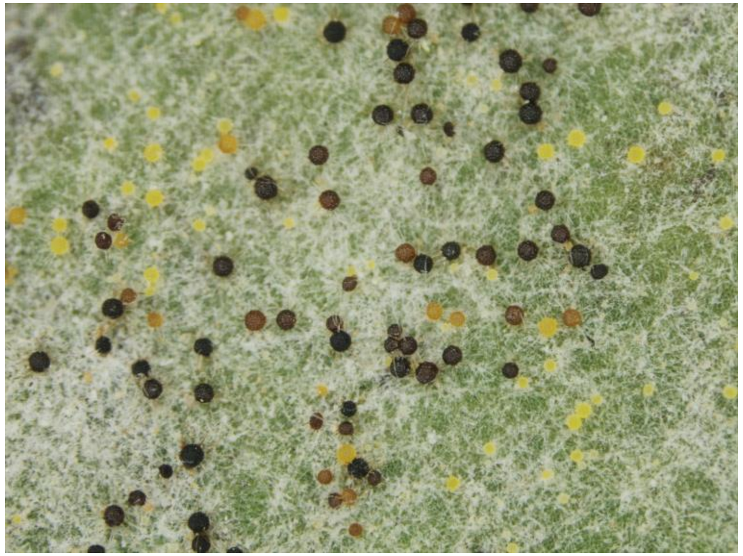
Source:
https://www.agric.wa.gov.au/table-grapes/powdery-mildew-grapevines-western-Australia

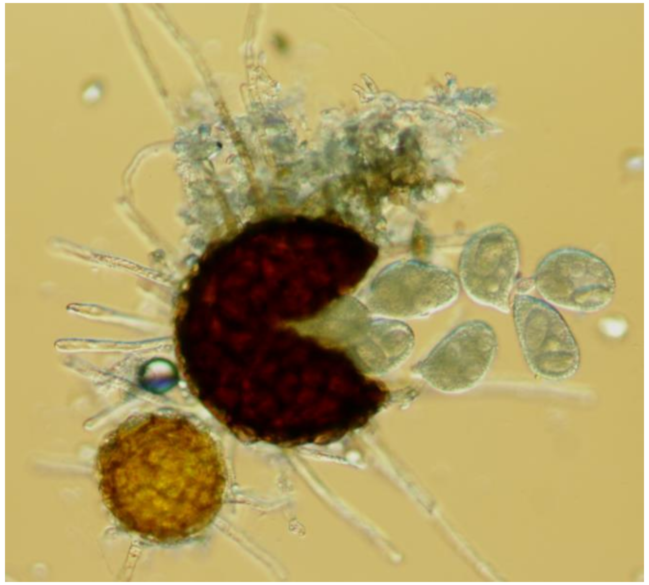
Two phases

Asexual

Source: Jones et al. (2014)

