

Epidemiology and post-harvest management of the sexual state of *Erysiphe necator*

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Protea Hotel, Technopark, Stellenbosch
24 November 2025

Grapevine powdery mildew

Erysiphe necator

Huge economic losses in South Africa

Lower quality and quantity of grapes

Cost associated with fungicides

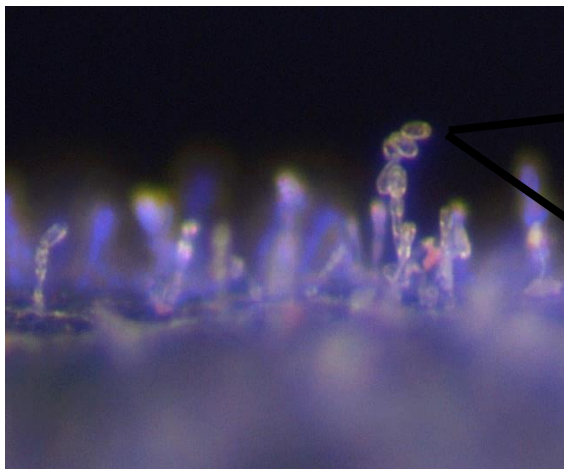
Obligate biotroph

Require green tissue to survive



Reproduction strategies

Asexual (Conidia)

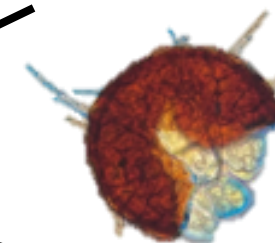


Flag shoot



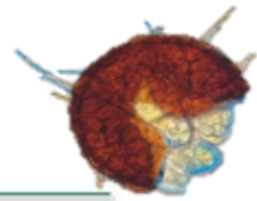
- Clonal
- Conidia **overwinter** in buds
- Give rise to **flag shoots** in **spring** during **bud break**
 - Deformed
 - Stunted: 5-15 cm
 - 3-8 weeks after bud break

Sexual (Chasmothecia)



- Dormant **overwintering structures** - Chasmothecia
- **Genetically unique individuals**
 - Allow organisms to adapt to changing environments
 - Associated with shifts in fungicide sensitivity

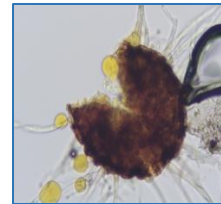
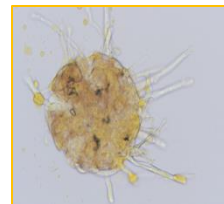
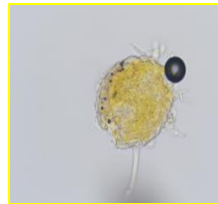
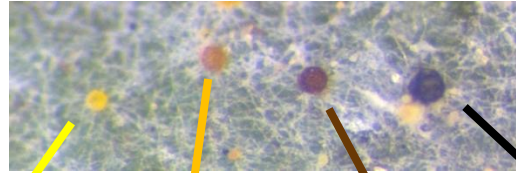
Chasmothecia incidence over time



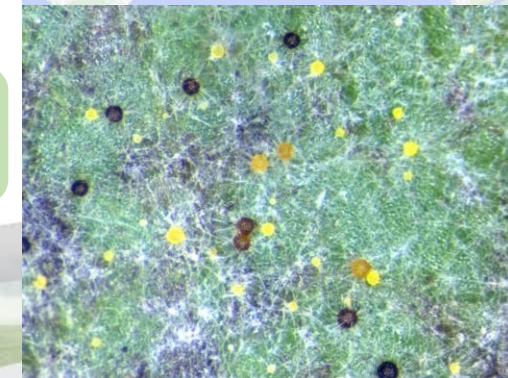
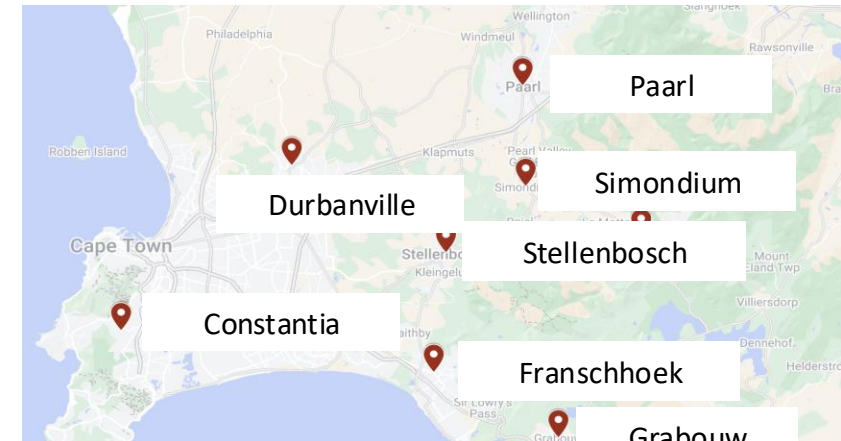
1996 – 1997 (Halleen & Holz, 2001)

2016

- 1-10 sexual structures per leaves
All immature
- Simondium and Stellenbosch
- Flag shoots in Carignane vineyard, Somerset West

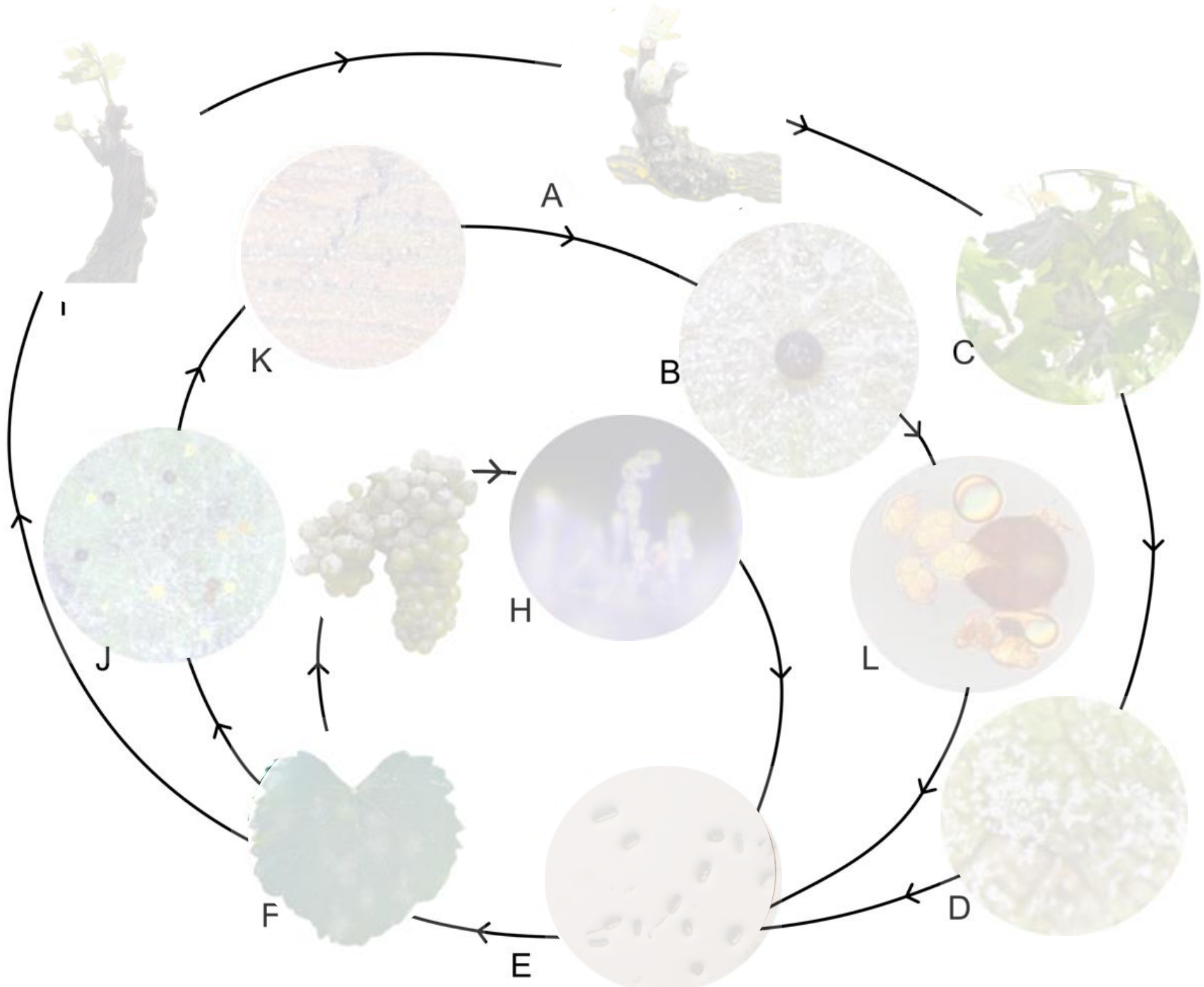


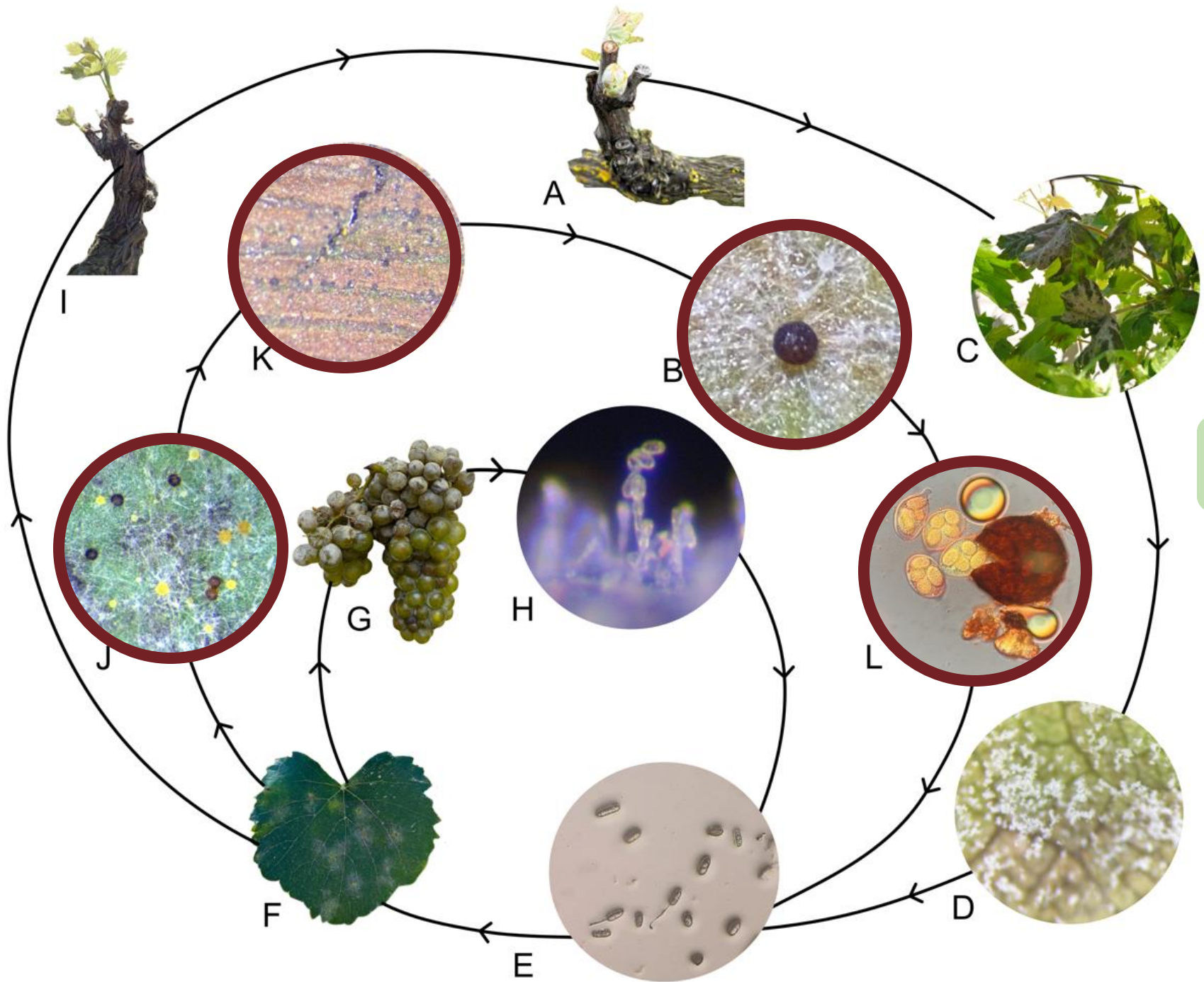
- 100s of sexual structures seen per leaf
All maturity stages



Source: F. Halleen

Control failure in South African vineyards despite well calculated spray programmes





Widespread occurrence of chasmothecia?

When do chasmothecia form and mature?

Where does chasmothecia overwinter?

When are ascospores released?

