

International Macadamia Symposium 2023



IMS'23

MOVING FORWARD TOGETHER

Macadamias South Africa (NPC)
(SAMAC)



Flower Diseases on Macadamia

Femi Akinsanmi

Hort Innovation MACADAMIA
FUND



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

QAAFI
Queensland Alliance for
Agriculture and Food Innovation

Macadamia flowering period



Macadamia raceme development

Bud emergence
(Bud break)



Raceme elongation



Fully elongated raceme



Macadamia flower development

Immature green
(Punching-bag)

Style emergence
(Bent elbow)

Pollination
(Open flower)

Early senescence
(Swollen ovary)



Stage 1



Stage 2



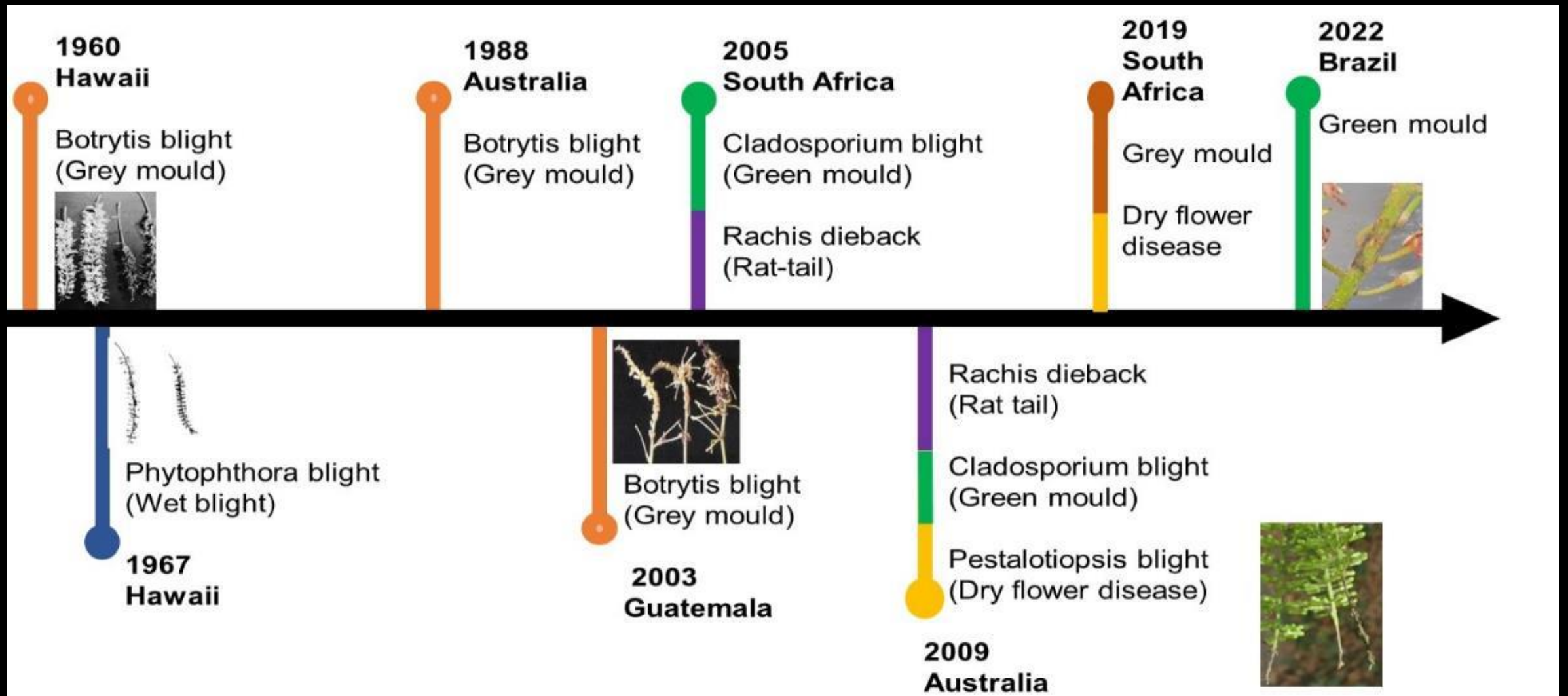
Stage 3

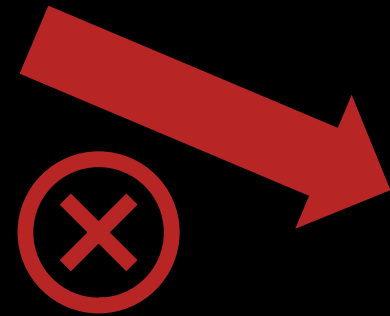
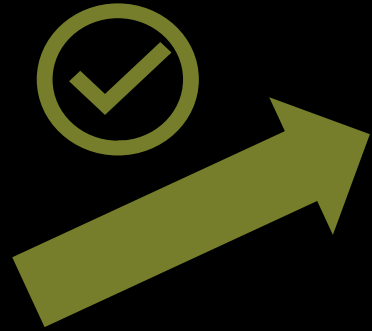


Stage 4

Flower diseases – The beginning

Historical context and impact







Types of flower diseases in macadamia



Botrytis blight (Grey mould)

Casual agents:

Botrytis cinerea

Botrytis macadamiae

Key symptoms:

Brown to dark brown flowers clustered by **grey fungal strands**

Disease develops a **fuzzy grey appearance** on flowers



Cladosporium blight (Green mould)

Casual agents:

Cladosporium species (10)

Key symptoms:

Brown necrotic flowers

Olive green mould clumps with abundant fungal spores



Pestalotiopsis blight (Dry flower disease)

Casual agents:

Neopestalotiopsis species (6)

Pestalotiopsis species (2)

Key symptoms:

Dry looking, dark brown flowers
Infected flowers dislodge easily



Phytophthora blight (Wet blight)

Casual agents:

Phytophthora palmivora

Phytophthora capsici

Key symptoms:

Wet or water-soaked dark necrosis of irregular shape
on raceme



Rachis tip dieback (Rat tail)

Casual agents:

Botrytis species

Cladosporium species

Neopestalotiopsis species

Other factors?