Sexual





Asexual phase

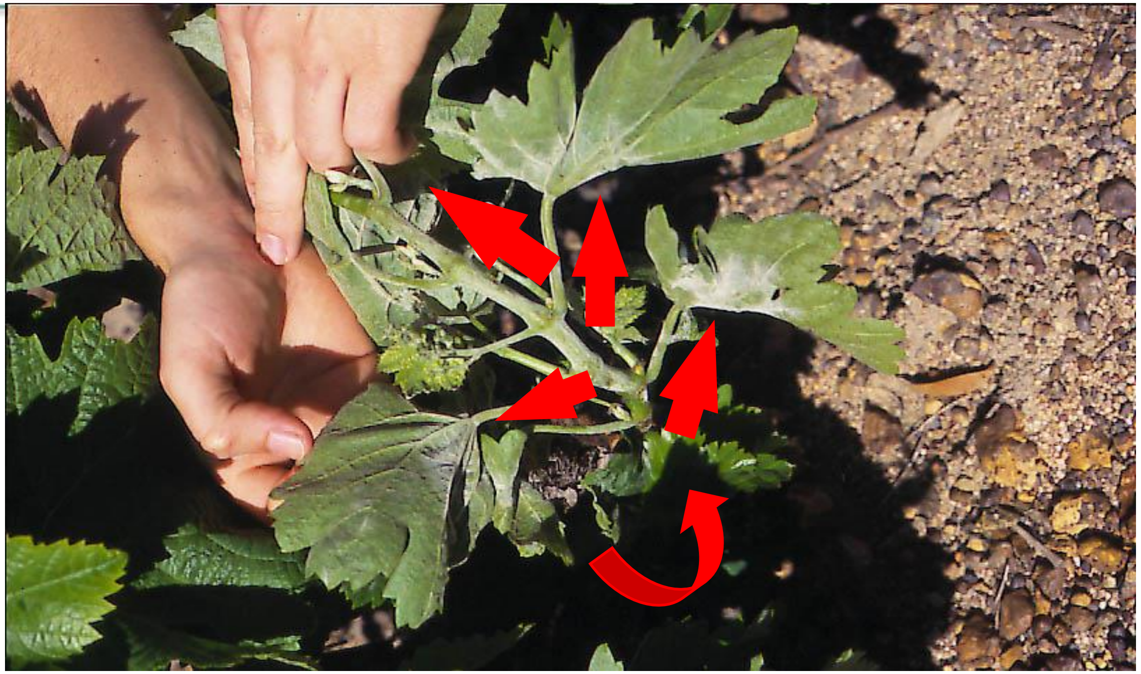
Overwinter in buds

Activated during bud break

Infection early in the season

Grow with shoots – result in flag shoot

Produce a mass of spores



Spores appear under the leaf

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Sexual structure

Two individuals of opposite mating types

Autumn – wash to trunk

Form overwintering chasmothecia (previously known as cleistothecia)

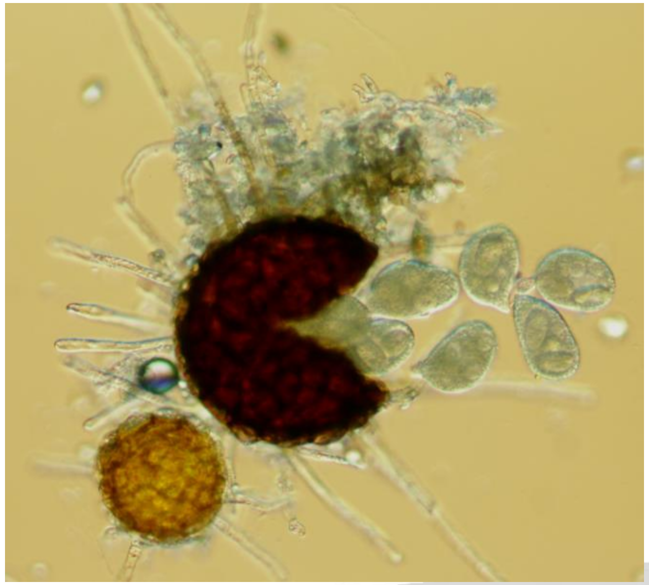
Spring – burst open after 2.5 mm rain

Immature:

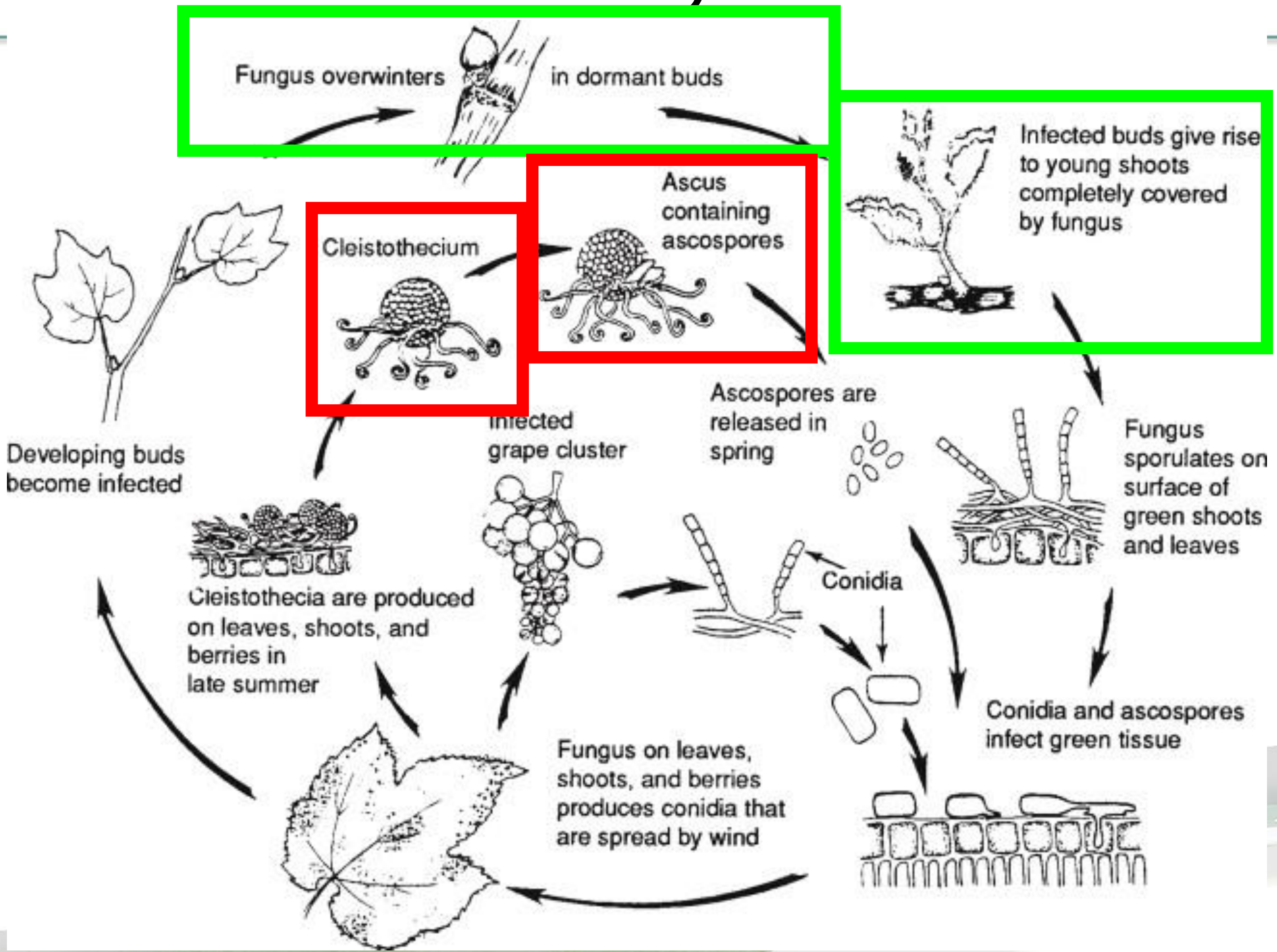
Susceptible to fungicides

Mature:

Dormant overwintering structure for survival



Life cycle



Drawing by R. Sticht (Kohlage), from Pearson and Goheen, 1988

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Life cycle - unknowns

When chasmothecia matures become resistant

Up to what period will fungicides be effective?

Will a post-harvest application reduce inoculum?

Where chasmothecia overwinters (bark or leaf litter)

