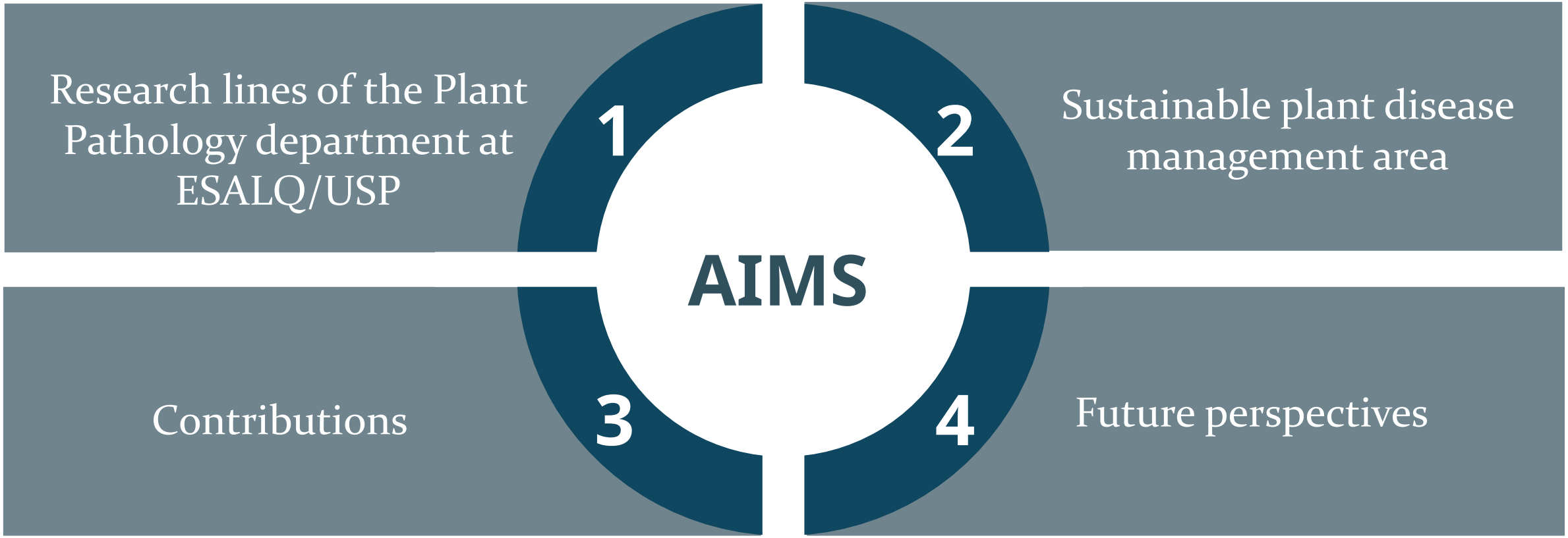
ESALQ
Luiz de Queiroz College of Agriculture
University of São Paulo

Comparative genomics to unveil adaptation mechanisms of *Austropuccinia psidi* in Myrtaceae host species and beyond

Professor Thaís R. Boufleur

thaisboufleur@usp.br

FAPESP Week CHINA 2024, June 28 - 29


Research lines of the Plant Pathology department at ESALQ/USP
1
2
Sustainable plant disease management area
AIMS
Contributions
3
4
Future perspectives


LUIZ VICENTE
DE SOUZA
QUEIROS
PELA VIA DATIVA

Plant Pathology Department

Research lines

- Cellular and molecular biology of plant-pathogen interactions
- Epidemiology of plant diseases
- Identification, variability and mechanisms of pathogenicity
- Plant resistance to pathogens
- Control of plant diseases

PROFESSORS

SUSTAINABLE PLANT DISEASE MANAGEMENT

It is an area that spans different lines of research in the Plant Pathology department

Started in January 2024 (6 months ago)

RESEARCH LINES ON SOYBEAN ANTHRACNOSE: 2017 - CURRENT

Unveiling the association of *Colletotrichum* species with soybean anthracnose using histological, populational and genomic approaches

FAPESP 17/09178-8

FAPESP 21/11356-7

Deep inside anthracnose: identification of soybean resistance markers by GWAS, use of comparative genomics to study the adaptation of *Colletotrichum truncatum* to the host, phylogeny and pathogenicity of new *Colletotrichum* species

Epidemiological components, damage characterization and control of tropical and temperate rusts at a global climate change scenario

FAPESP 2019/13191-5

RESEARCH LINES ON MYRTLE RUST

National and international partnerships established. FAPESP funding 2021/01606-6 and 2022/11900-1

ESALQ

Australian National University

Australian Government
Australian Research Council

THE UNIVERSITY OF SYDNEY

FAPESP Week CHINA 2024, June 28 - 29

WHAT IS MYRTLE RUST?