Can a post-harvest treatment control chasmothecia



AIM



Investigate the epidemiology of powdery mildew in South Africa and determine the effect of post-harvest treatments on chasmothecia



OBJECTIVE 1

Determine the wide-spread occurrence of chasmothecia in South Africa

Survey

-  Mature chasmothecia
-  Immature chasmothecia

Growing region:

- Berg river valley
- Breede river valley
- Cape South coast
- Coastal region
- Klein-Karoo region
- Olifants river
- Orange river region

Climate of regions:

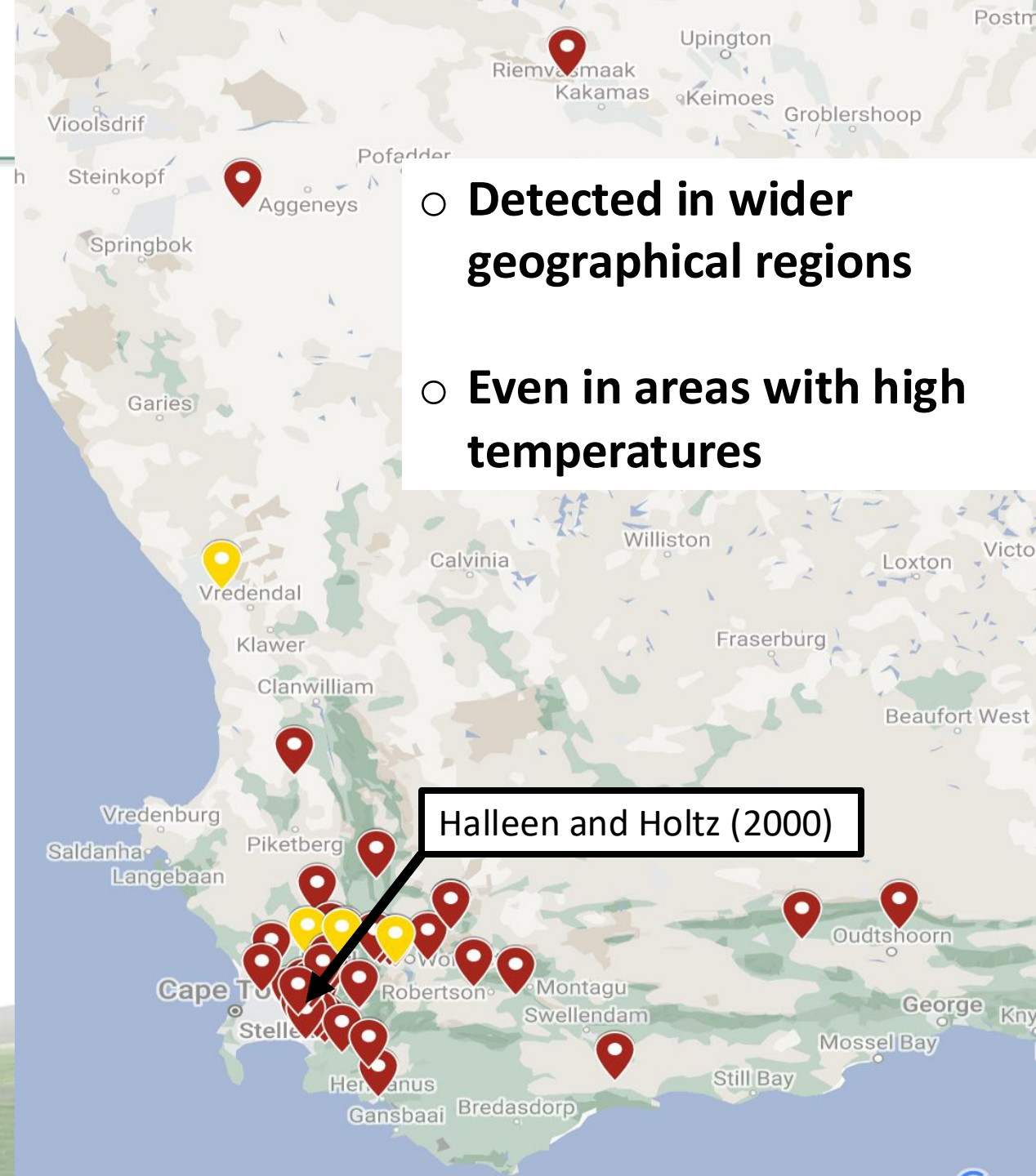
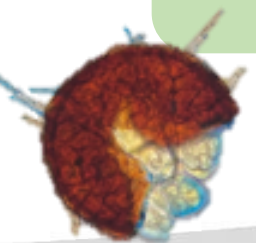
- BSk
- BWh
- BWk
- Cfa
- Csa
- Csb

- **105** vineyards sampled

Chasmothecia found – 72 vineyards

Hyphal growth limited $>32^{\circ}\text{C}$
No chasmothecia formation $>35^{\circ}\text{C}$
(Thiessen et al. (2019))

90.41% of vineyards: $>32^{\circ}\text{C}$
60.27% of vineyards: $>35^{\circ}\text{C}$



- **Detected in wider geographical regions**
- **Even in areas with high temperatures**



OBJECTIVE 2

Re-examining the epidemiology of grapevine powdery mildew over two seasons

Monitor epidemiology in four commercial vineyards

| Vineyard type | Area | Climatic region | Spray program |
|---------------|--------------|-----------------|------------------------|
| Table grapes | de Doorns | BSk | Conventional fungicide |
| Table grapes | Wellington | Csa | Conventional fungicide |
| Wine grapes | Stellenbosch | Csb | Biodynamic and organic |
| Wine grapes | Simondium | Csa | Conventional fungicide |

Post-harvest treatment

Two seasons

- Five vines per site
 - Every two weeks
- (March 2023 – Dec 2024)

5 Symptomatic leaves



5 g Bark



15 g Leaf litter



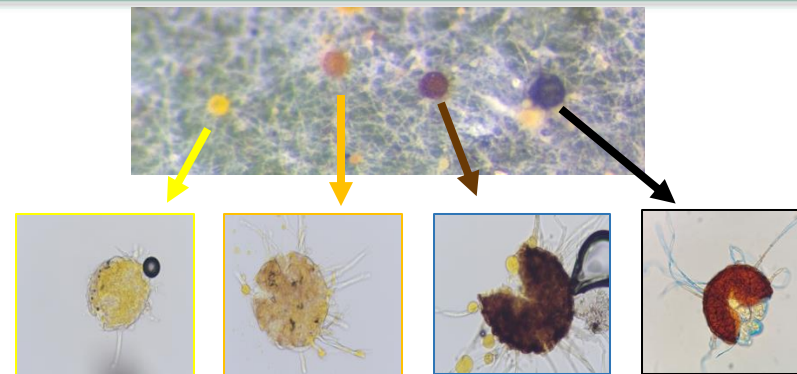
45 g Pruning debris



Monitor Epidemiology

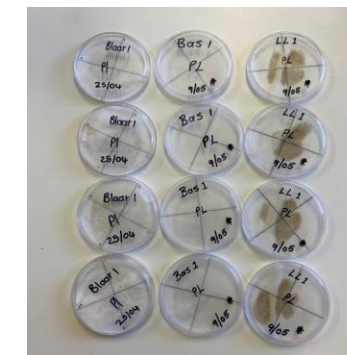
Colour stages on leaves over time

- 100 Randomly selected chasmothecia per leaf
- 500 Chasmothecia per vine



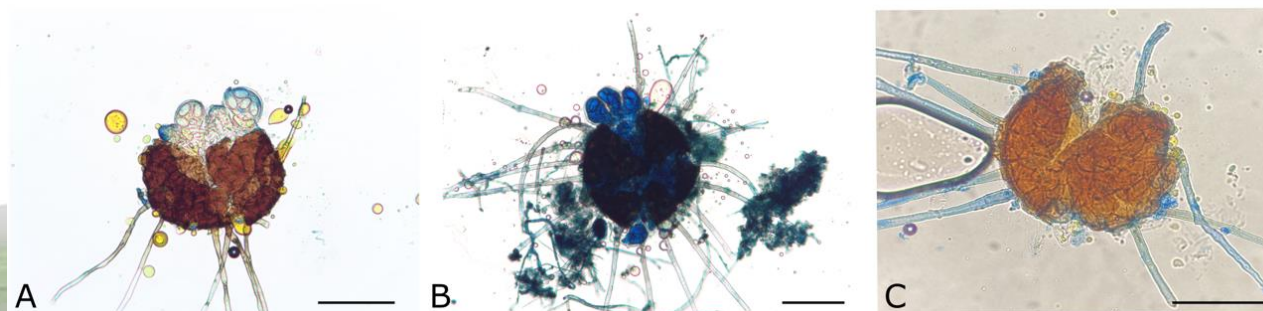
Harvested and counted mature chasmothecia Redl et al. (2021)

- Shake, filter, pipette
- Count number of mature (black) chasmothecia per 10 ml suspension



Tested viability

- 25 Chasmothecia per vineyard
- 0.4% Trypan Blue solution



Viable

Not viable

Empty

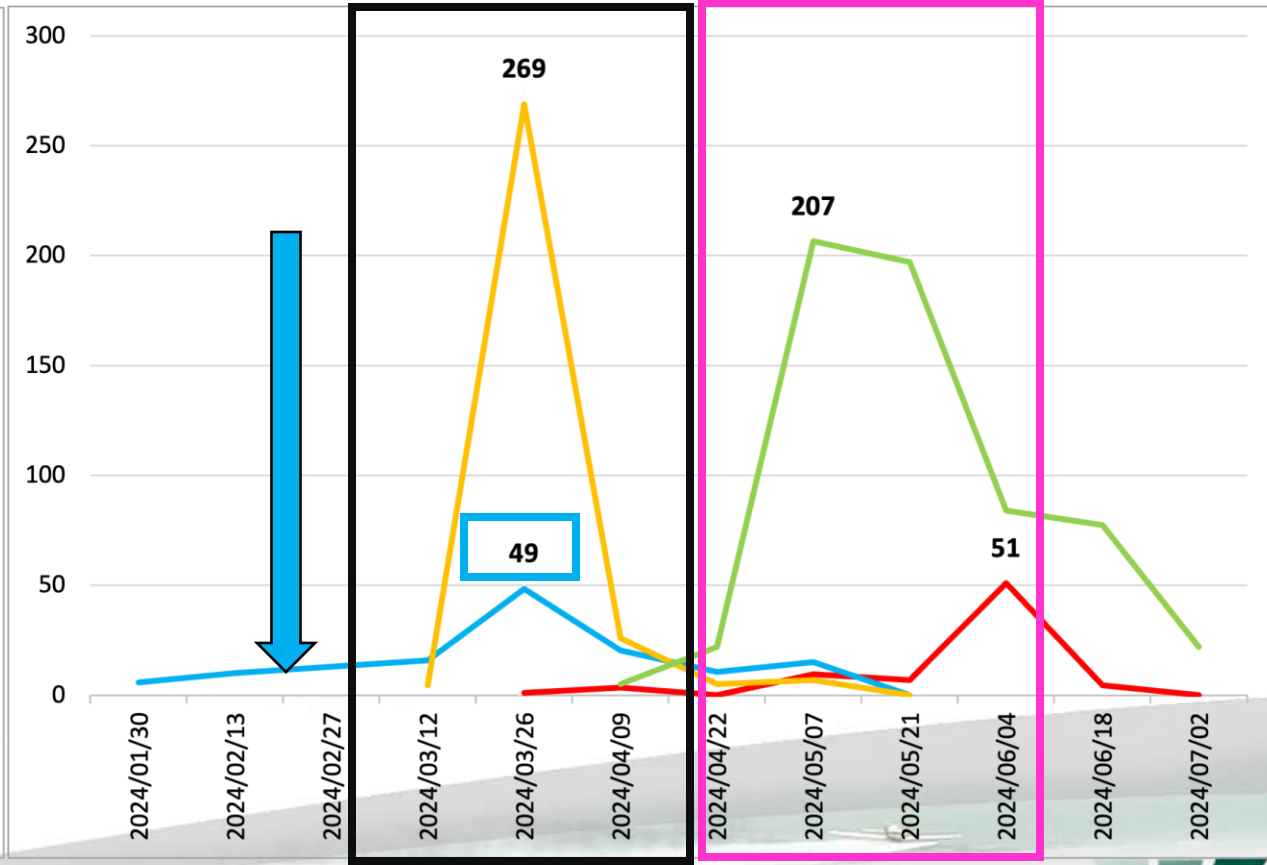
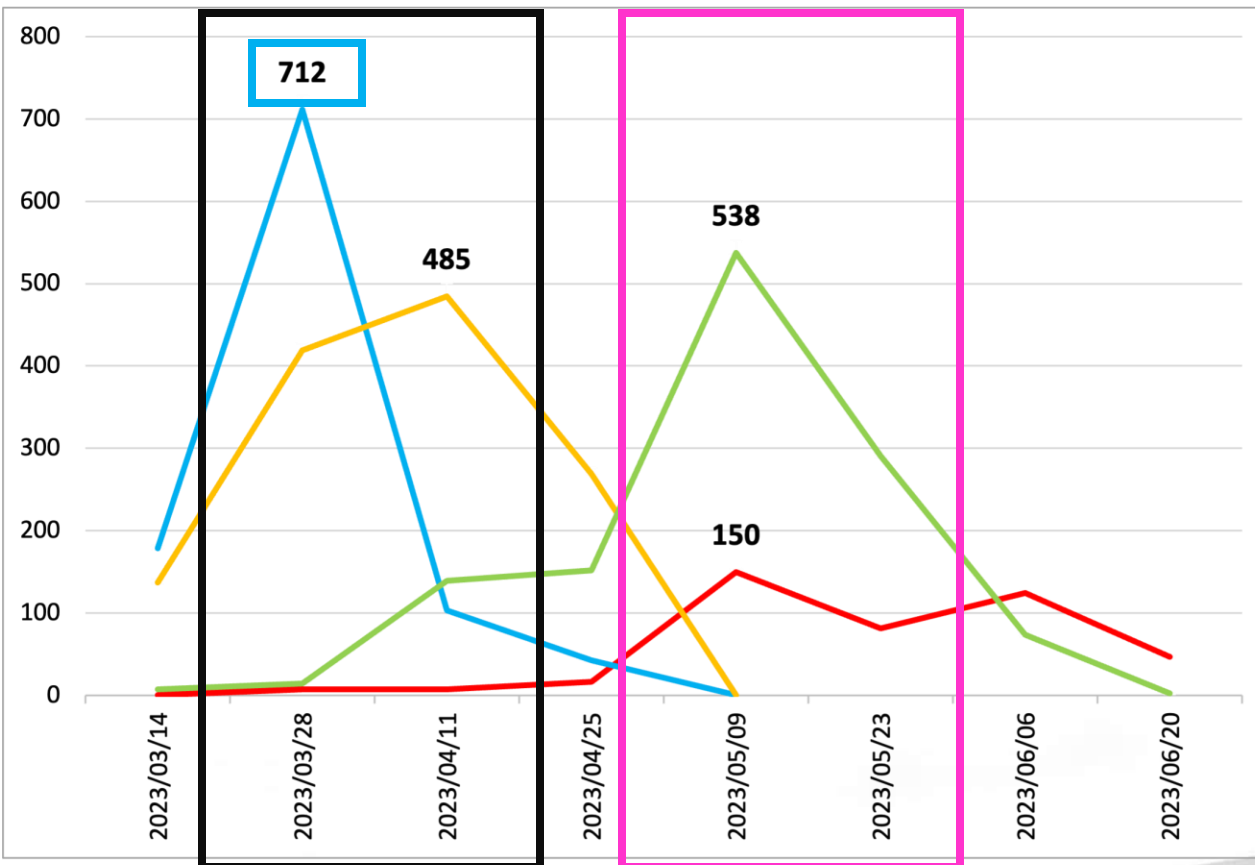
Mature chasmothecia per five leaves