NOT a flower disease (Dry condition)

Casual factor:

Environmental factor

Excessive heat

Water stress

Bronze colour appearance on flowers
Stamen clean and healthy looking



NOT a flower disease

Casual factor:

Environmental
Sucking insects

Dark lesion appearance on tip of flowers
Stamen clean and healthy looking





Sources of inoculum



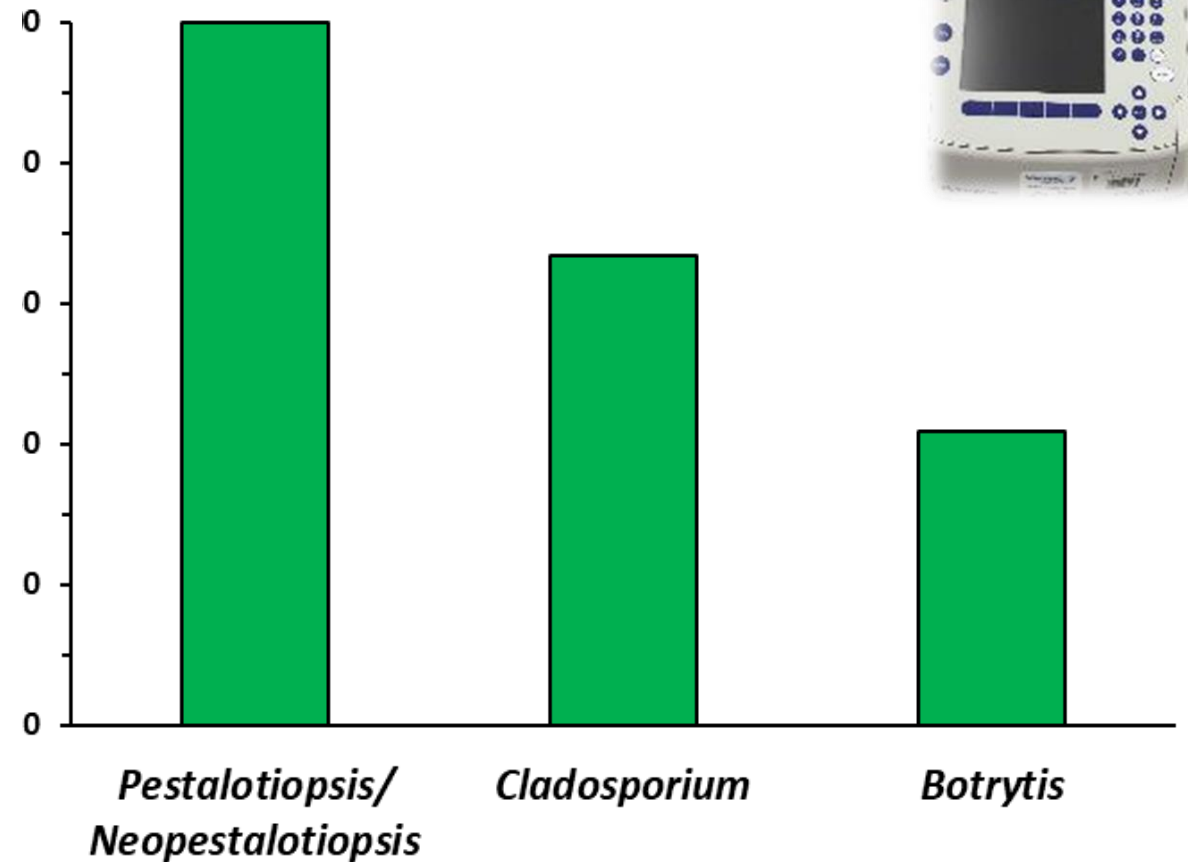
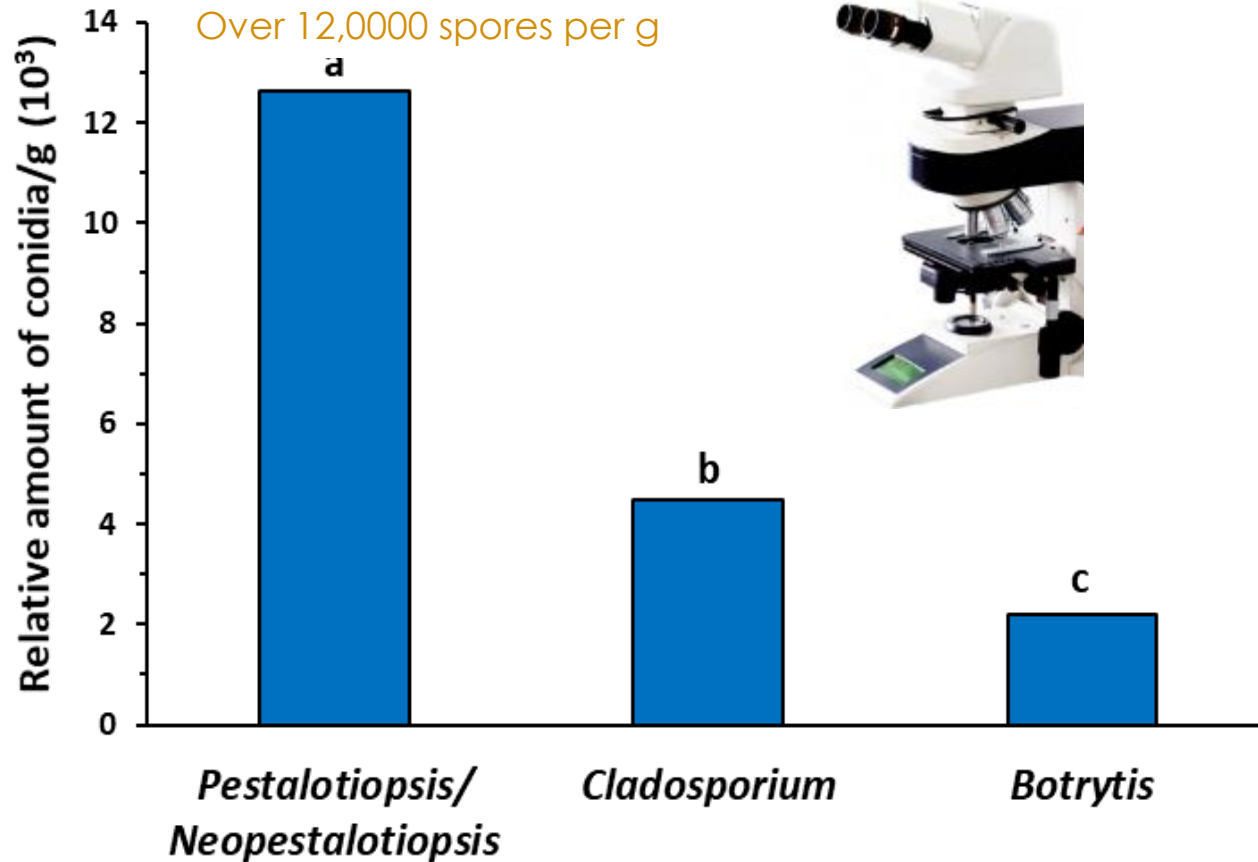