Austropuccinia psidii





More than 480 host species within the myrtle family reported

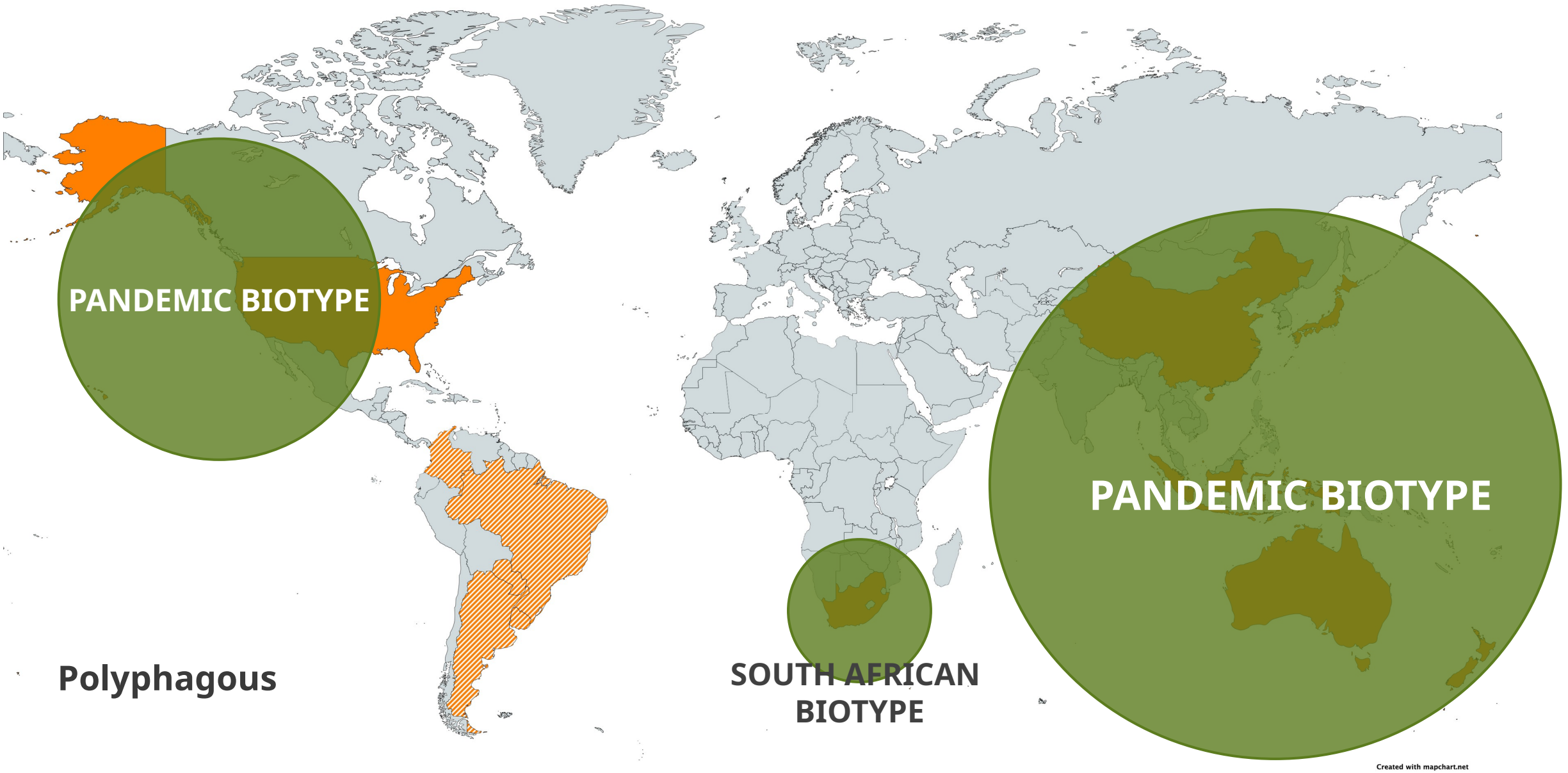
https://www.anpc.asn.au/myrtle-rust/

Native guava - dieback



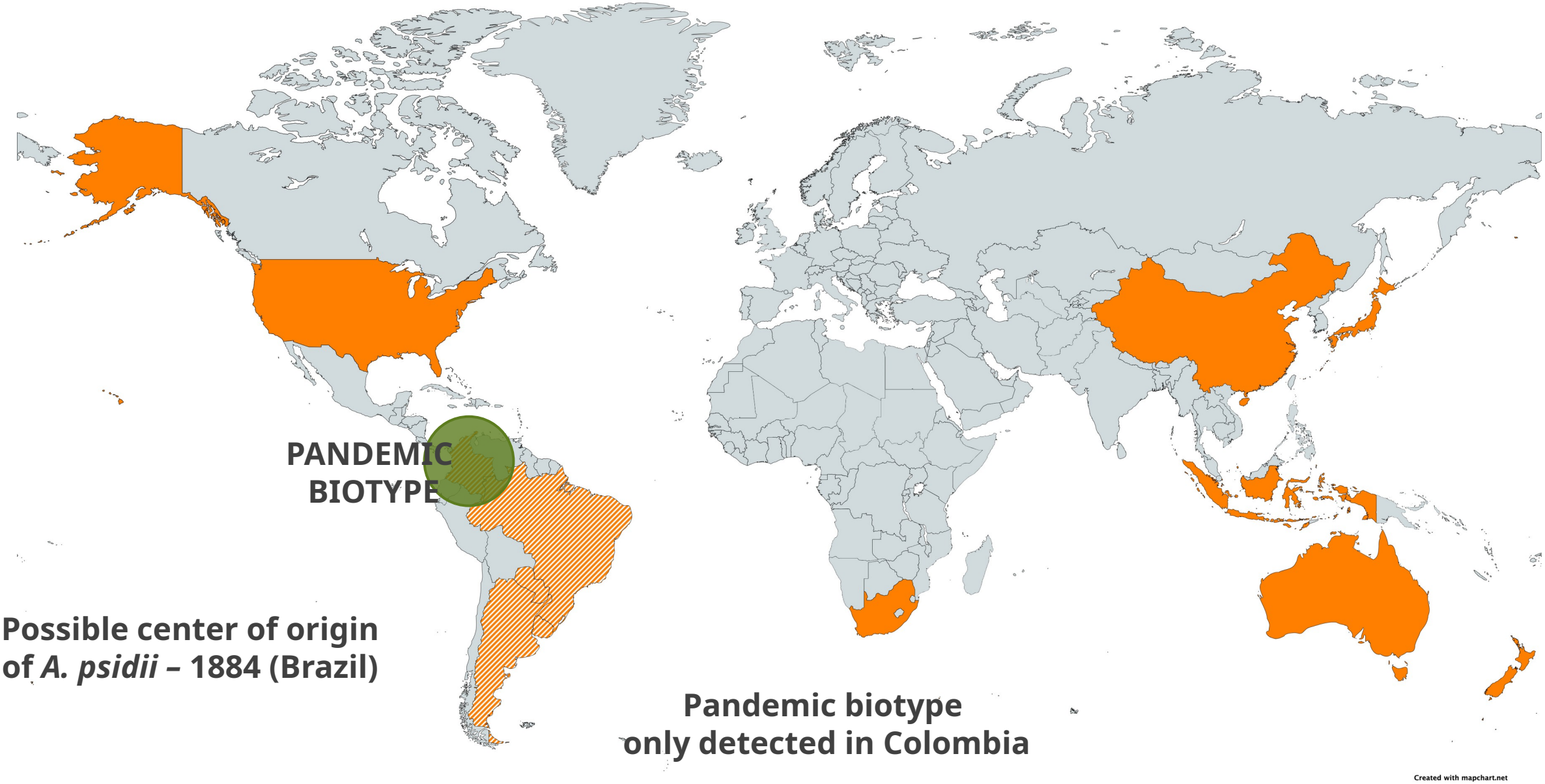
Geoff Peeg, NSW (Australia) - https://www.abc.net.au/news/science/2022-08-10/