Large numbers of mature chasmothecia found on leaves

Larger numbers in 2023

2023

2024



Stellenbosch (Wine)
Simondium (Wine)

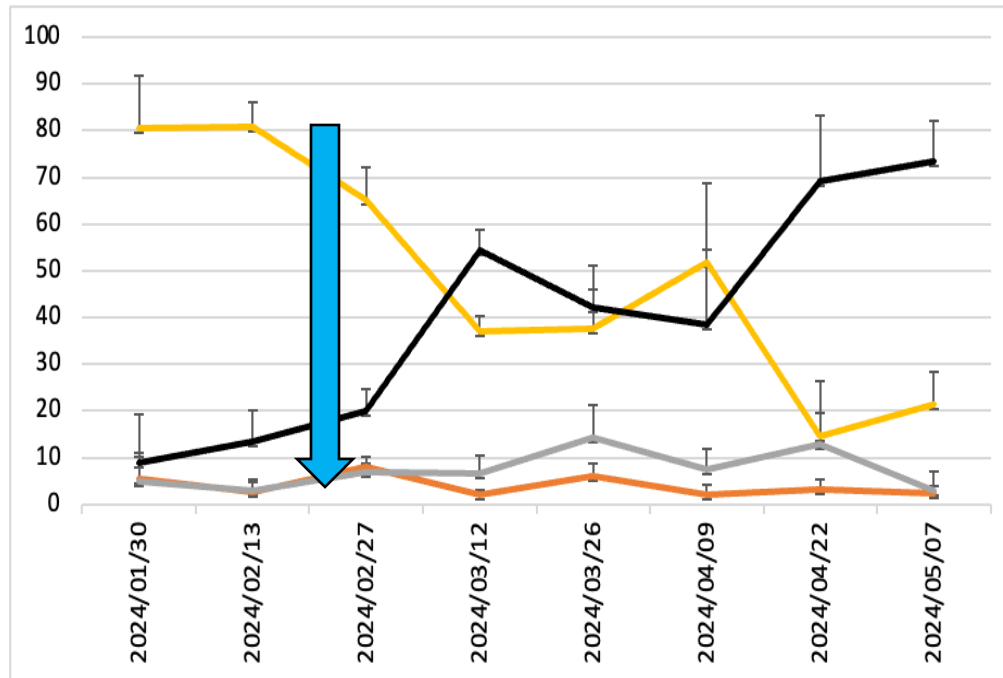
de Doorns (Table)
Wellington (Table)

Number of mature chasmothecia from 5 leaves

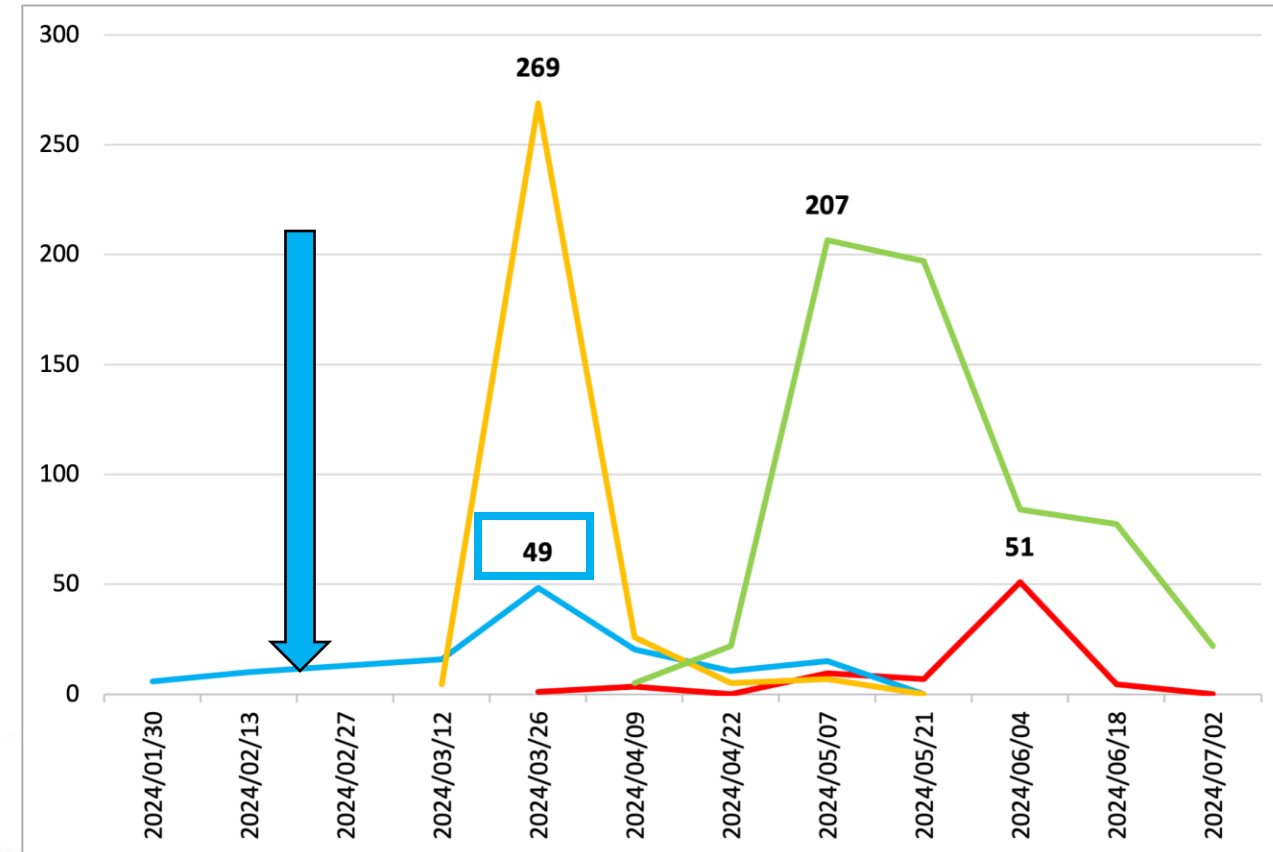
Yellow Orange Brown Black

2024

Percentage of each colour stage



Simondium

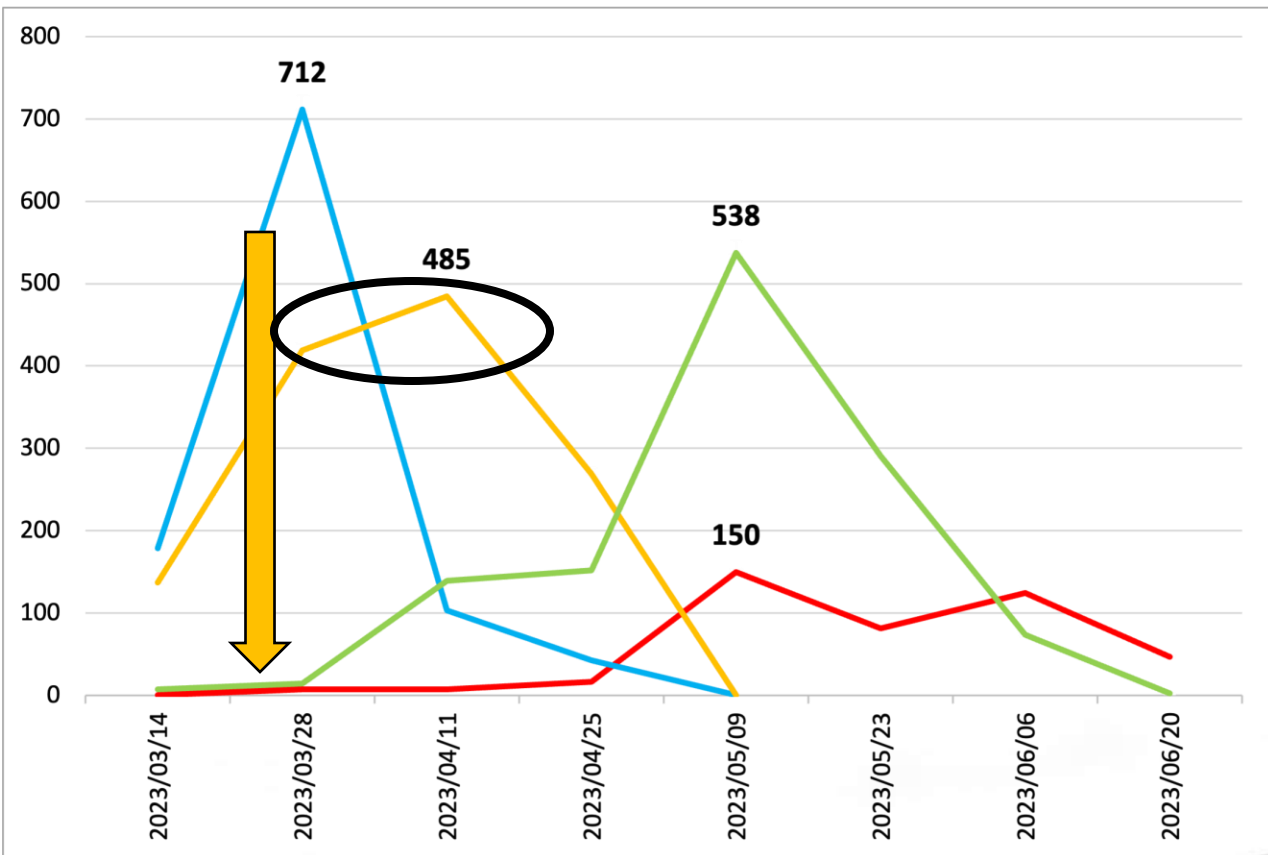


Simondium (Wine)