Detection and quantification of inoculum



Microscope count

Molecular detection (qPCR)



Detection and quantification of inoculum



Yellow halo leaf spots



Dry flower disease conidia
100 to 1000 conidia per cm²



Grey mould and Green mould
conidia

Weather conditions promoting occurrence

Prasannath et al.. 2022. . Journal of Applied Microbiology 132:1291-306

Journal of
Applied Microbiology



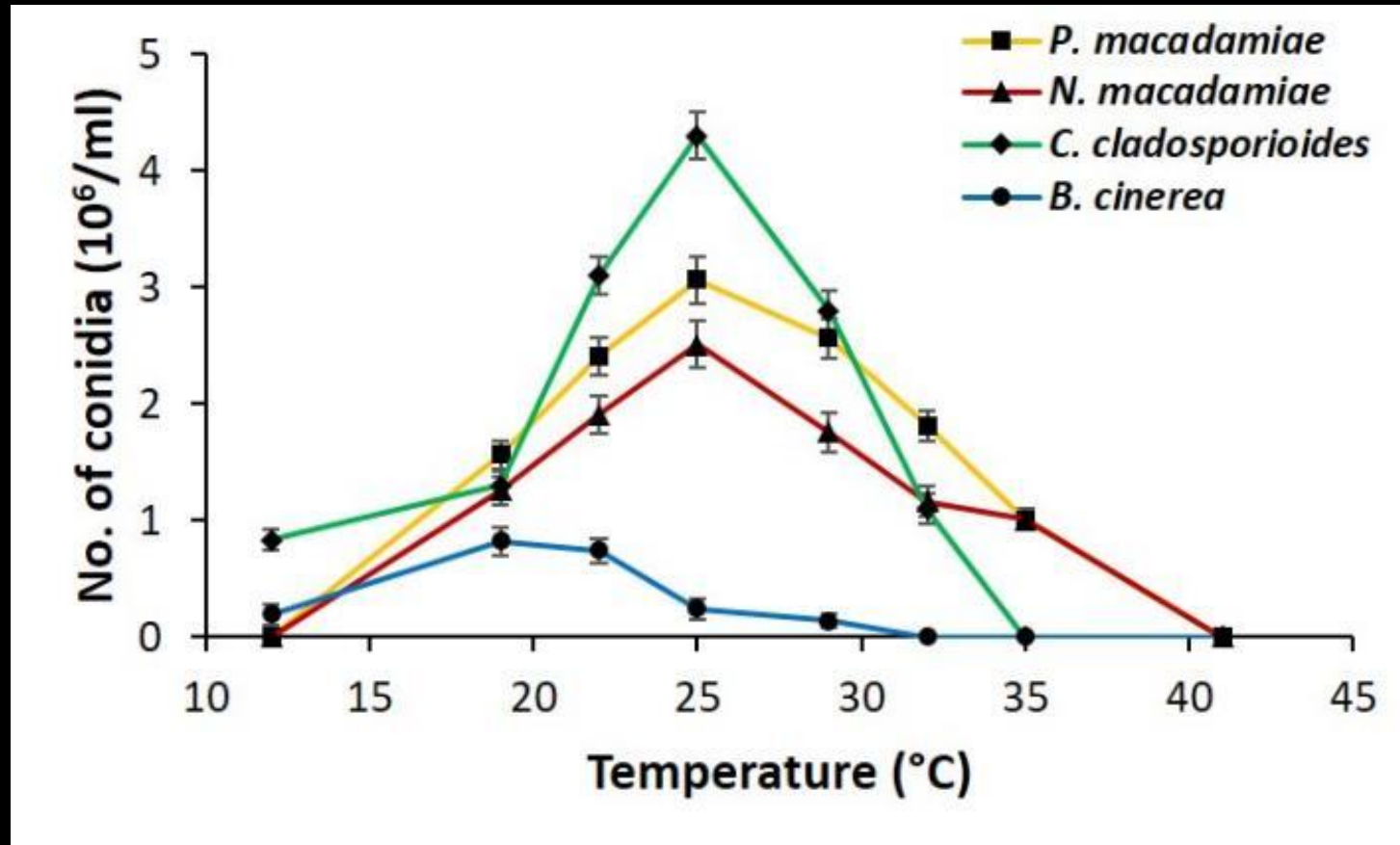
ORIGINAL ARTICLE |  Full Access

Influence of climatic factors on dry flower, grey and green mould diseases of macadamia flowers in Australia