<u>Australia</u> – leaf litter is an important inoculum source

<u>Europe</u> – colder region, leaf litter decomposed by bud break

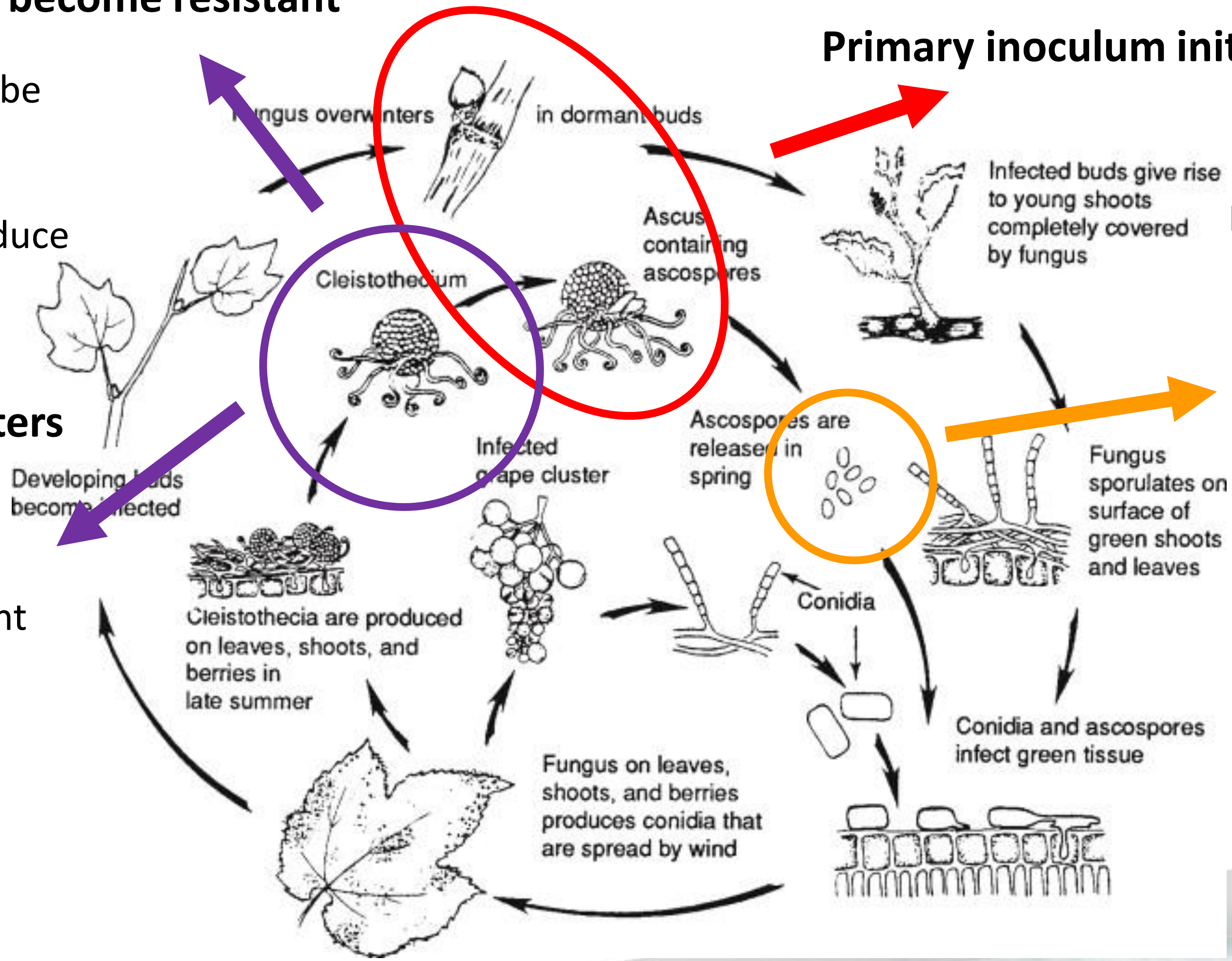
Primary inoculum initial infection: asexual or sexual?

Different environmental conditions

Disease models cannot be calibrated

When ascospores are released

Indication on first spray application



Drawing by R. Sticht (Kohlage), from Pearson and Goheen, 1988

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1999 to now

1996-1999

A few immature chasmothecia

- One or two per 100 leaves in three vineyards

Now

Large numbers of chasmothecia

- Several thousand per leaf on almost all powdery mildew infected leaves
- Stellenbosch, Paarl, Franschhoek, Somerset West, Grabouw, Hermanus, Constantia and Durbanville

In Austria similar observation from 1990 – 2021

(Steinkellner, 1998); (Redl et al., 2021)

Climate change drives survival and viability of ascospores

Practical impact on management

Linked to reduced fungicide sensitivity

Pathogen can spread further throughout the vineyard compared to flag shoots

Reference: Halleen and Holt (2000) *South African Journal of Enology and Viticulture* 21: 66-68

Reference: Halleen et al. (2016) *SASEV conference poster*

Sexual reproduction is concerning

- Sexual reproduction leads to genetically unique individuals
- Shift in fungicide sensitivity against several actives are suspected
- The level of reduced sensitivity is unknown

Examples of fungicide sensitivity shifts:

South Africa (Halleen *et al*., 2001) – DMI
Australia (Scott, 2020) – DMI
USA (Miles et al., 2012; Baudoin et al., 2008) - QoI
Chile (Frenkel et al., 2015) – QoI
Europe (Frenkel et al., 2011) - QoI

How could these studies assess this?