WORLD SCENARIO



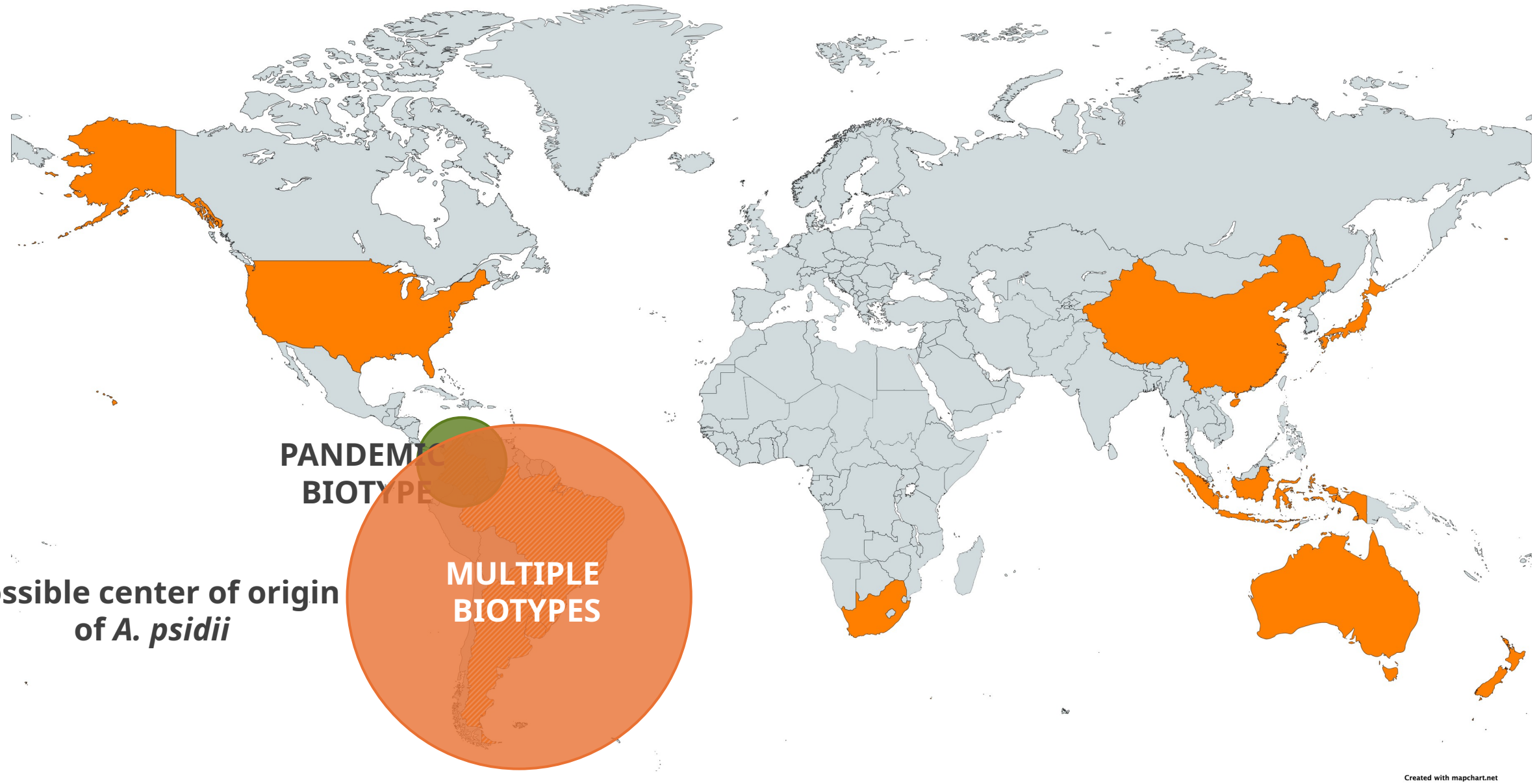
Roux et al., 2016 (10.1007/s13313-016-0447-y); Sandu et al., 2016 (10.1111/ppa.12501) (Stewart et al., 2018 (10.1111/efp.12378); du Plessis et al., 2019 (10.1007/s13313-019

WORLD SCENARIO



Granados et al., 2017 (10.1007/s13313-017-0488-x)

WORLD SCENARIO



Aparecido et al., 2003; Graça et al., 2013 (10.1111/mec.12545); Quecine et al., 2016 (10.1371/journal.pone.0145343); Stewart et al., 2018 (10.1111/efp.12378);

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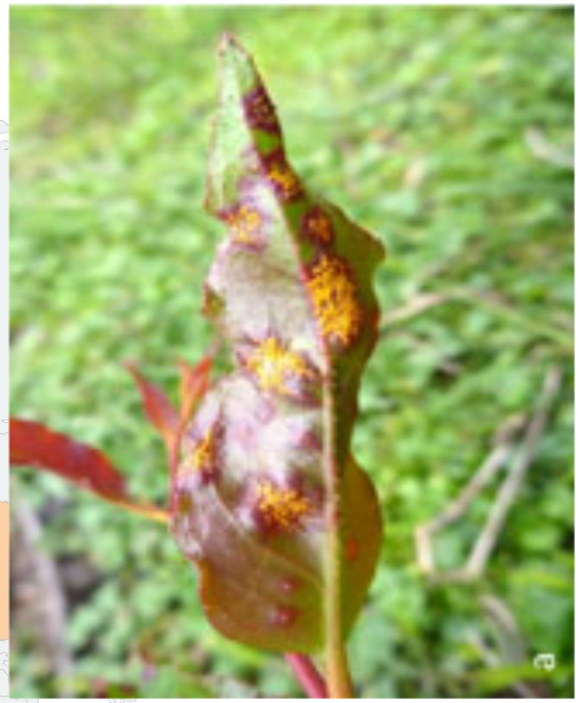
GUAVA



ROSE APPLE



EUCALYPTUS



Carnegie *et al.*, (10.1094/PDIS-09-14-0901-PDN)

Possible center of origin of *A. psidiii*

Aparecido et al., 2003; Graça et al., 2013 (10.1111/mec.12545); Quecine et al., 2016 (10.1371/journal.pone.0145343); Stewart et al., 2018 (10.1111/efp.12378);

What are the genetic traits associated with the rapid global dissemination and establishment of the pandemic biotype of *A. psidii?*

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Comprehend in order to manage...