Kandeepraroopan Prasannath  Victor J. Galea. Olufemi A. Akinsanmi 

First published: 28 July 2021 | <https://doi.org/10.1111/jam.15241>

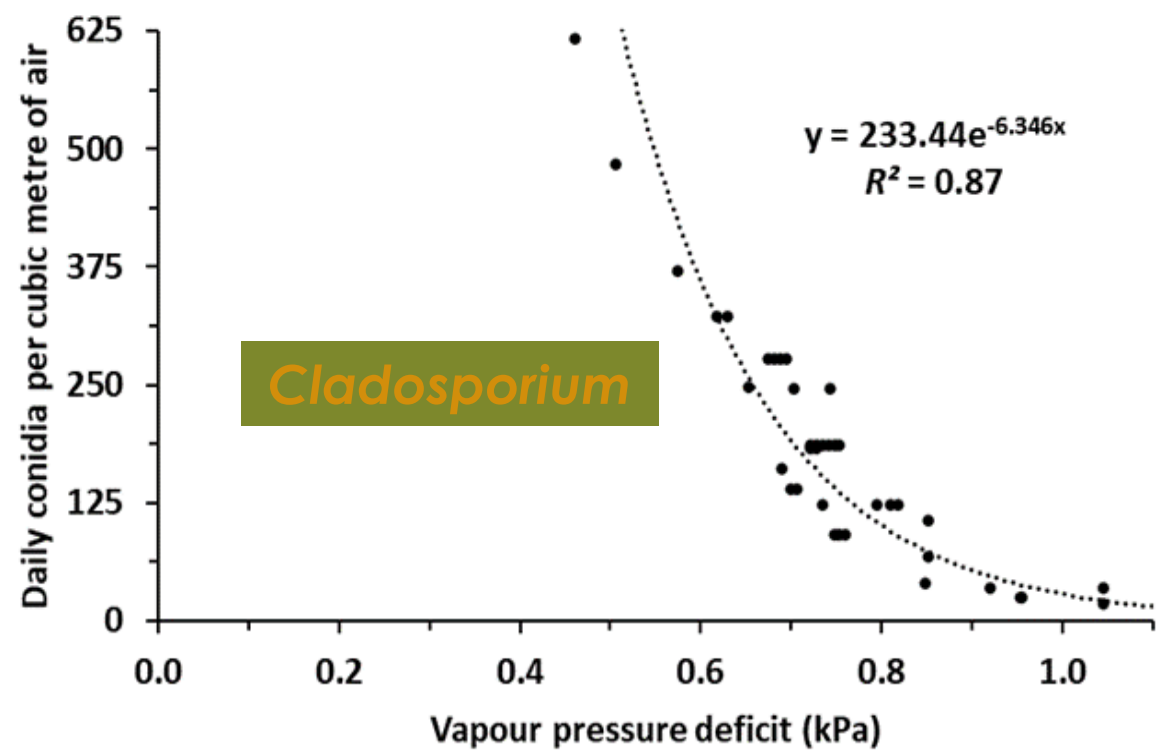
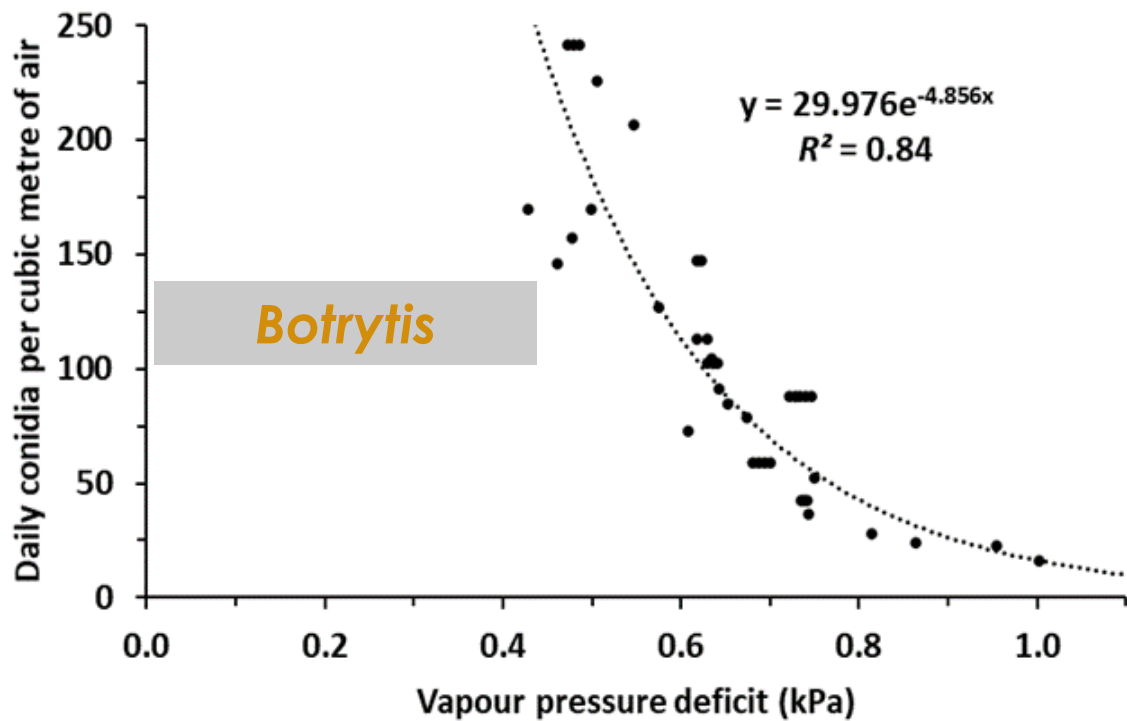
Temperature affects conidia abundance