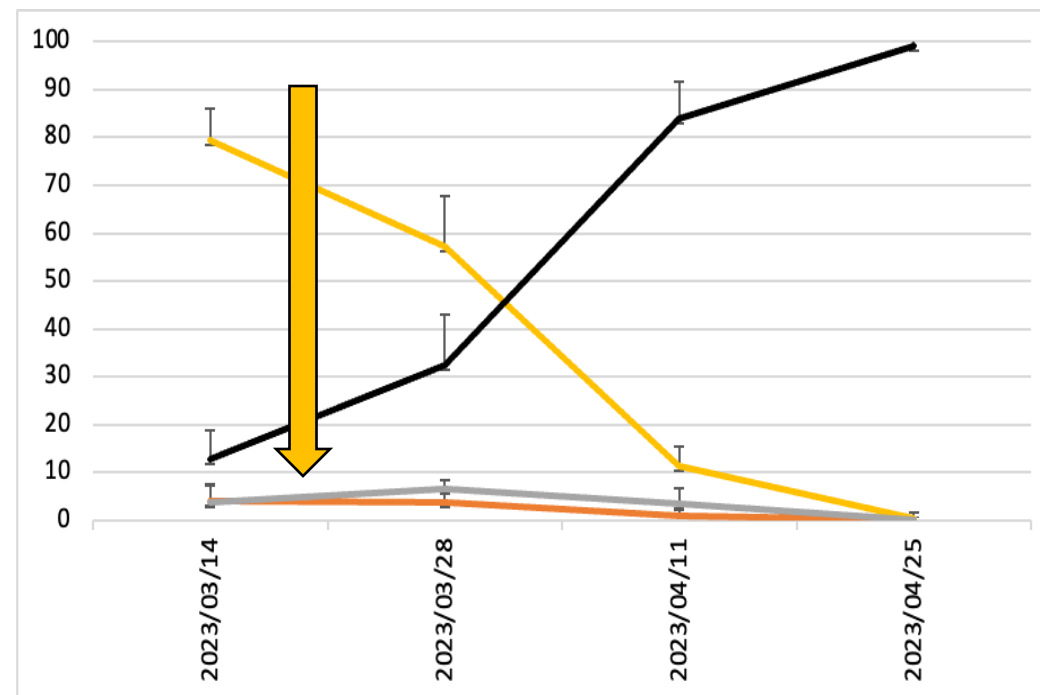
Number of mature chasmothecia from 5 leaves

2023

Yellow Orange Brown Black



Percentage of each colour stage



Stellenbosch (Wine)

Stellenbosch

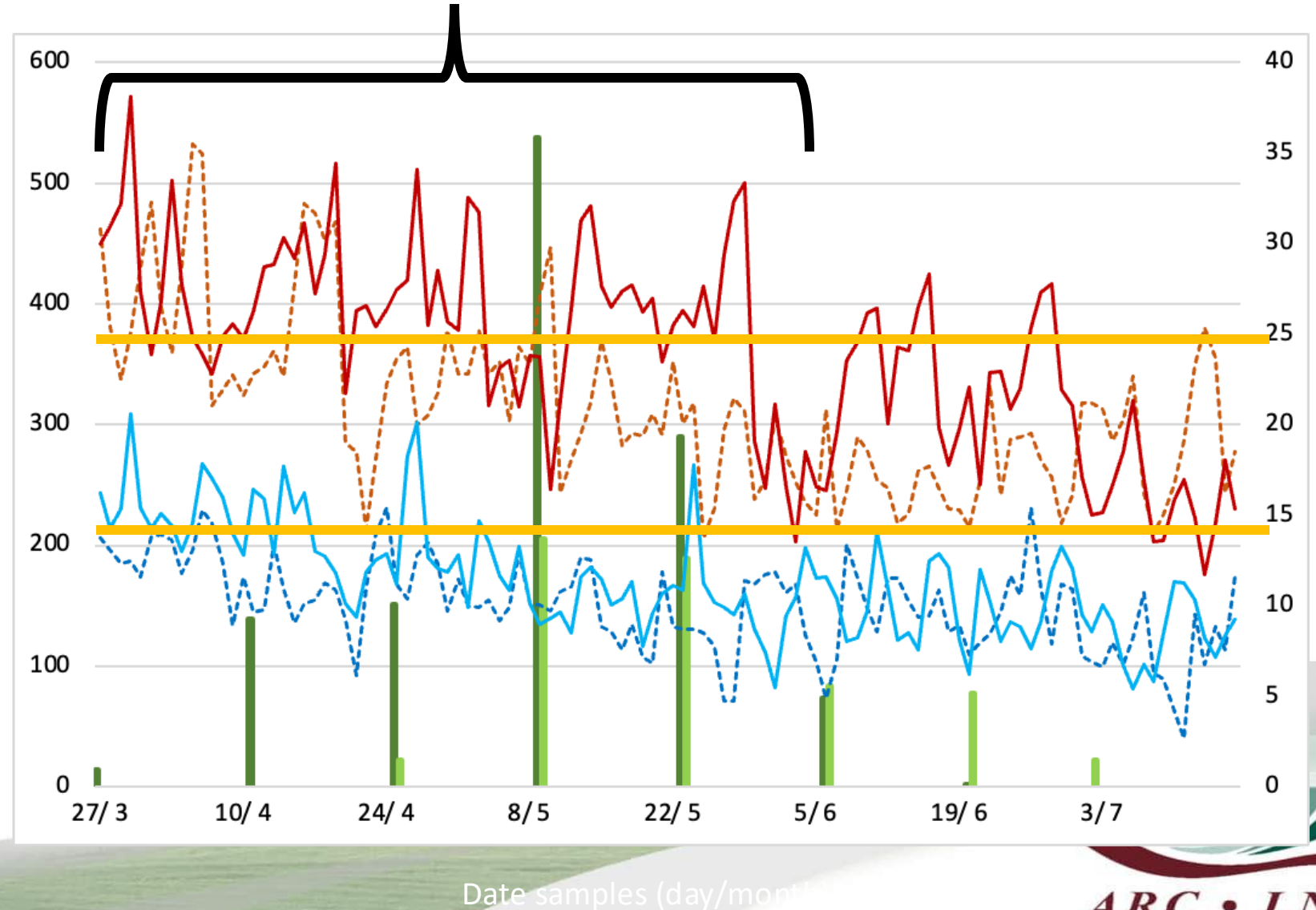
Temperature over two seasons

Wellington (Csa)

Optimal chasmothecia development
16°C – 25°C
(Thiessen et al. 2019)

Higher temperatures in 2024 –
exceed optimal temperature
range

- 2023 Chasmothecia
- 2024 Chasmothecia
- 2023 TMax
- 2023 TMin
- 2024 TMax
- 2024 TMin

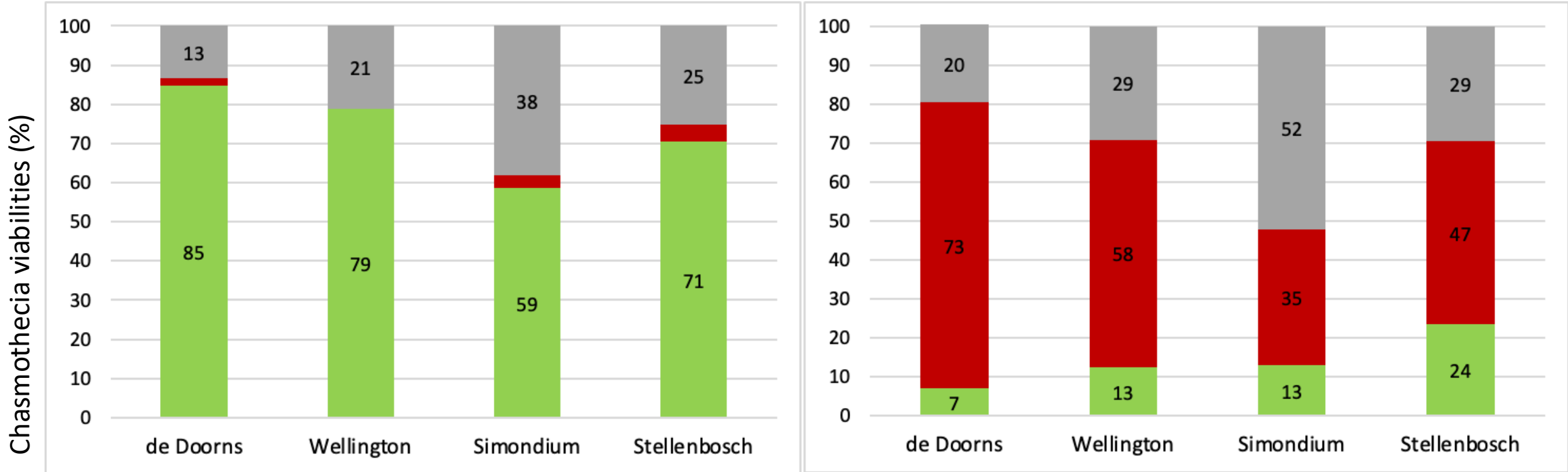


Date samples (day/month)

Viability chasmothecia (%)

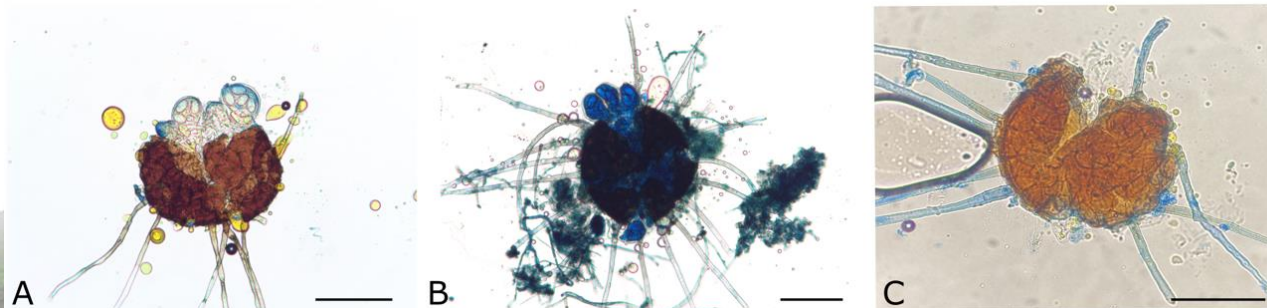
2023

2024



■ Viable
 ■ Not viable
 ■ Empty

Most were viable



Most were not viable or empty

Ascospore release pattern

Simondium vineyard

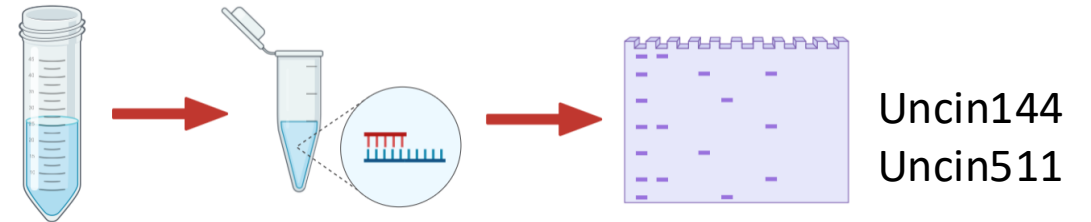
- 2 Vaseline-coated microscope slides per vine
- 5 vines = 10 slides
- Replaced weekly
- Start of leaf fall up to first signs of powdery mildew