PATHOGENIC VARIABILITY

Isolate from rose apple



Isolate from guava



Received: 9 May 2023 | Accepted: 3 December 2023
DOI: 10.1111/ppa.13850

ORIGINAL ARTICLE

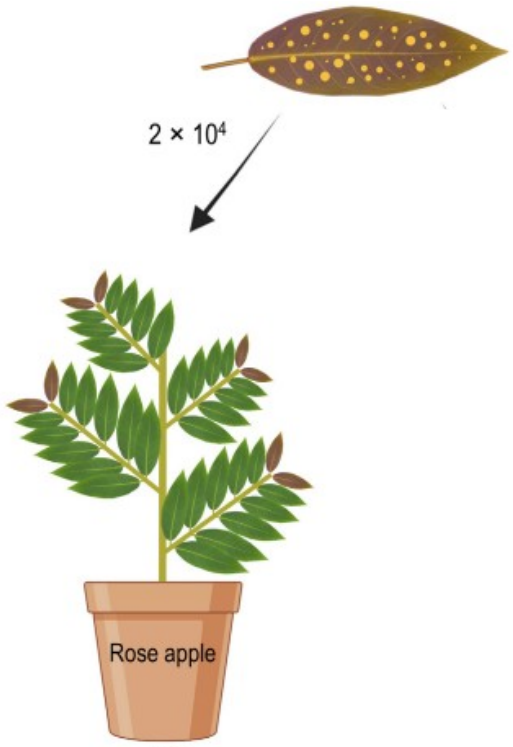
Plant Pathology WILEY

Differential aggressiveness of *Austropuccinia psidii* isolates from guava and rose apple upon cross-inoculation