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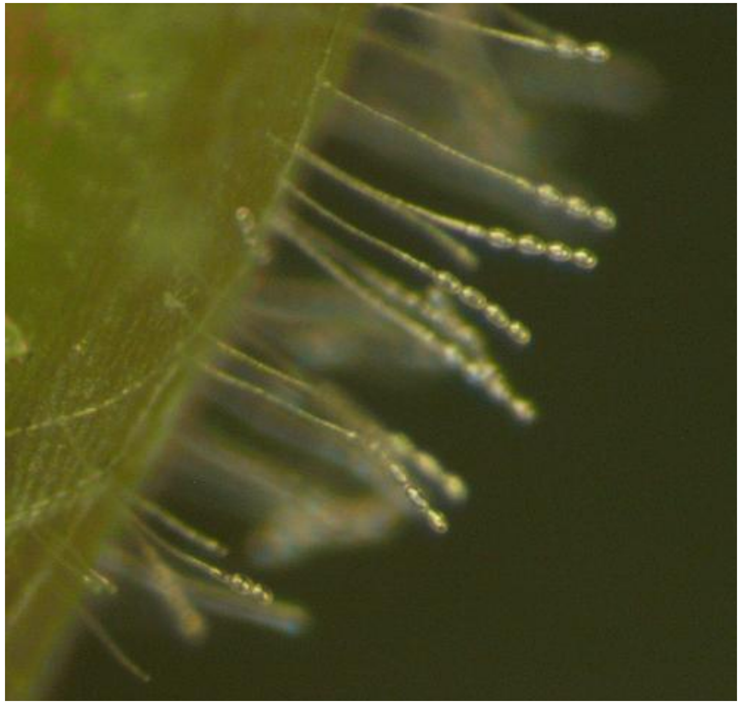
Challenges working with this fungus

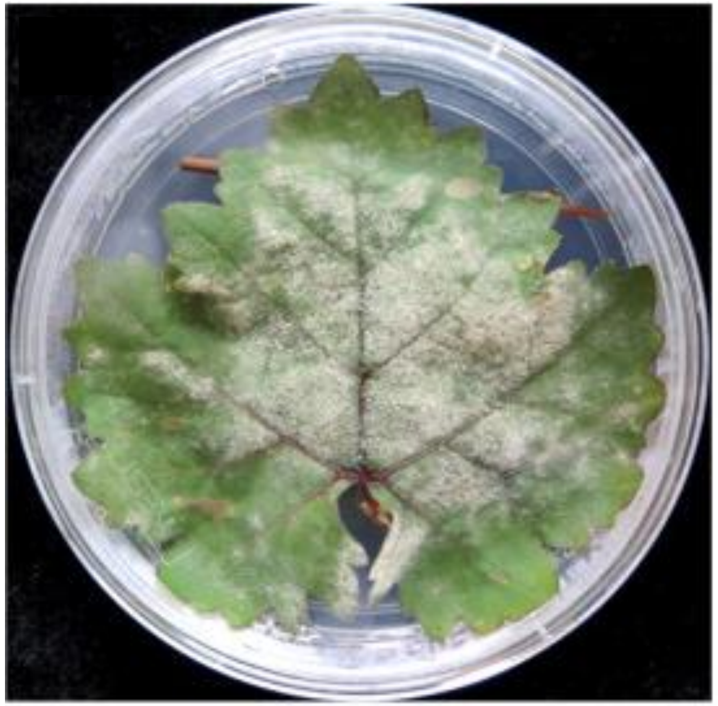
Cannot use standard laboratory protocols to grow, maintain or store the fungus

Single conidia chain transfer



Source: https://www.agric.wa.gov.au/table-grapes/powdery-mildew-grapevines-western-Australia

Detached leaf on water agar



Source: Gao et al. (2016)