Between leaves



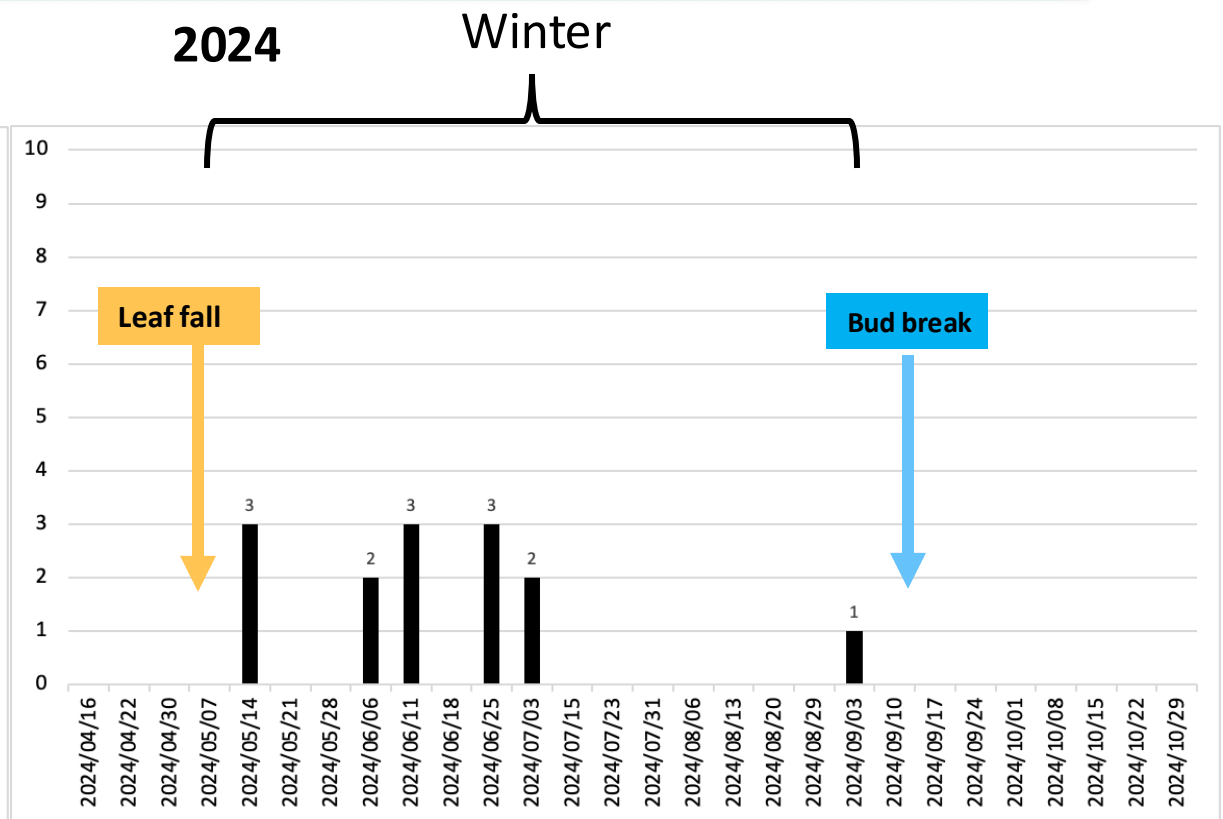
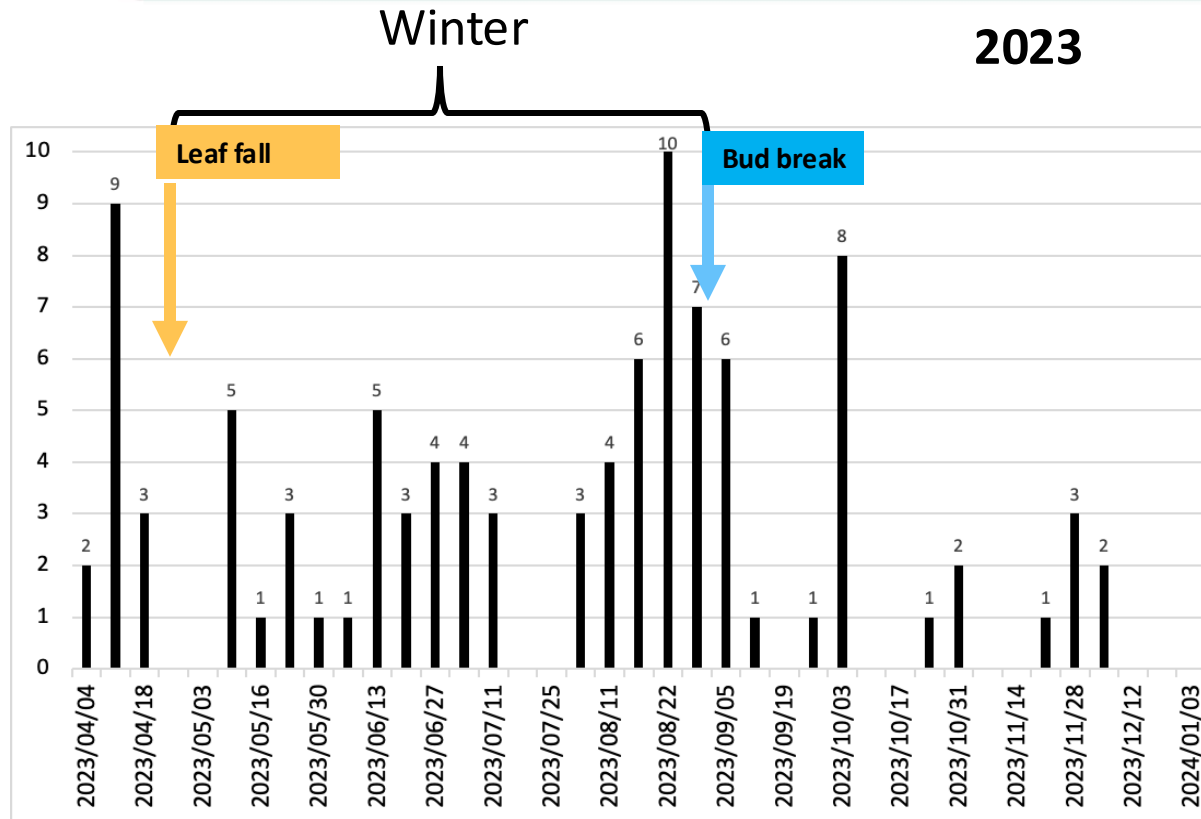
Cordon height



Number of positive powdery mildew amplifications per week from 10 slides

Ascospore release in Simondium

Number of positive amplifications (/10)



Ascospore release

- Before leaf fall
- Throughout winter
- Increased before bud break
- After bud break

Climatic requirements for ascospore release

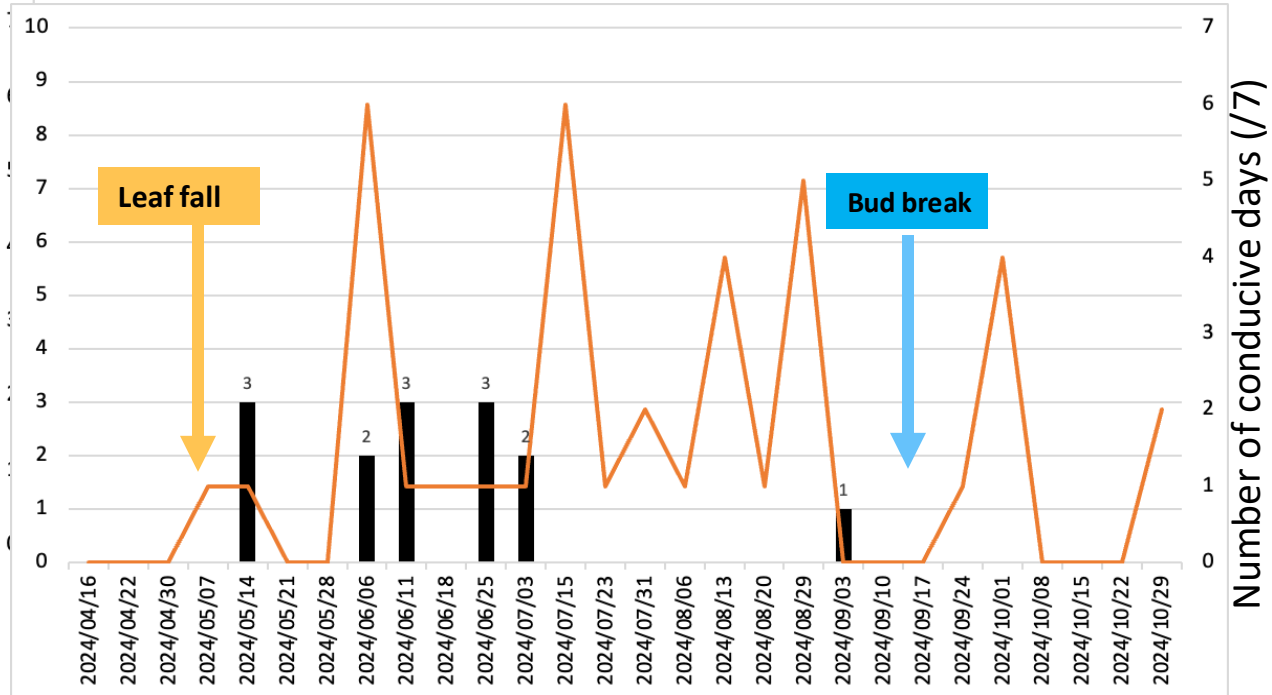
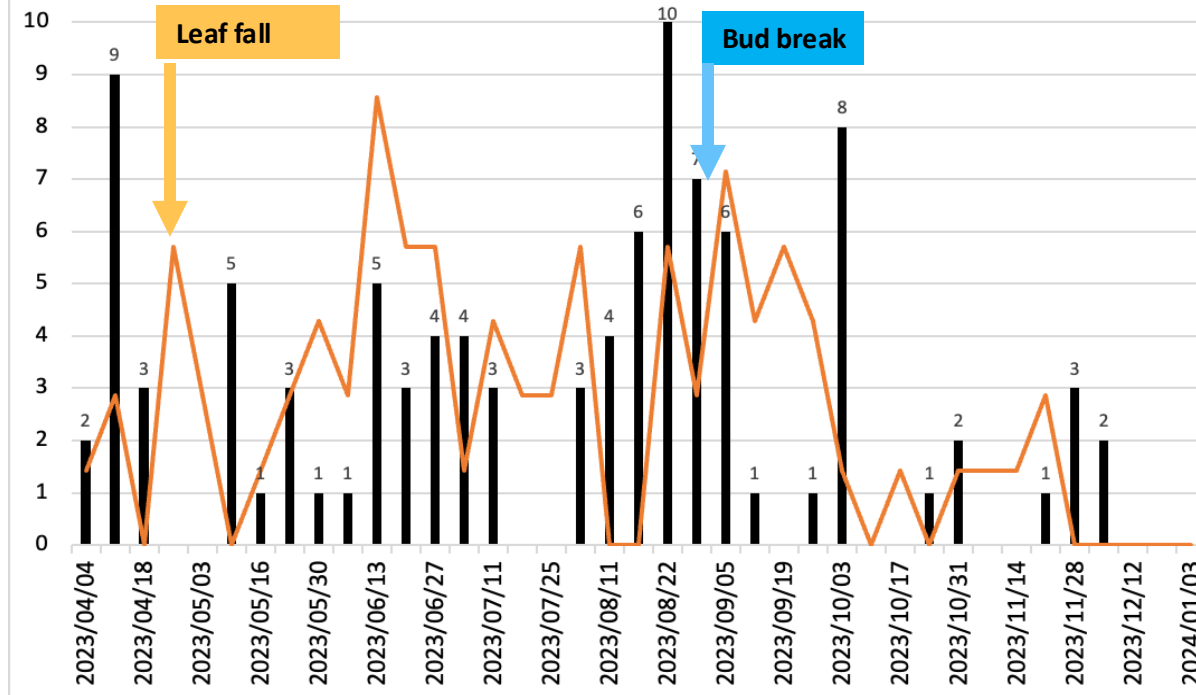
- Temp > 4°C
- Rain > 2.5 mm
- RH > 80%
- Leaf wetness > 6h

Ascospore release in Simondium

2023

2024

Number of positive amplifications (/10)



█ Positive amplifications

— Conducive weather days

- Conditions are conducive for ascospore release

Overwintering of chasmothecia : Bark (15 g)

Wine grape

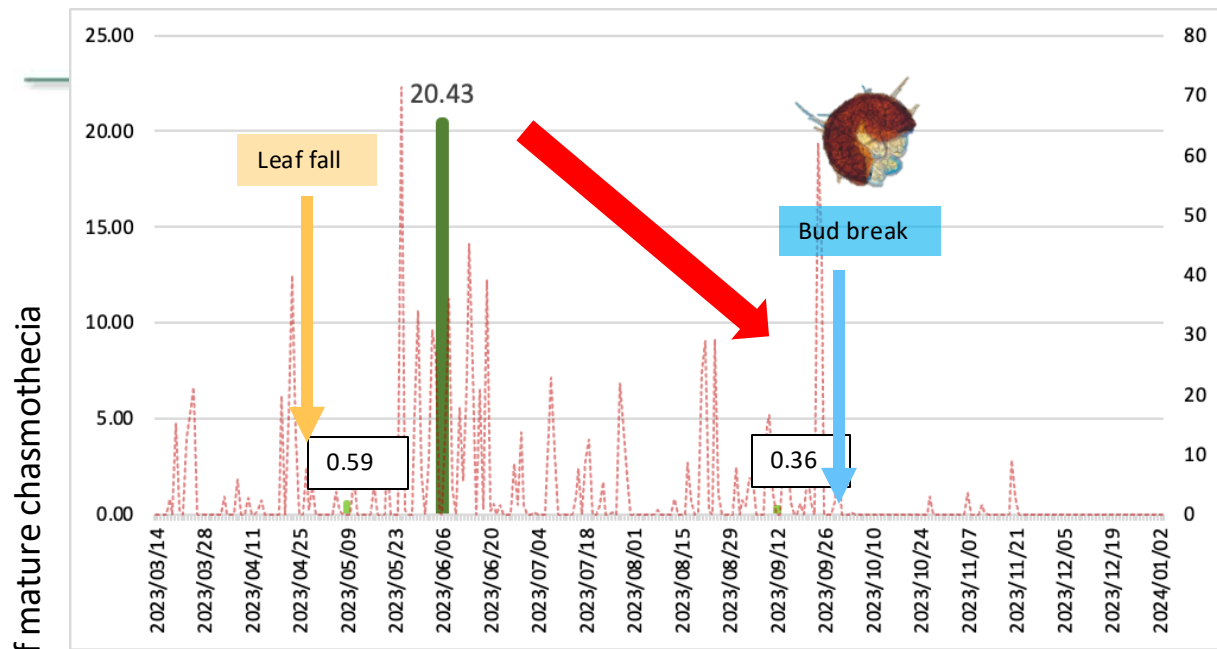
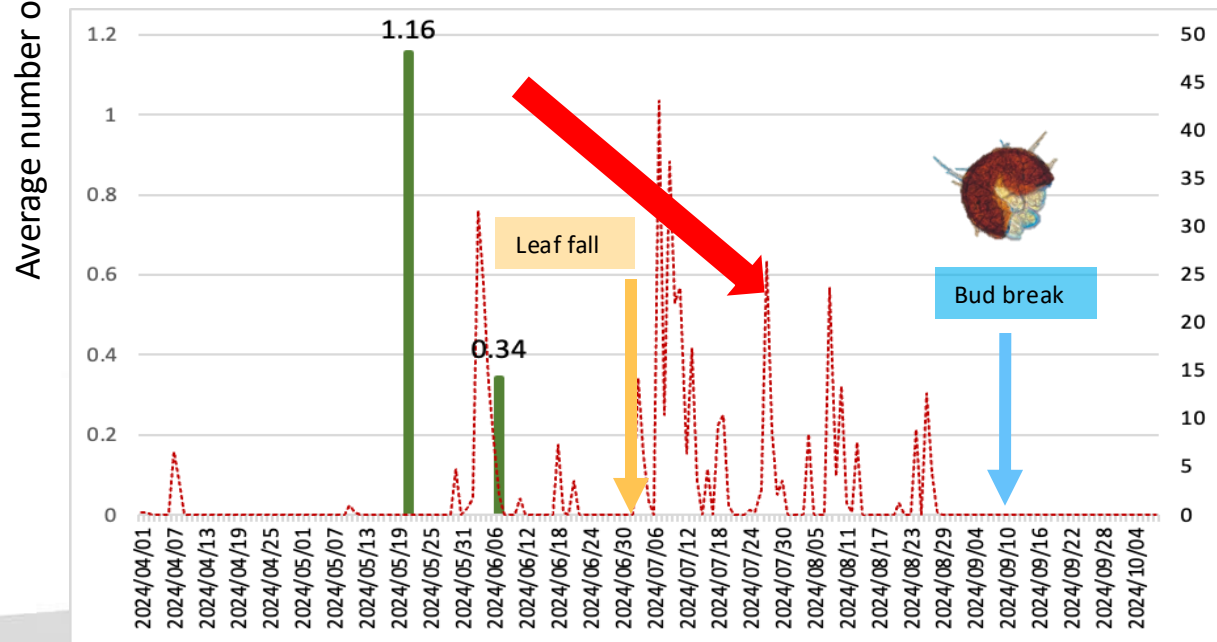
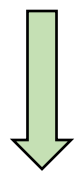