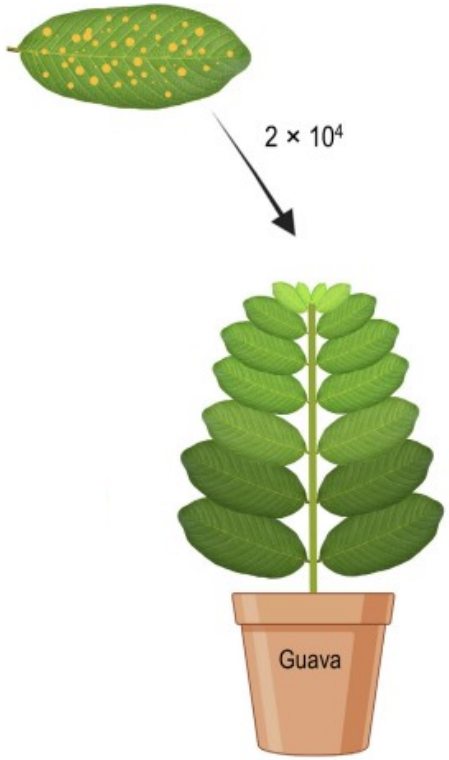
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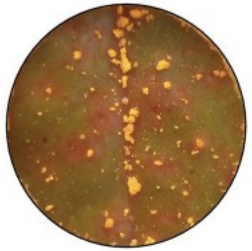
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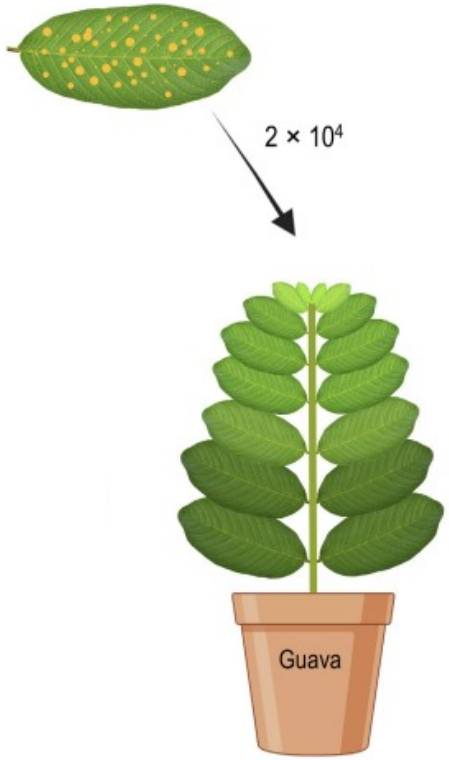
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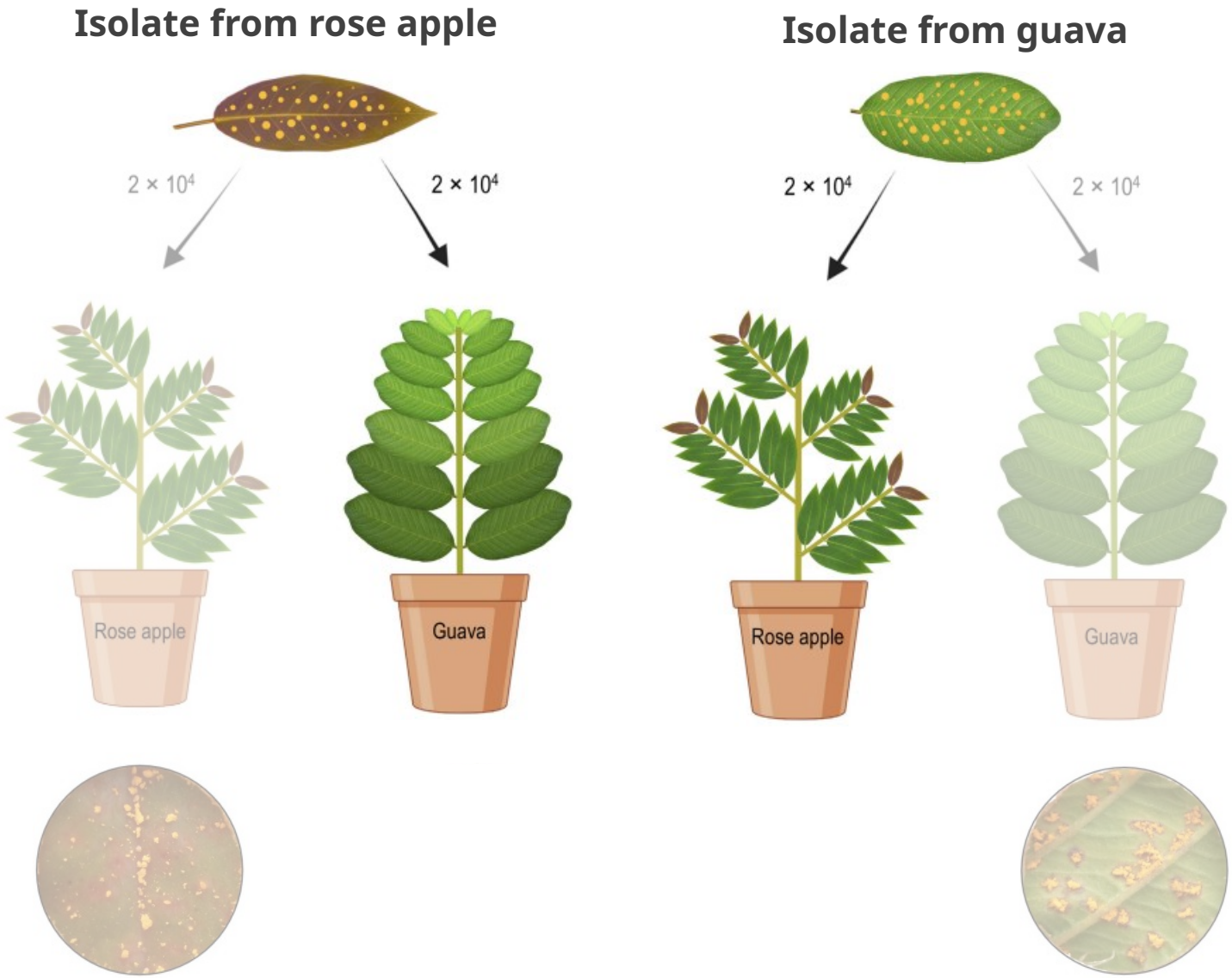
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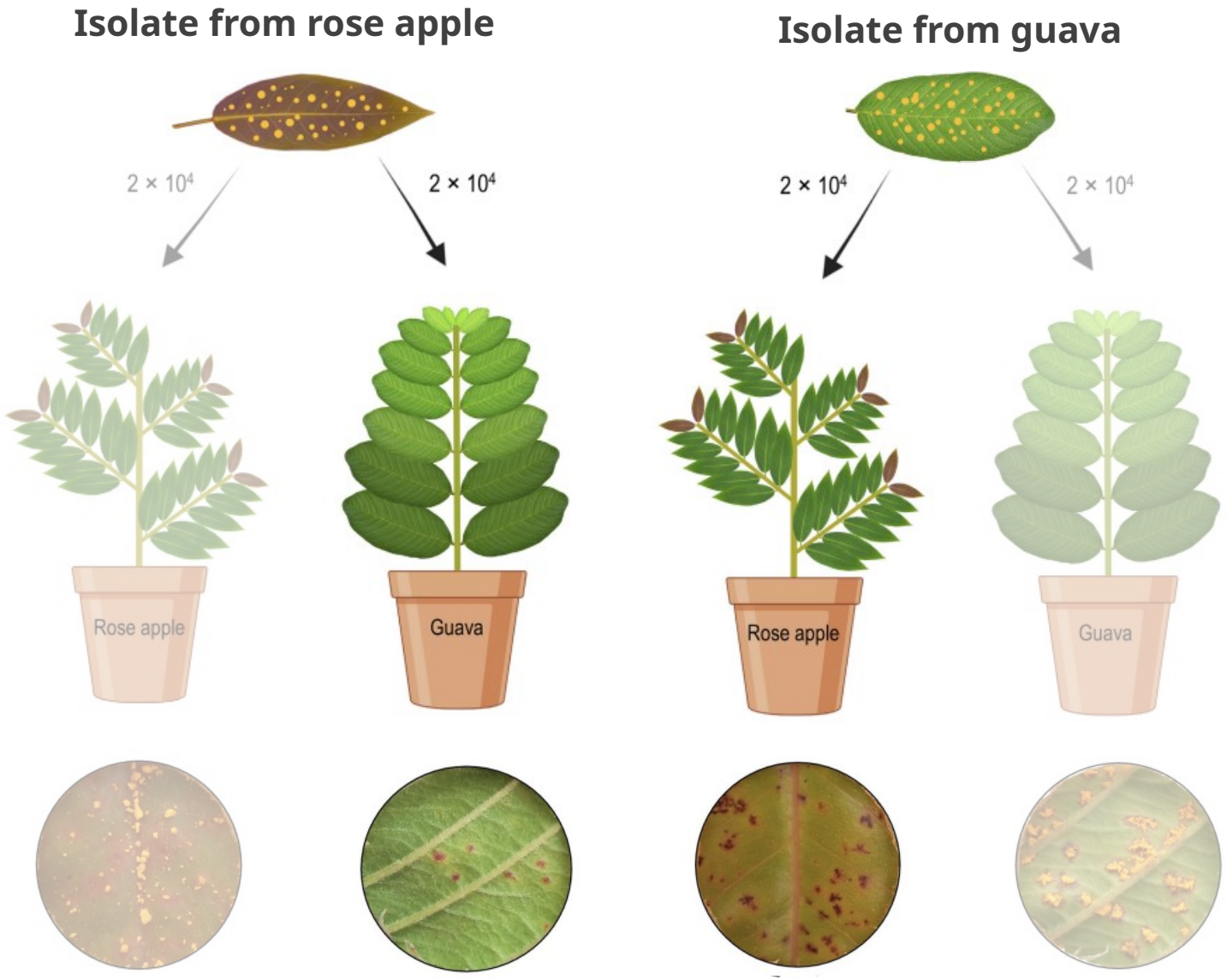
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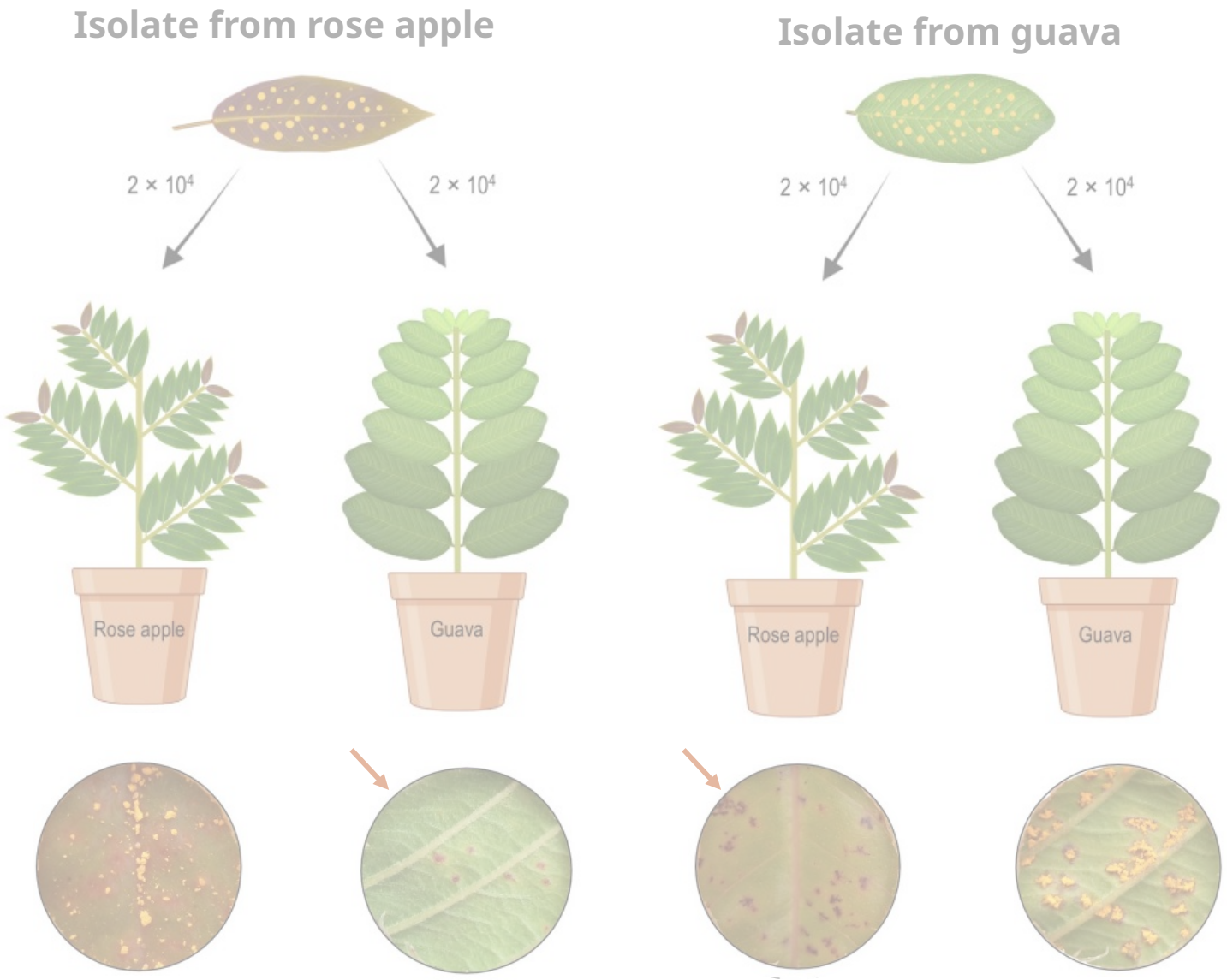
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Sporulation did not ocurred, the life cycle was not completed.