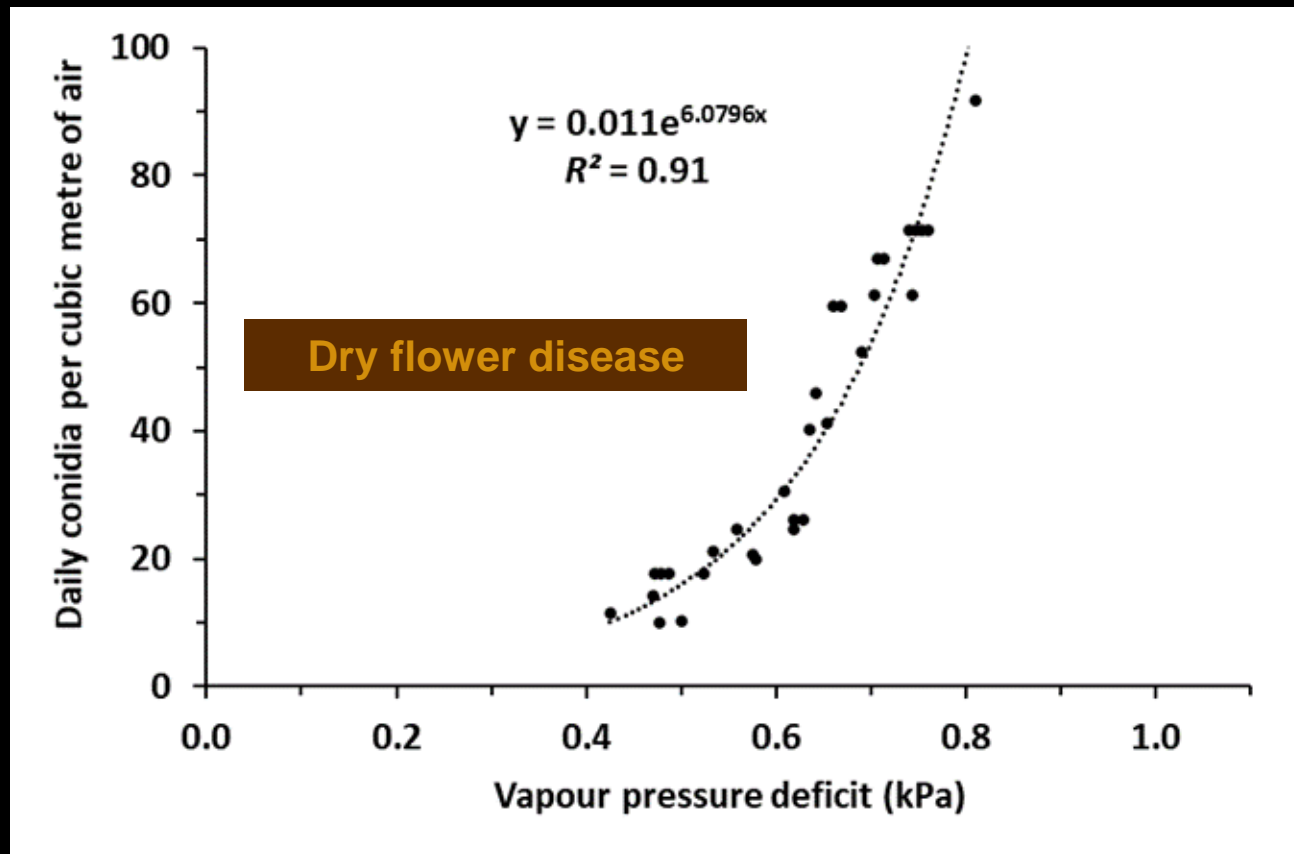
Relative field abundance of conidia

Moist ← Atmosphere → Dry

Moist ← Atmosphere → Dry



Relative field abundance of conidia



Weather conditions promoting occurrence



**Botrytis blight
(Grey mould)**



**Cladosporium blight
(Green mould)**



**Pestalotiopsis blight
(Dry flower disease)**

- Wet and cool conditions
- Rain or humidity above 70%
- 18 - 20°C

- Wet and warm conditions
- Rain or humidity above 60%
- 25 - 27°C

- Dry and warm conditions
- Humidity below 40%
- 25 - 30°C





Risk of infection



Timing of infection



**Botrytis blight
(Grey mould)**



**Cladosporium blight
(Green mould)**



**Pestalotiopsis blight
(Dry flower disease)**





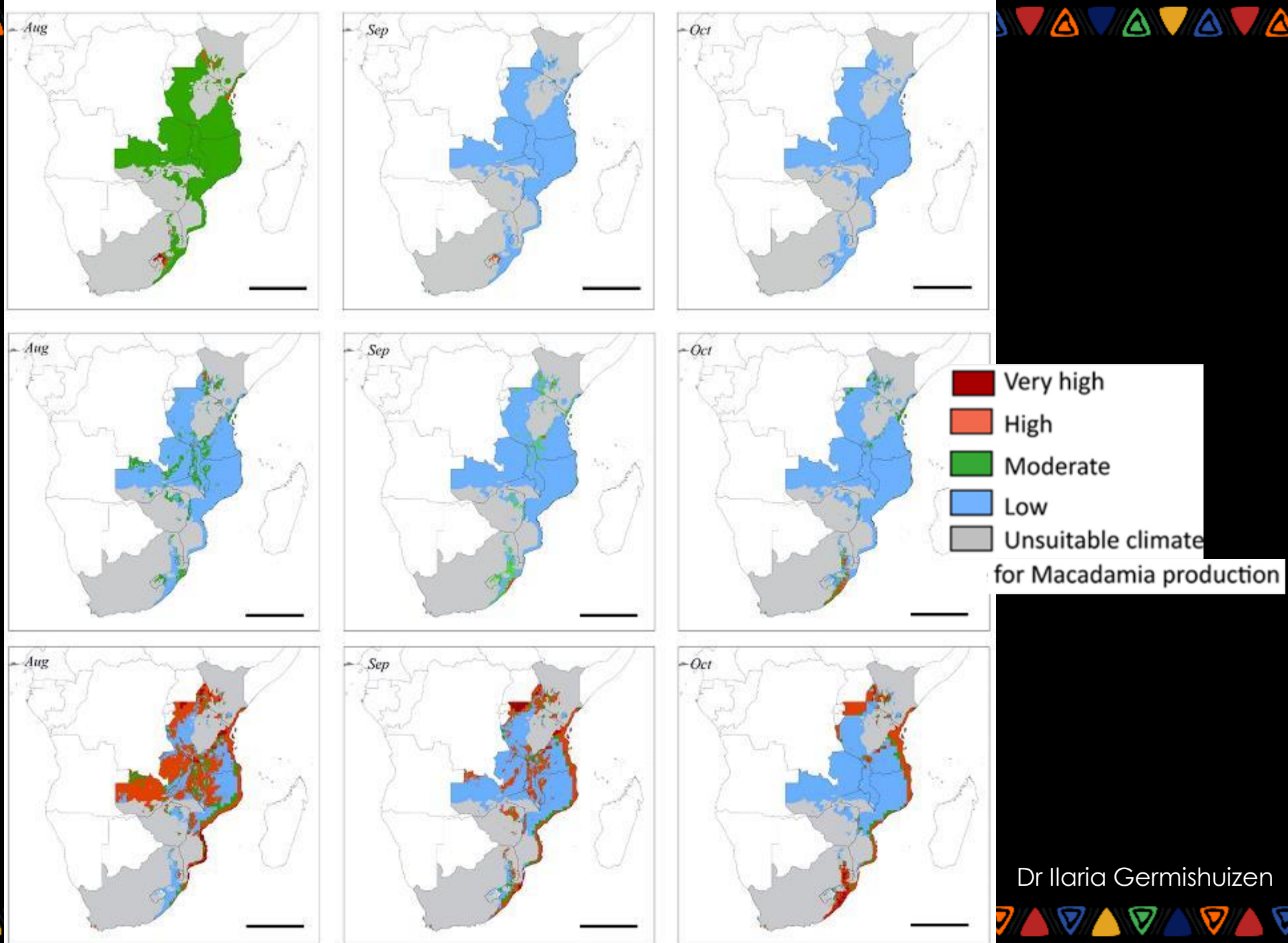
Botrytis blight
(Grey mould)



Cladosporium blight
(Green mould)



Pestalotiopsis blight
(Dry flower disease)