Table grape



Mature chasmothecia count (solid green bar) Rain (dashed red line)

Wine grapes



Chasmothecia observed after 2mm rain

Chasmothecia decreased from leaf fall to bud break

- Due to ascospore release during winter
- Burst open chasmothecia

Viable chasmothecia present at bud break

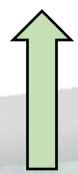
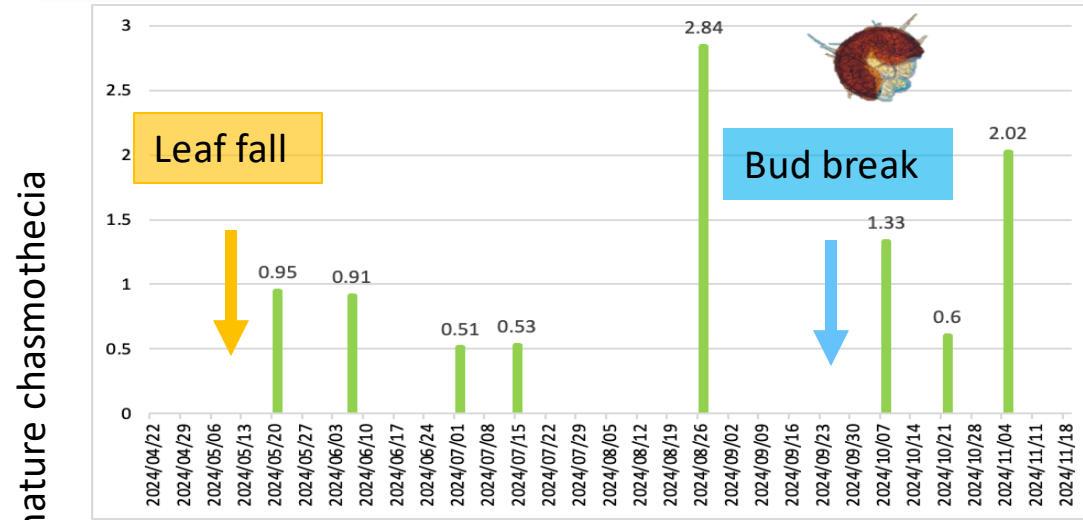


Table grapes

Overwintering: Pruning debris (45g)



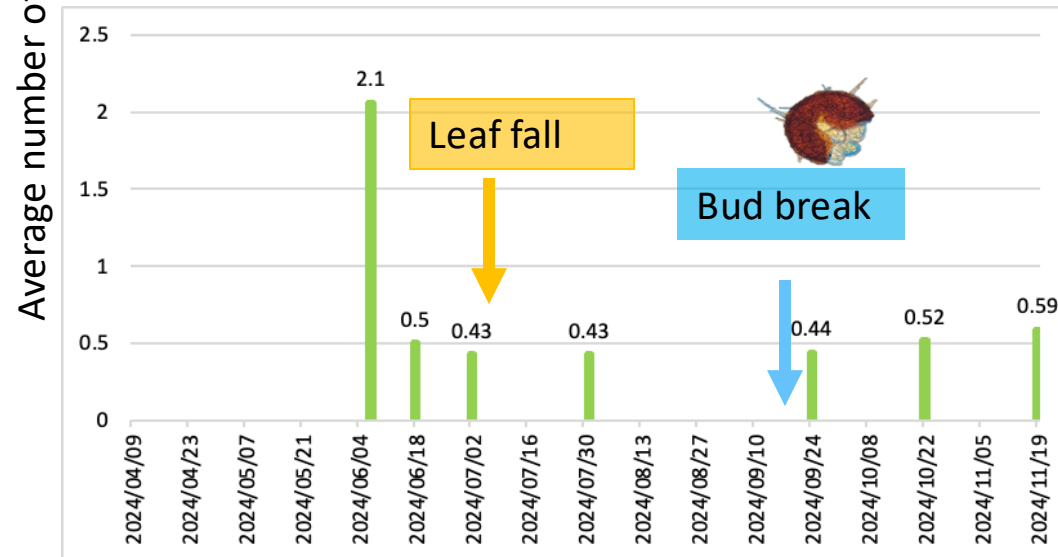
Wine grape



Chasmothecia regularly detected in low frequencies

Viable chasmothecia at bud break

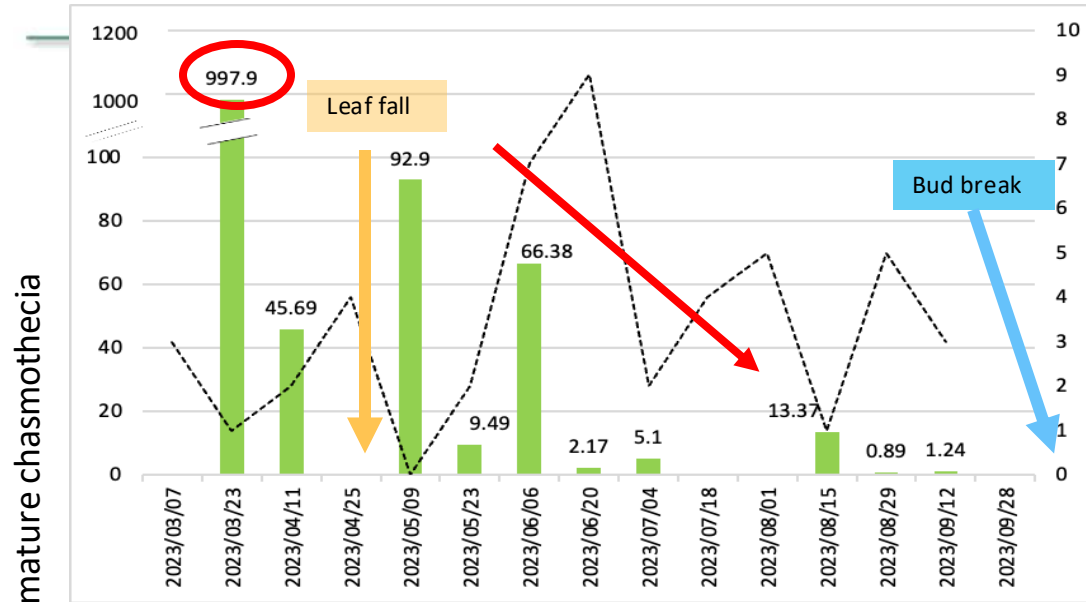
Table grape



No chasmothecia on weeds, soil or grass

Overwintering of chasmothecia : Leaf litter (45 g)

Wine grape



■ Mature chasmothecia - - - - - Conducive weather days

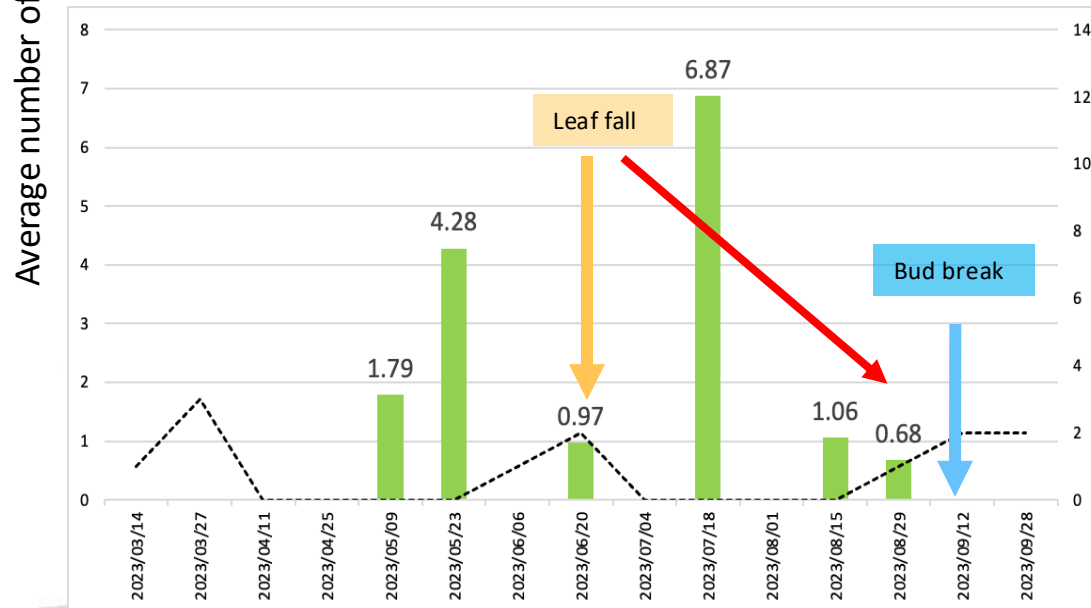
Wine grapes

Chasmothecia decreased from leaf fall to bud break

No leaf litter available at bud break

Table grapes

Table grape



Conducive days for ascospore release (/14)

Chasmothecia decreased from leaf fall to bud break

Leaf litter present at bud break:
No viable chasmothecia detected

Overwintering of chasmothecia: Leaf litter



- 100g leaf litter at leaf fall
- From 5 vines per site

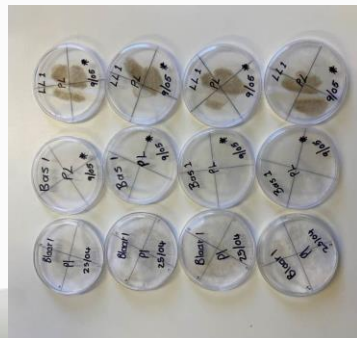


- Mesh bags
- Under 5 vines

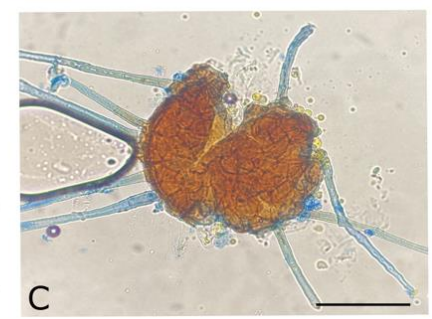
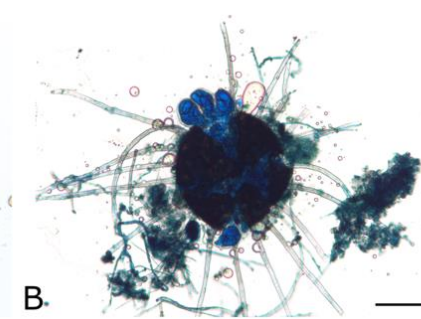
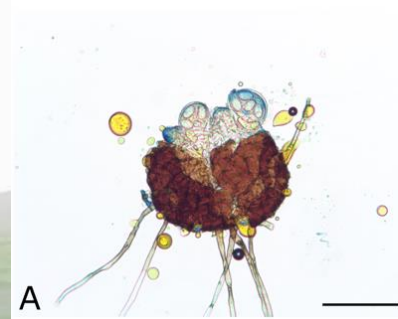