PATHOGENIC VARIABILITY

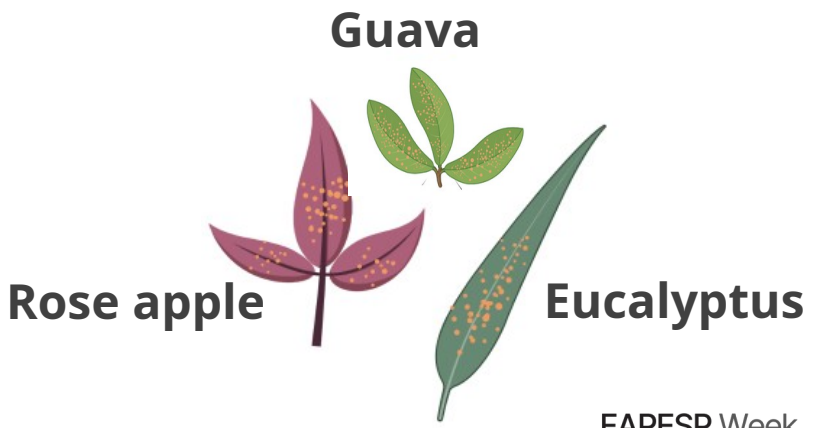


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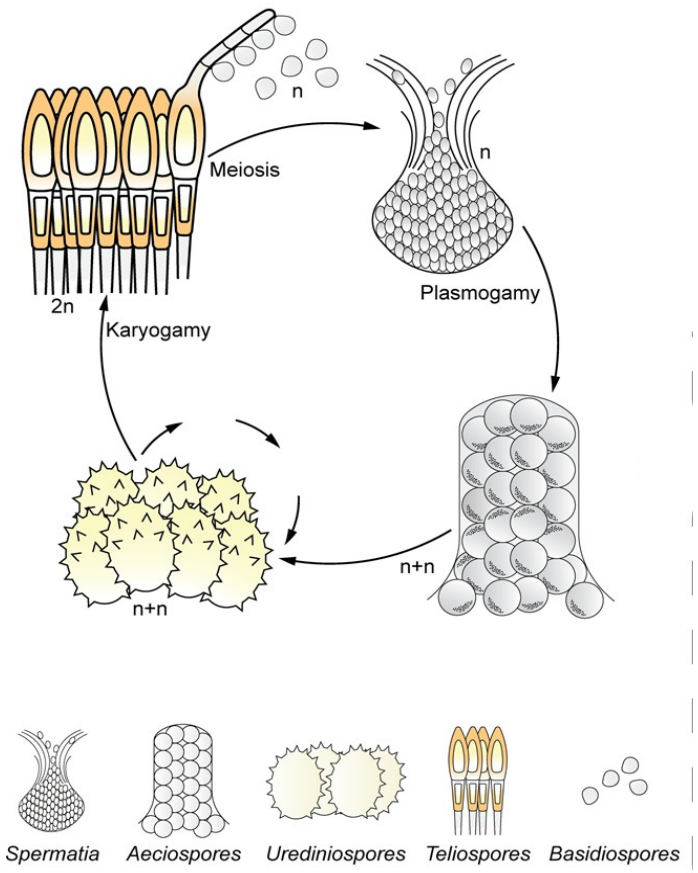
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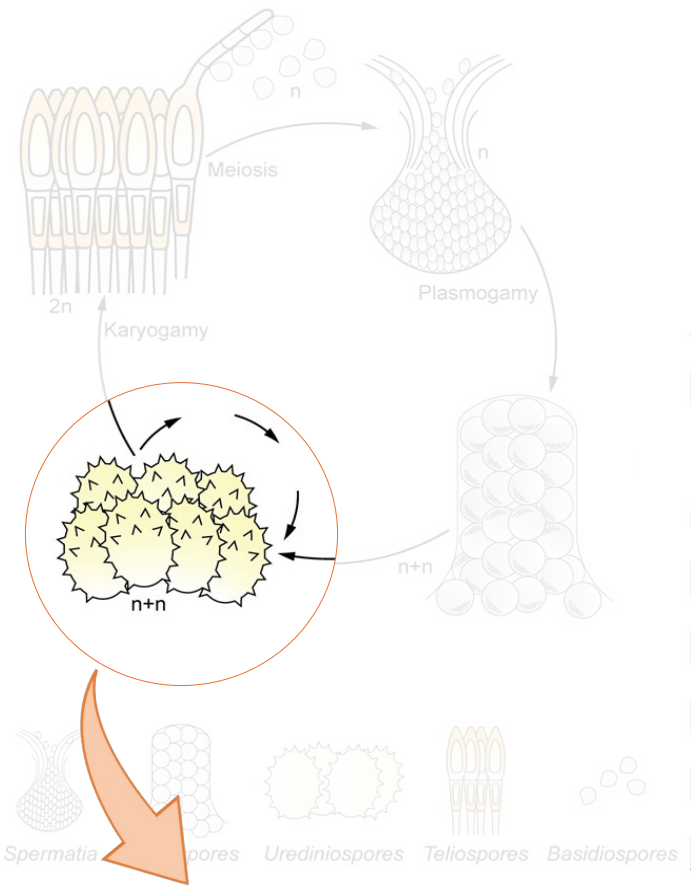