Very high
High
Moderate
Low
Unsuitable climate
for Macadamia production

Dr Ilaria Germishuizen



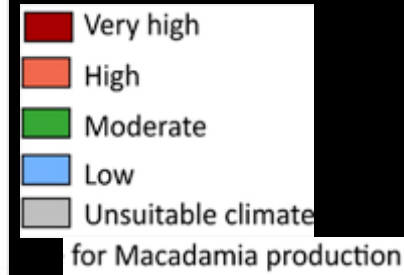
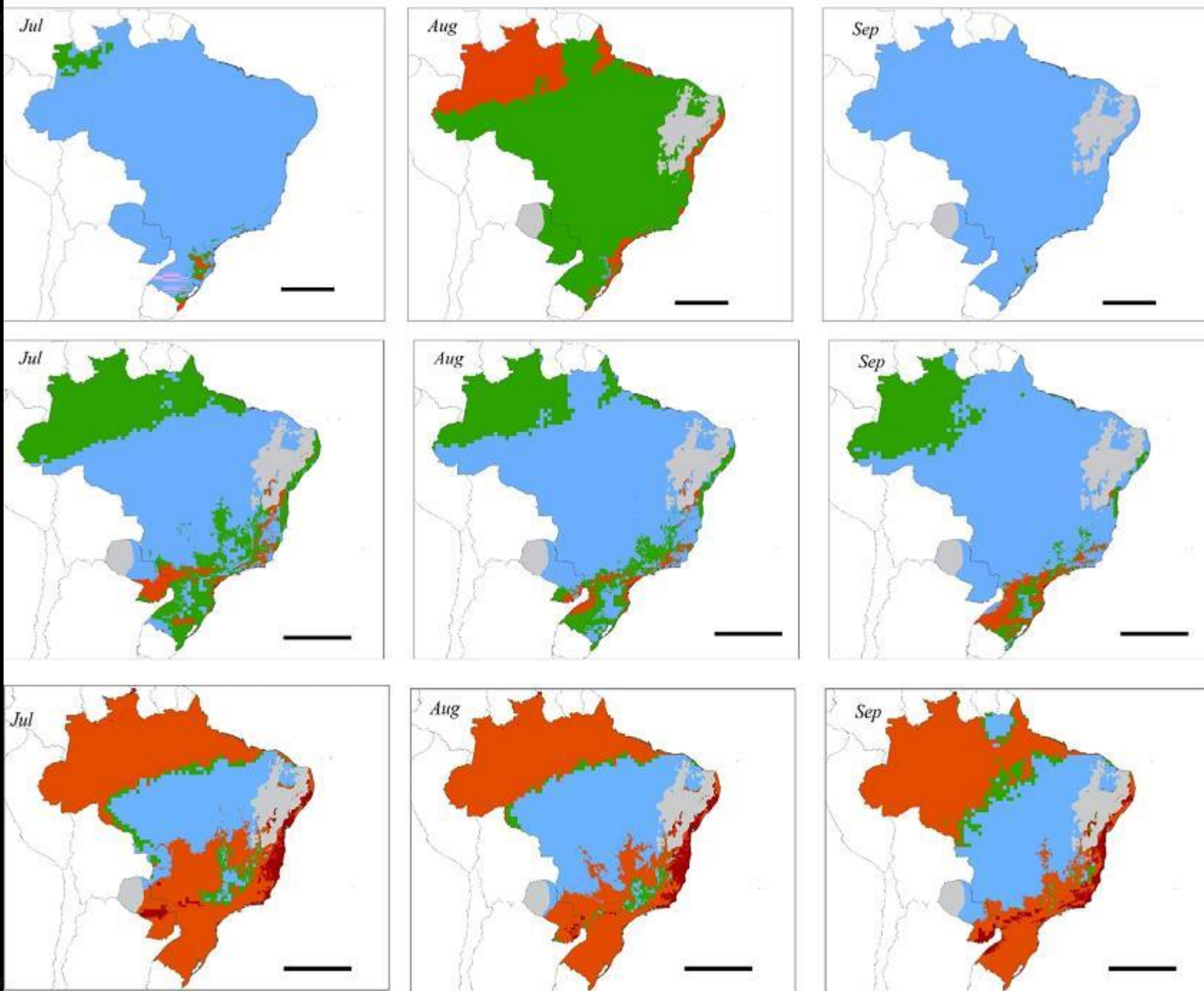
**Botrytis blight
(Grey mould)**