Harvest and store fungal material

Reference: Evans et al. (1996) *Mycological Research* 100: 675-680

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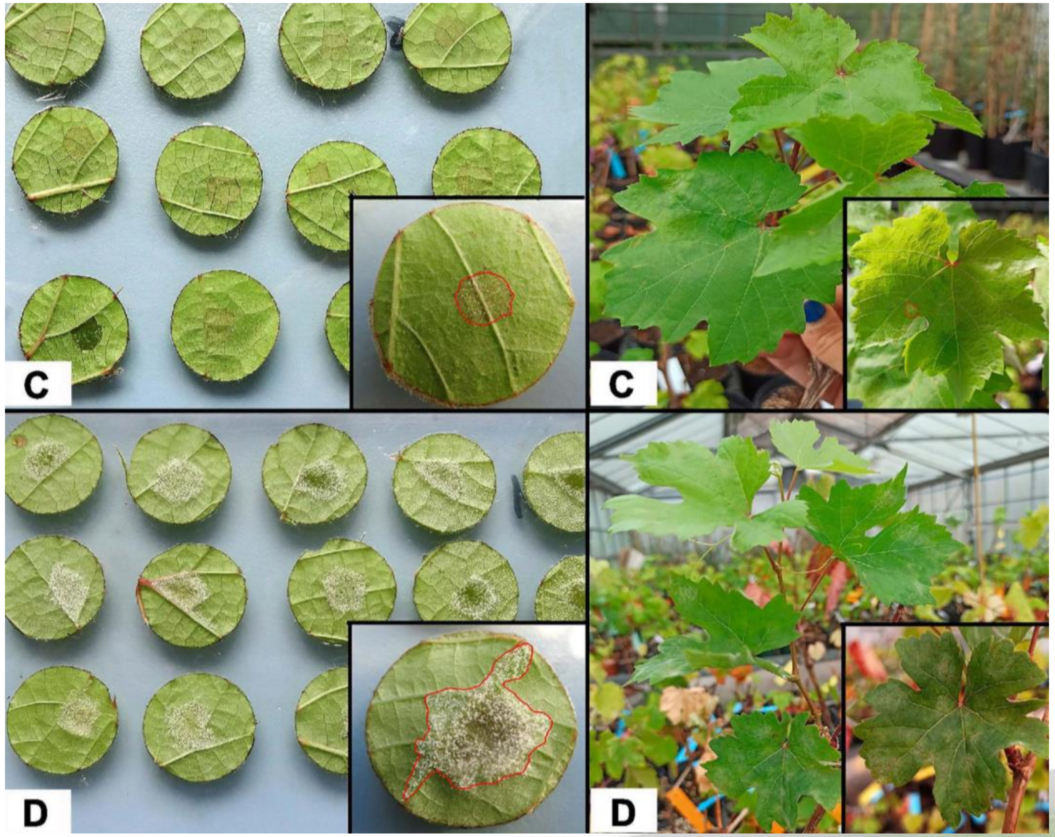
Reduced fungicide sensitivity

Efficacy of fungicides/ level of aggressiveness of isolates



Source: Ruiz-Garcia et al. (2021)

Level of reduced fungicide sensitivity

<u>Molecular techniques (qPCR):</u>

Identify point mutation

QoI

DMI

SDHI

Management - fungicides

Repeated and extensive fungicide application

Bud break to pea size stage - susceptible

Registered active in South Africa

FRAC	Group name	Active
1	MBC	benomyl
3	DMI	difenoconazole, flusilazole, flutriafol, hexaconazole, myclobutanil, penconazole, tebuconazole, triadimenol
5	Amines	spiroxamine
7	SDHI	boscalid, fluopyram, pydiflumetofen
11	QoI	azoxystrobin, pyraclostrobin, trifloxystrobin, kesoxum-methyl
13	quinolines	quinoxyfen
29	uncoupler of oxidative phosphorylation	meptyldinocap
M1	inorganic	copper ammonium acetate, cuprous oxide
M2	inorganic	sulphur

Risk to become less sensitive to fungicides

Pressure from EU to reduce fungicide use

Management (biological / alternative / non-classified)

Registered products in South Africa

Ampelomyces quisqualis
Bacillus amyloliquefaciencs
Potassium bicarbonate [syn. Potassium hydrogen carbonate]
Borax [syn. Sodium tetraborate] + orange oil
Melaleuca alternifolia oil
Non-ionic surfactant + orange oil
Organic plant acids
Polysulphide sulphur [syn. Calcium polysulphide; lime sulphur]
Salicylic acid

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Conclusion

An urgent and critical re-assessment of primary inoculum in Western Cape vineyards is required

- do chasmothecia overwinter successfully? And where?
- how much does it contribute to initial infections
- when are ascospores released (is it correlated with budbreak and early growth)?
- ascospore release (environmental requirements) differ from country to country (Riedl *et al*., 2021), we need to study our own situation

The efficacy of post harvest applications to reduce chasmothecia formation and inoculum pressure must be determined

Conclusion

Fungicide sensitivity of the most important / widely used fungicide groups must be determined

Climate change !   ……..fungal pathogens also adapt …..be aware

- re-think spray programs (i.e. correlate with ascospore release)
- prediction models (ask whether model is "calibrated" according to the sexual or asexual phase, and why???)

More than ever critically IMPORTANT to follow the manufacturers recommendations