RUST LIFE CYCLE



McTaggart et al., 2022 (DOI: 10.1371/journal.ppat.1010439)

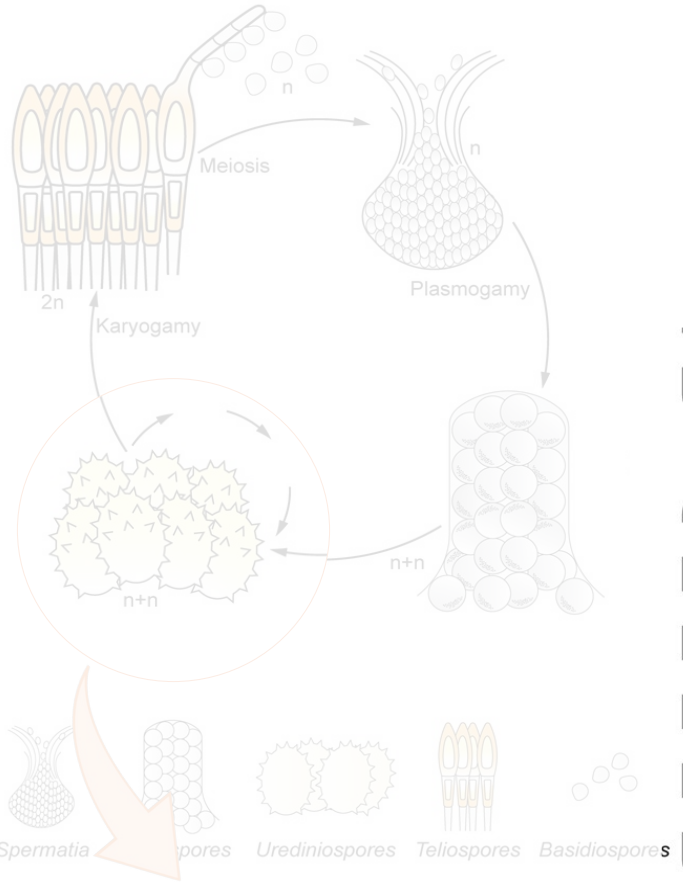
RUST LIFE CYCLE



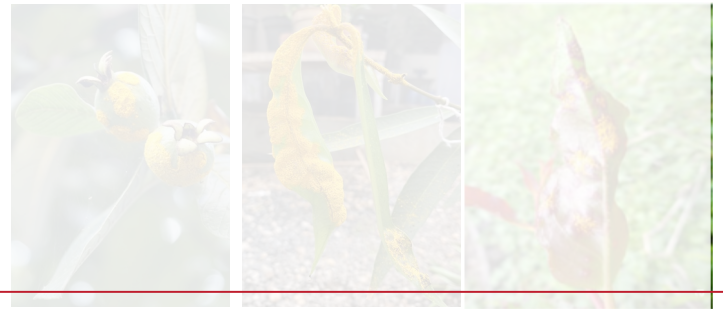
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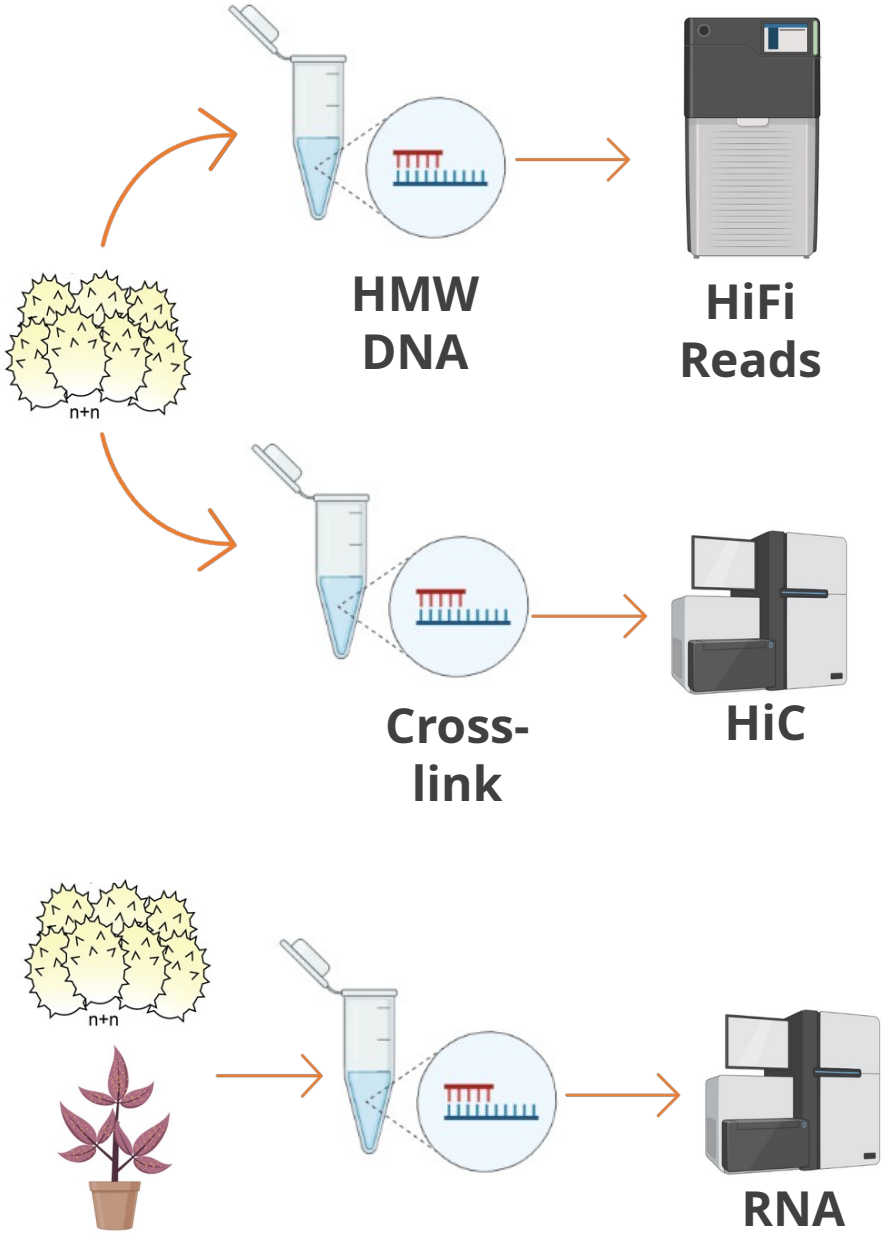