**Cladosporium blight
(Green mould)**



**Pestalotiopsis blight
(Dry flower disease)**





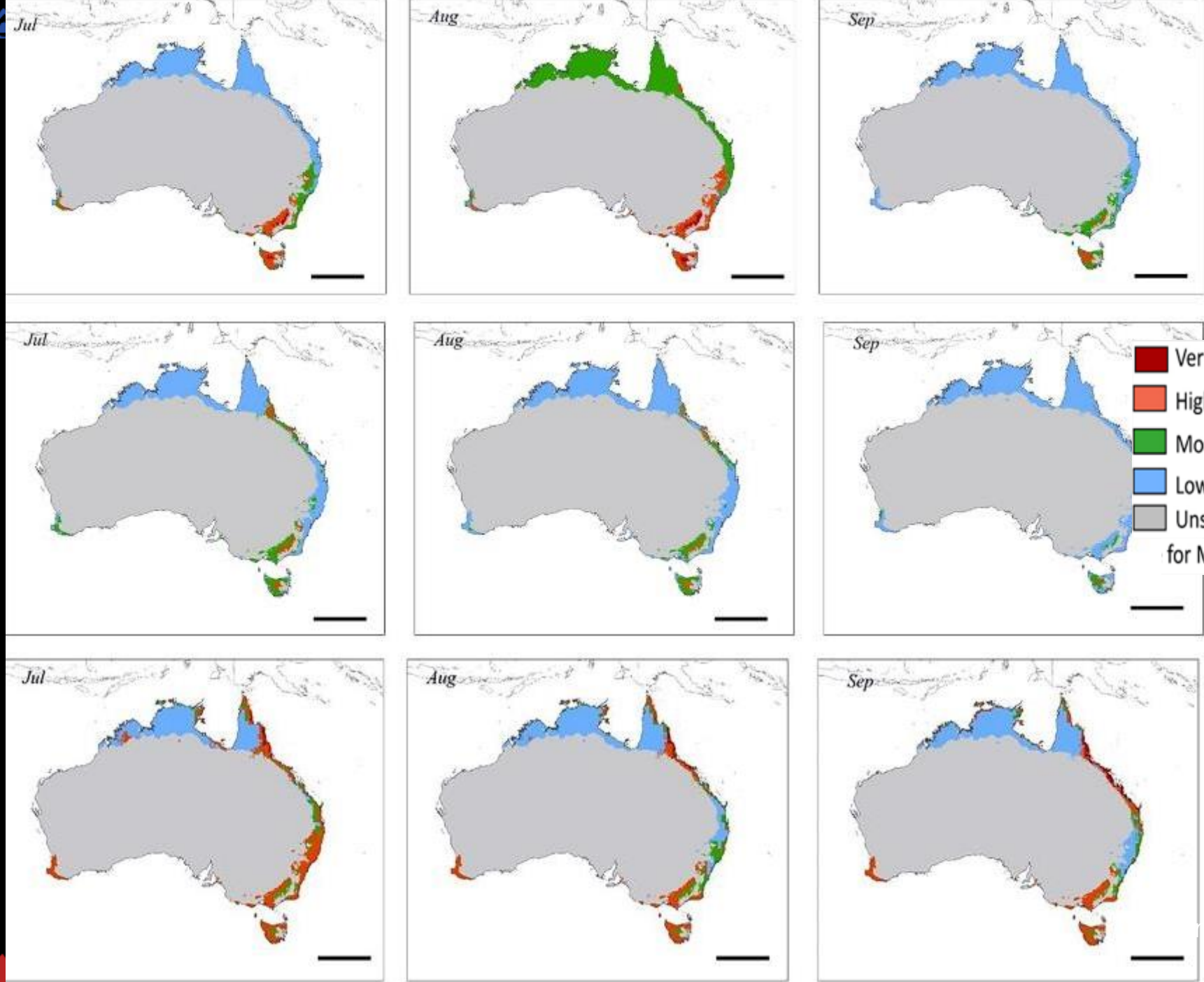
**Botrytis blight
(Grey mould)**



**Cladosporium blight
(Green mould)**



**Pestalotiopsis blight
(Dry flower disease)**





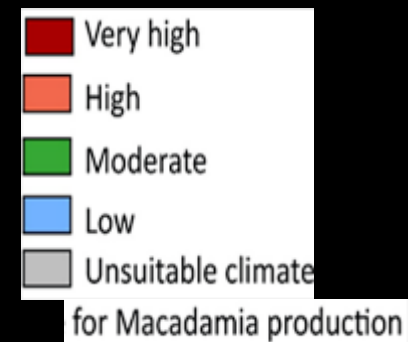
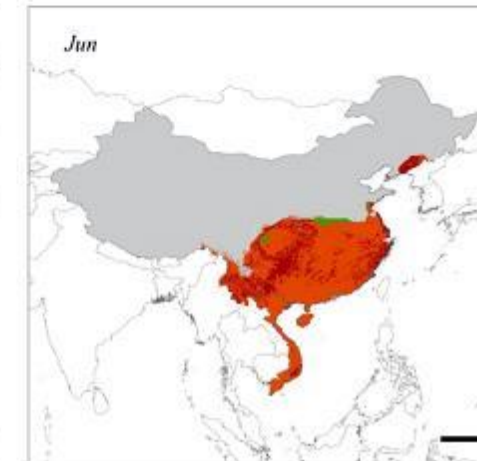
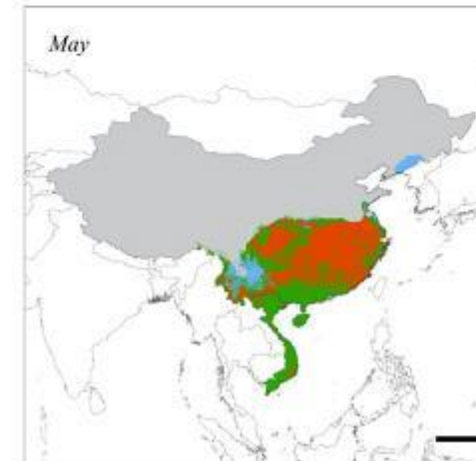
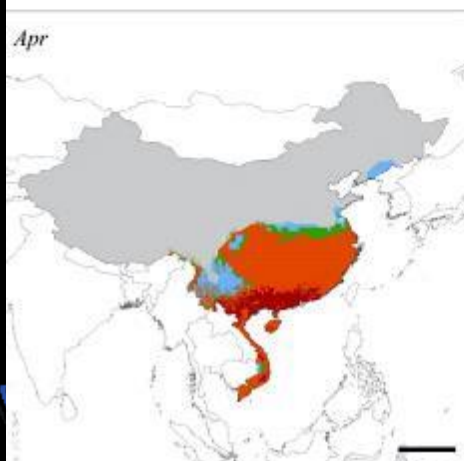
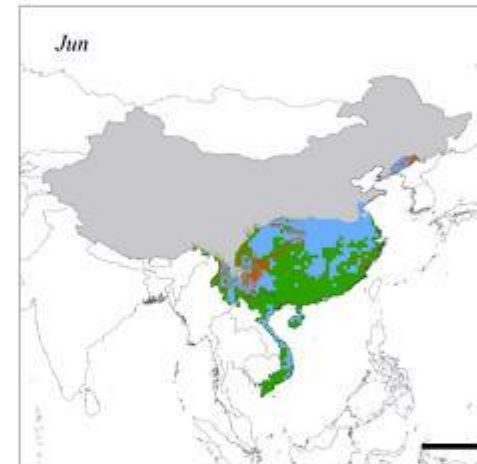
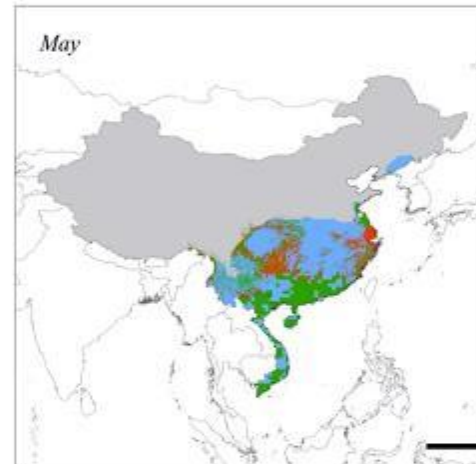
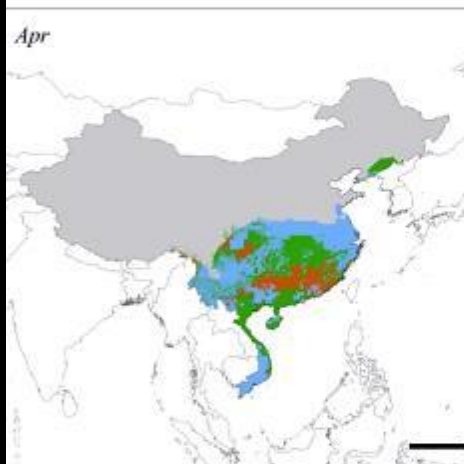
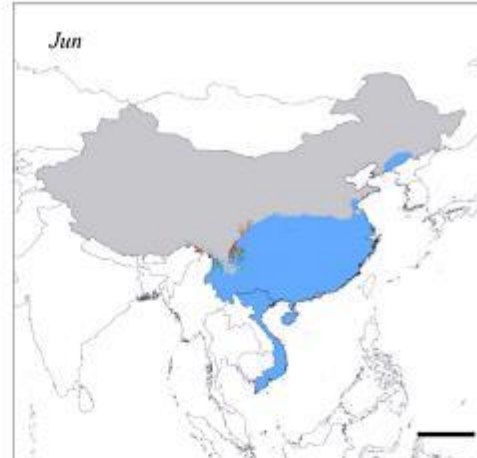
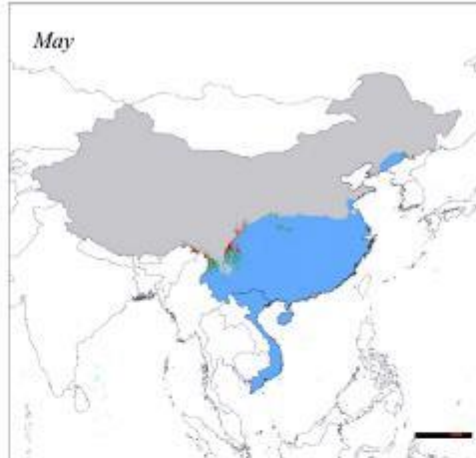
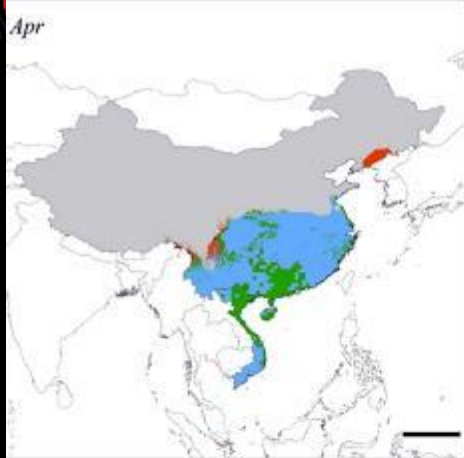
**Botrytis blight
(Grey mould)**