- Collected at bud break

1. Harvested chasmothecia & counted



2. Tested viability



Overwintering of chasmothecia: Leaf litter



- 100g leaf litter at leaf fall
- From 5 vines per site



- Mesh bags
- Under 5 vines



- Collected at bud break

Leaf litter was not completely decomposed by bud break

No chasmothecia at bud break

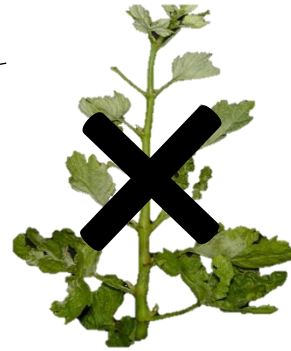
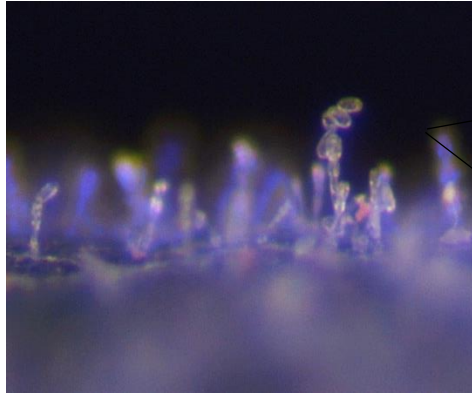
- Three vineyards

No viable chasmothecia

- One vineyard

Leaf litter is not an important source of inoculum in Western Cape vineyards

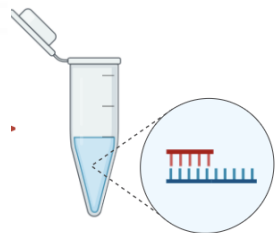
Asexual phase: Flag shoots



One flag shoot in a home garden on Hanepoot in Somerset West (18 October 2023)



- Every two weeks
- Bud break – 10 weeks later
- Surveyed 30 rows per site
- Sampled 10 emerging leaves
- Spores/mycelia harvested with scotch tape



Uncin144
Uncin511



OBJECTIVE 3

Effect of single post-harvest treatments on chasmothecia

In-field post-harvest treatment

2023

As part of commercial spray program

2024

4 Vineyards – Stellenbosch (Csb)

- 5kg/ha water dispersible sulphur
- 5 vines per vineyard
- 5 leaves per vine

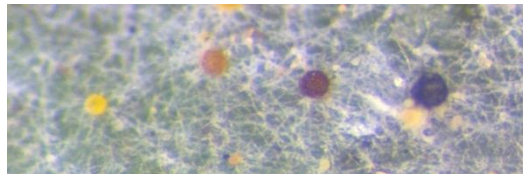
10 Vineyards

- 10 vines per vineyard
- 5 leaves per vine

BEFORE treatment 19 days **AFTER** treatment

Colour stages on leaves

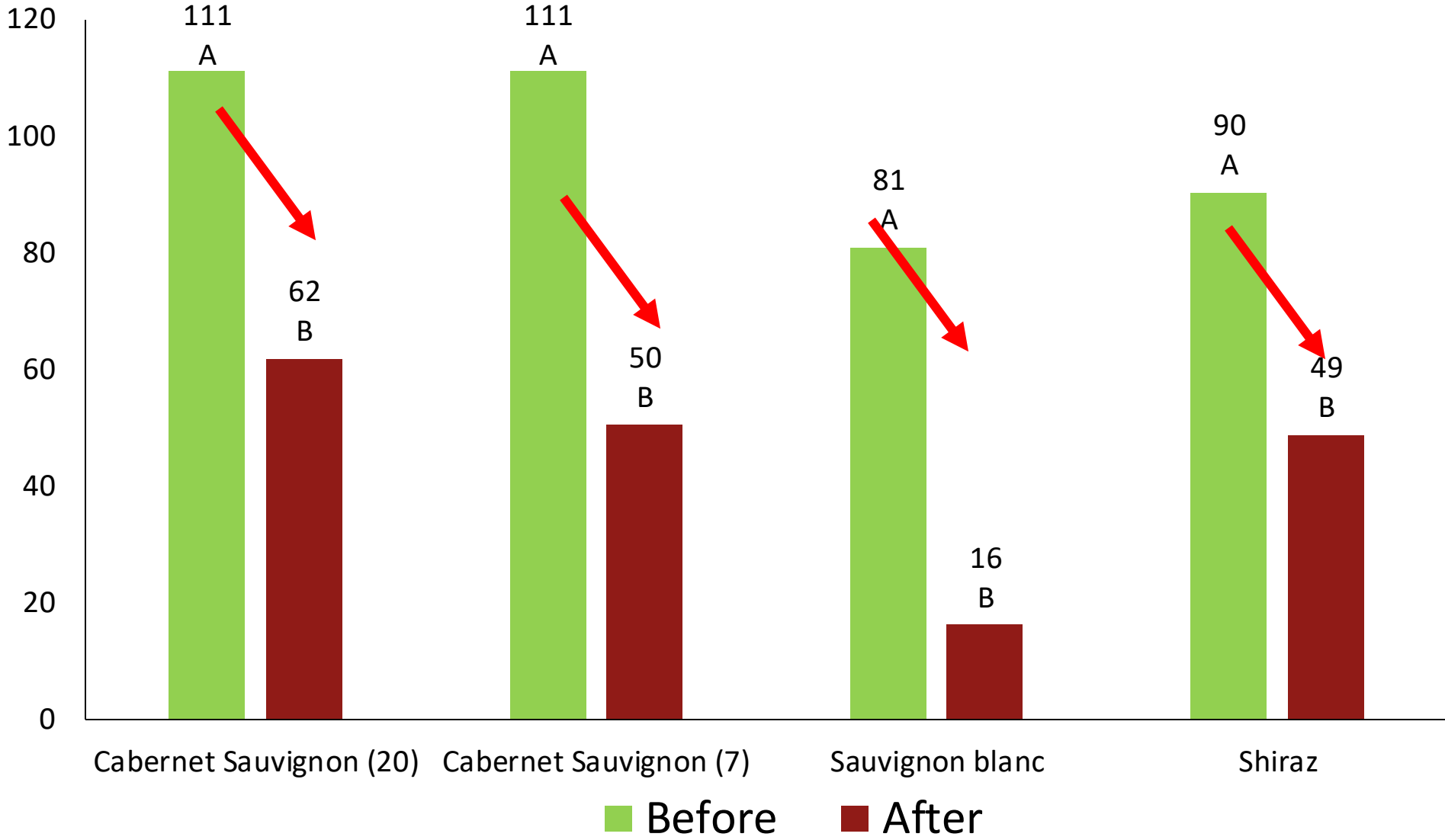
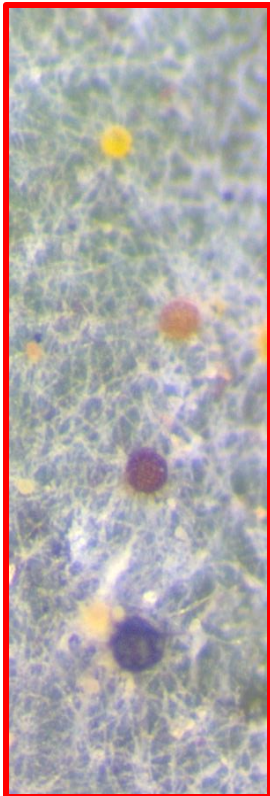
- 100 Randomly selected chasmothecia per leaf
- 500 Chasmothecia per vine



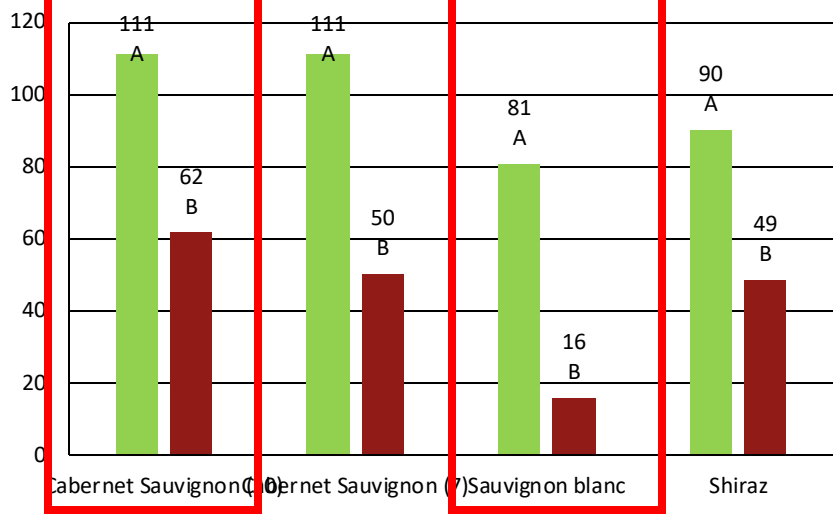
Harvested mature chasmothecia & counted Redl et al. (2021)

| Vineyard | Treatment |
|---------------|--|
| Durbanville | Dusting sulphur |
| Franschhoek | Copper hydroxide, penconazole, dusting sulphur |
| Simondium A | Meptyldinocap, suspension concentrate sulphur |
| Simondium B | Meptyldinocap, suspension concentrate sulphur |
| Simondium C | Meptyldinocap, suspension concentrate sulphur |
| Somerset West | Copper hydroxide, dusting sulphur |
| Slanghoek A | Meptyldinocap |
| Slanghoek B | Spiroxamine |
| Stellenbosch | DDAC, meptyldinocap, water dispersible sulphur |
| Wellington | Suspension concentrate sulphur |

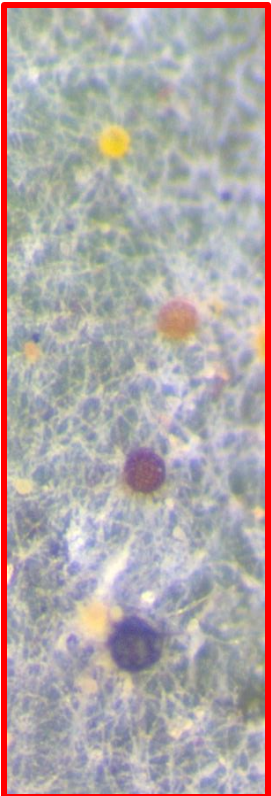
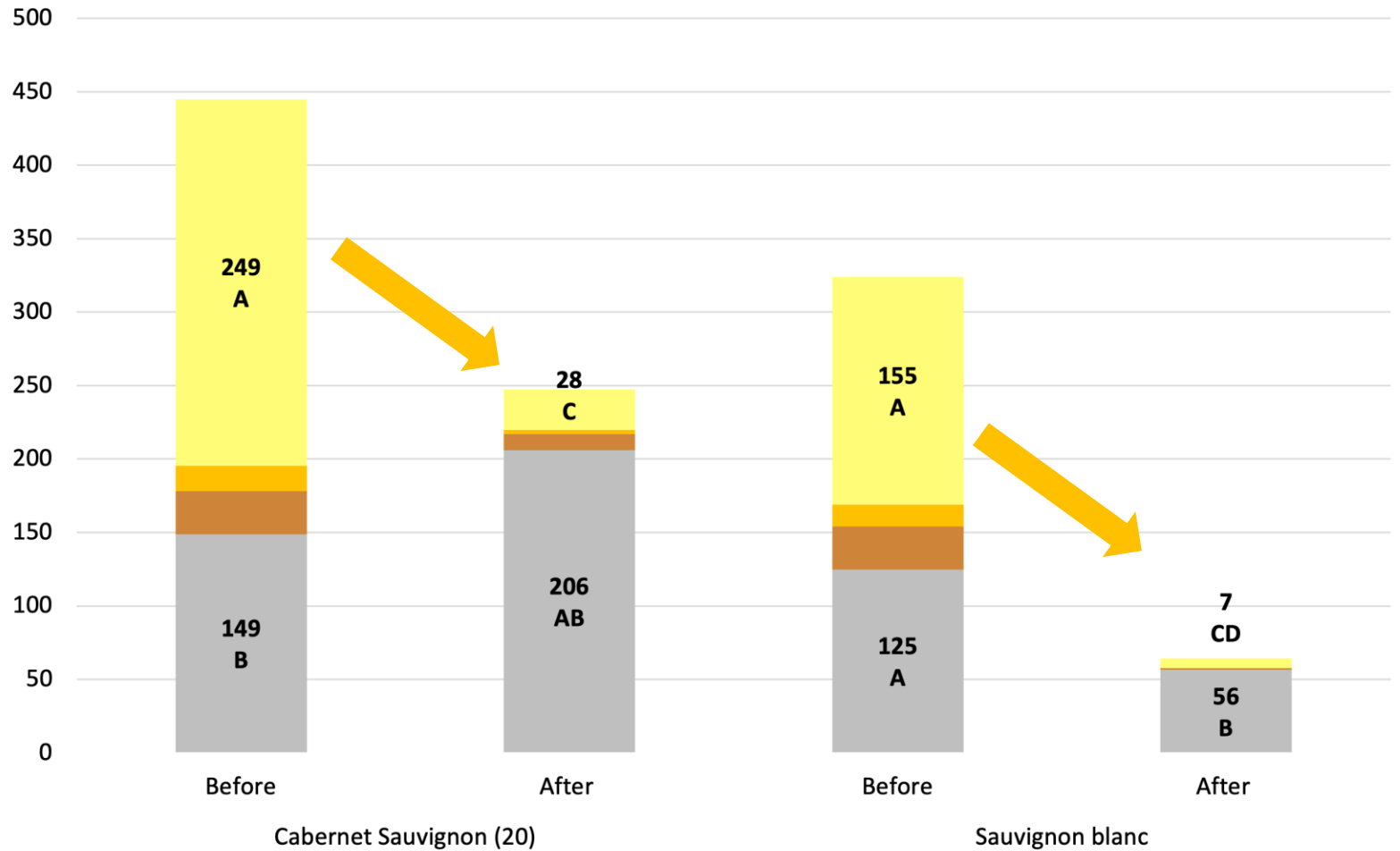
Average number of chasmothecia over all colour stages (2023)