**Cladosporium blight
(Green mould)**



**Pestalotiopsis blight
(Dry flower disease)**

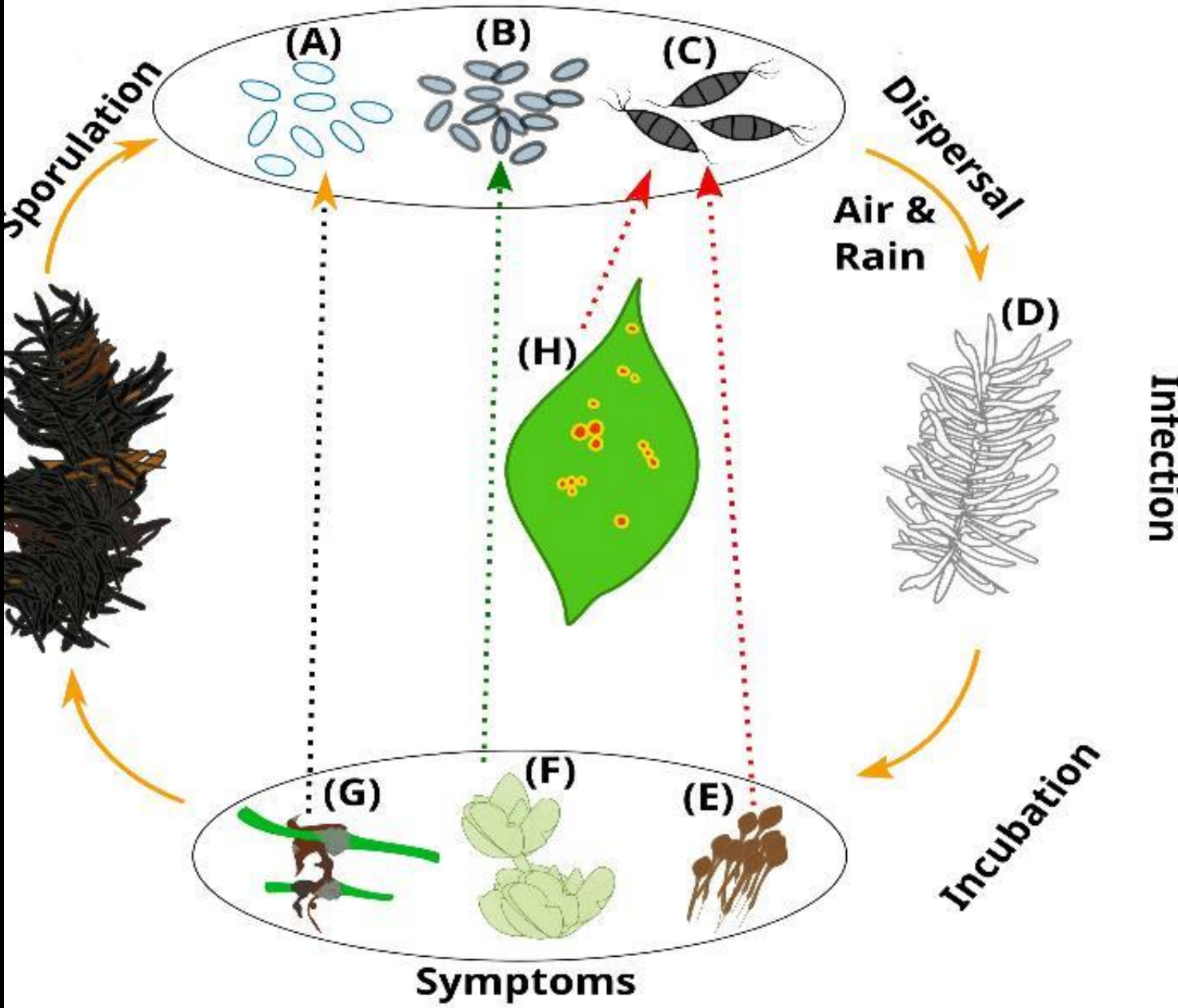




Macadamia flower diseases life cycle



Disease cycle



Disease management

Disease control options

- Cultural practices
- Biological control
- Chemical applications
- Cultivar susceptibility
- Disease forecasting



Cultural control

- Open, well-ventilated canopies
- Sunlight distributed throughout canopies
- Remove old diseased racemes from canopy



Biological control

Biological control agents inhibit the pathogens

Botrytis sp



A. pullans treatment



Cladosporium sp



A. pullans treatment



Neopestalotiopsis sp



A. pullans treatment



Chemical control

Pyraclostrobin

Penthioryrad

Tebuconazole and Fluopyram

@ Timing of spray application



Cultivar resistance

Tolerant

HEAS 695 (Beaumont)
HAES 741
Nelmak 2

Susceptible

A268
HAES 344
HAES 660
HAES 816
HAES 842
IAC 412B



Summary

1. Multiple and new fungal species cause flower diseases on macadamia
2. Environmental conditions influence the type and disease occurrence
3. Green mould and dry flower pathogens can infect all the flower stages
4. Grey mould pathogens infects from stage 2 when cold and wet
5. Remnant racemes are a source of inoculum for all types of flower blights



Acknowledgements



Dr Prasannath K.



Harry G.
(PhD student)



Xiaoxue Xu
(PhD student)

Research Collaborators

Dr Gerda Fourie (FABI)

Prof. Dr. Bernardo Halfeld Vieira (Embrapa)

Leonardo Moiya (Queen Nut Brazil)

Mariatha Schoeman (ARC-ITSC)

Dr Chris Searle (MacAvo Australia)

Dr Ilaria Germishuizen (UKZN South Africa)



Gerhard Bortha
(MSc student)





QUESTIONS ?