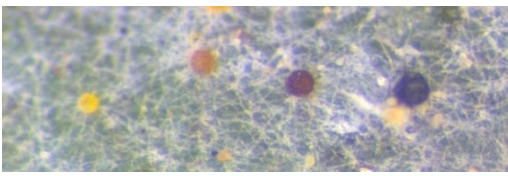


Average number of chasmothecia per colour stage (2023)



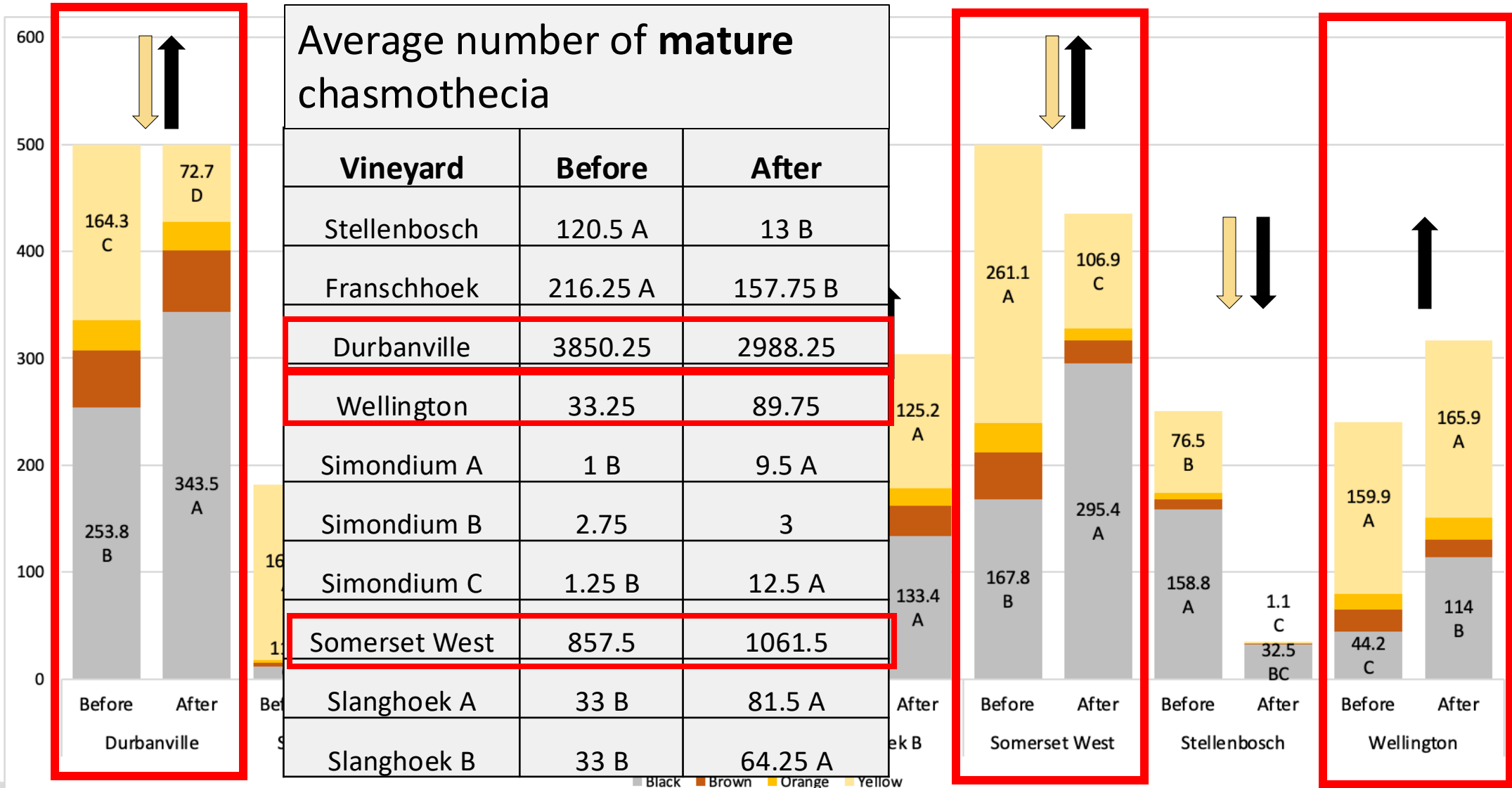
Only yellow chasmothecia decreased





Average number of chasmothecia of different colour stages (2024)

Maximum of 500 chasmothecia evaluated

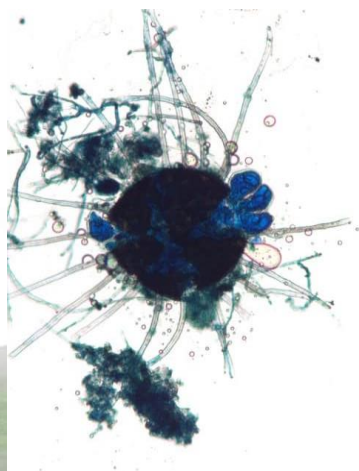
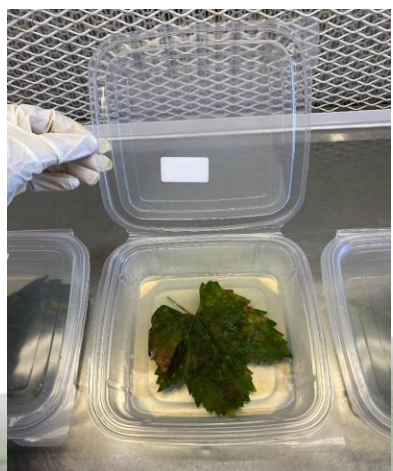


Effect of registered products on mature chasmothecia viability



Five leaves per treatment
Trial repeated

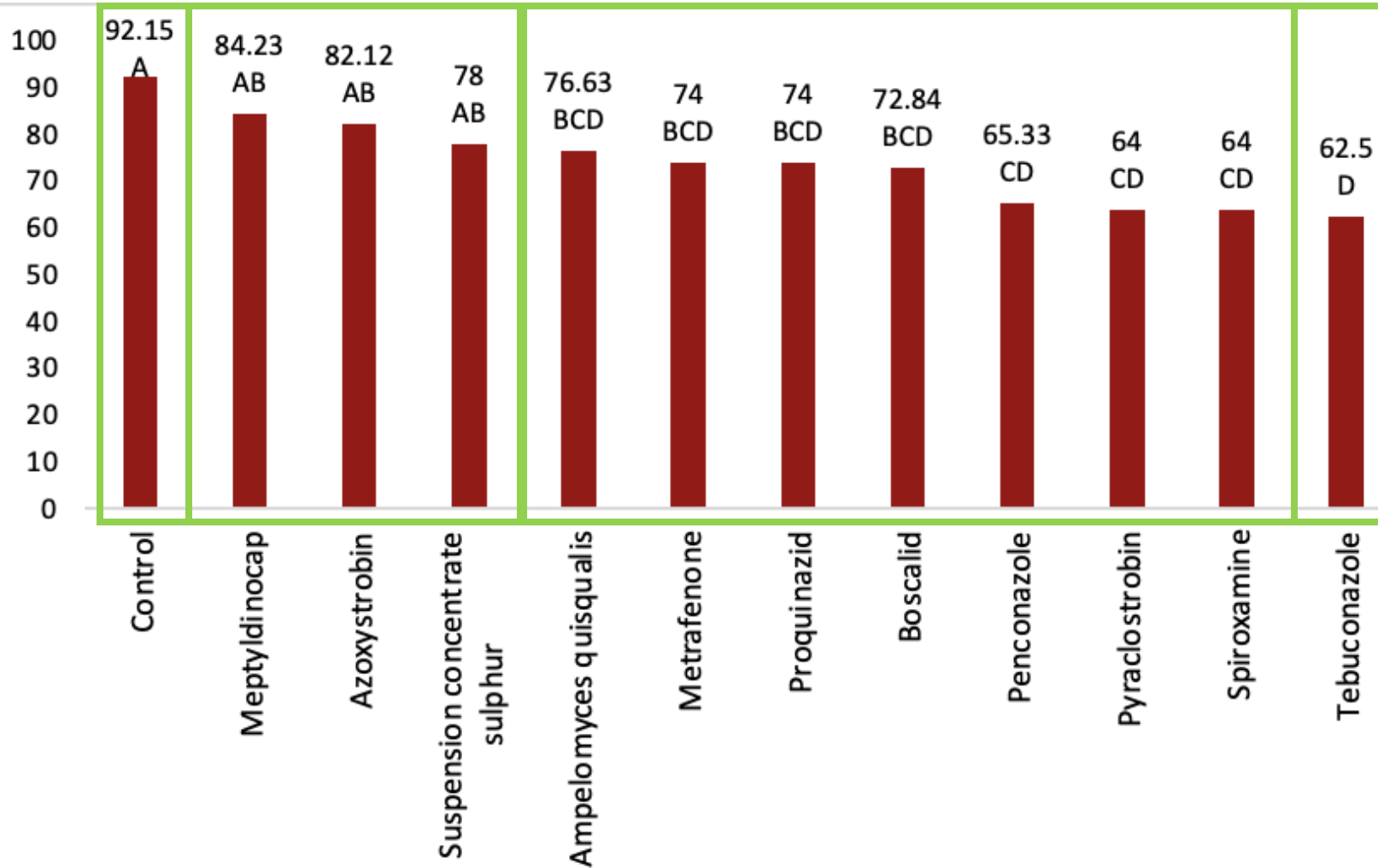
- 500 uL fungicides on each side
- Petioles in water agar
- Leaves incubated @ 25°C for 5 days
- Viability of 50 chasmothecia



| Treatment | FRAC group |
|--------------------------------|------------|
| Control | NA |
| Meptyldinocap | 29 |
| Azoxystrobin | 11 |
| Suspension concentrate sulphur | M02 |
| <i>Ampelomyces quisqualis</i> | NA |
| Metrafenone | 50 |
| Proquinazid | 13 |
| Boscalid | 7 |
| Penconazole | 3 |
| Pyraclostrobin | 11 |
| Spiroxamine | 5 |
| Tebuconazole | 3 |

Effect of registered products on chasmothecia viability

Viable chasmothecia after treatment (%)



Control = highest viability %

Meptyldinocap

Azoxystrobin

SC Sulphur

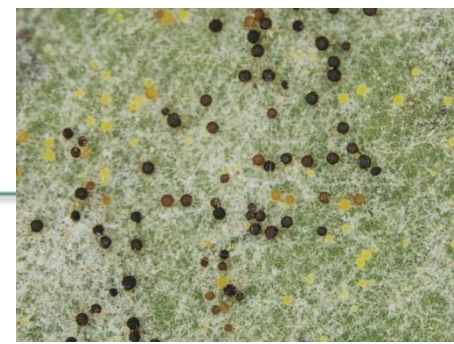
Tebuconazole (DMI) =

lowest viability %

Not significantly different from: 6 fungicides and *A. quisqualis*

Potential for future research

Take away message



Increased number of chasmothecia found

100s to >1000s of chasmothecia observed on leaves

- 3850 chasmothecia per leaf (Durbanville vineyard)
- All grape growing regions

In Austria similar observation from 1990 – 2021

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

Chasmothecia overwinter

Bark and pruning debris - viable

Leaf litter: Not an important source

Ascospore release

- Throughout winter
 - Conducive weather days throughout this period
 - Could lead to depletion of inoculum

No flag shoots or positive amplifications

- Incidence of 0.2% (Gadoury 1988)
- Not ruled out as a source of inoculum

Post-harvest treatment could potentially reduce number of chasmothecia before winter

- Yellow chasmothecia decreased
- Little effect on number of mature chasmothecia
 - Immature chasmothecia = lower lipid content
 - more permeable to fungicides
- Treatment when majority is yellow may reduce the number of overwintering chasmothecia



THANK YOU



- ⑩ Funding: SATI, SAWine, NRF Thuthuka, ARC
- ⑩ ARC Nietvoorbij Team
- ⑩ ARC weather stations