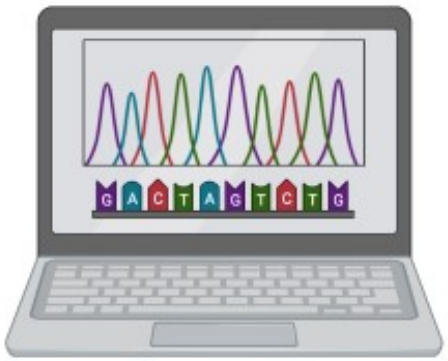
APPROACH



McTaggart et al., 2022 (DOI: 10.1371/journal.ppat.1010439)

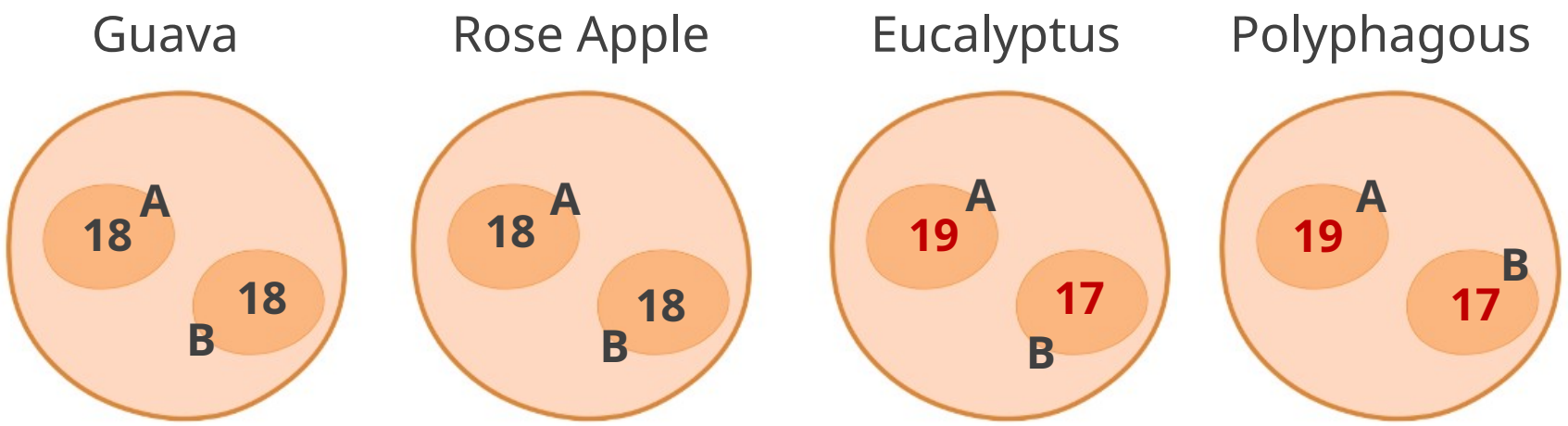






Bioinformatics

Phased chromosome level assemblies

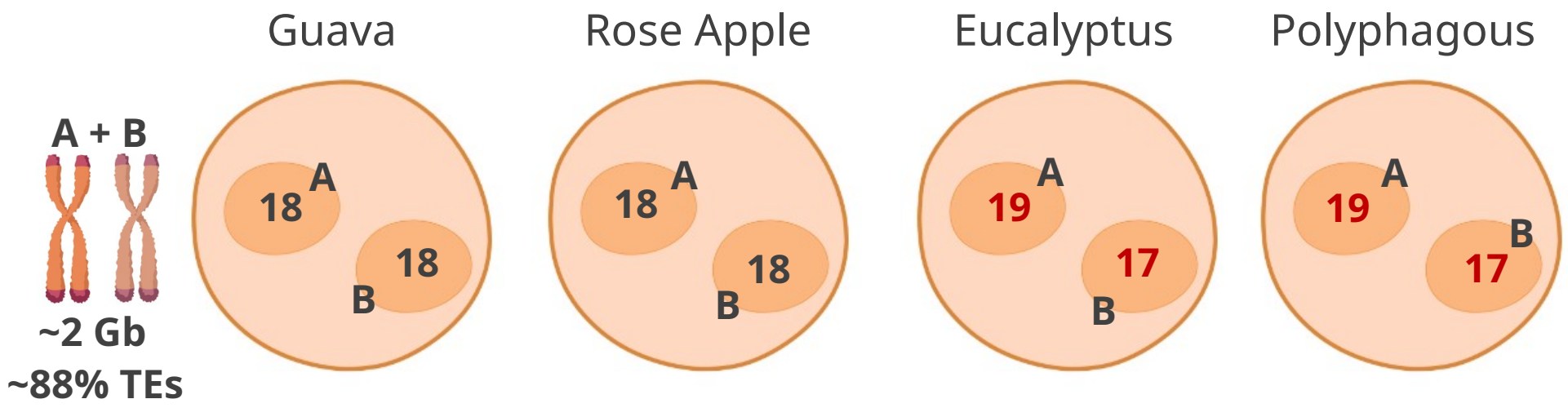


Brazilian strains

Pandemic strain

Eucalyptus MT genome: Ferrarezi et al., (10.1371/journal.pone.0248054); Pandemic biotype assembly: Edwards et al., (10.1101/2022.04.22.489119)

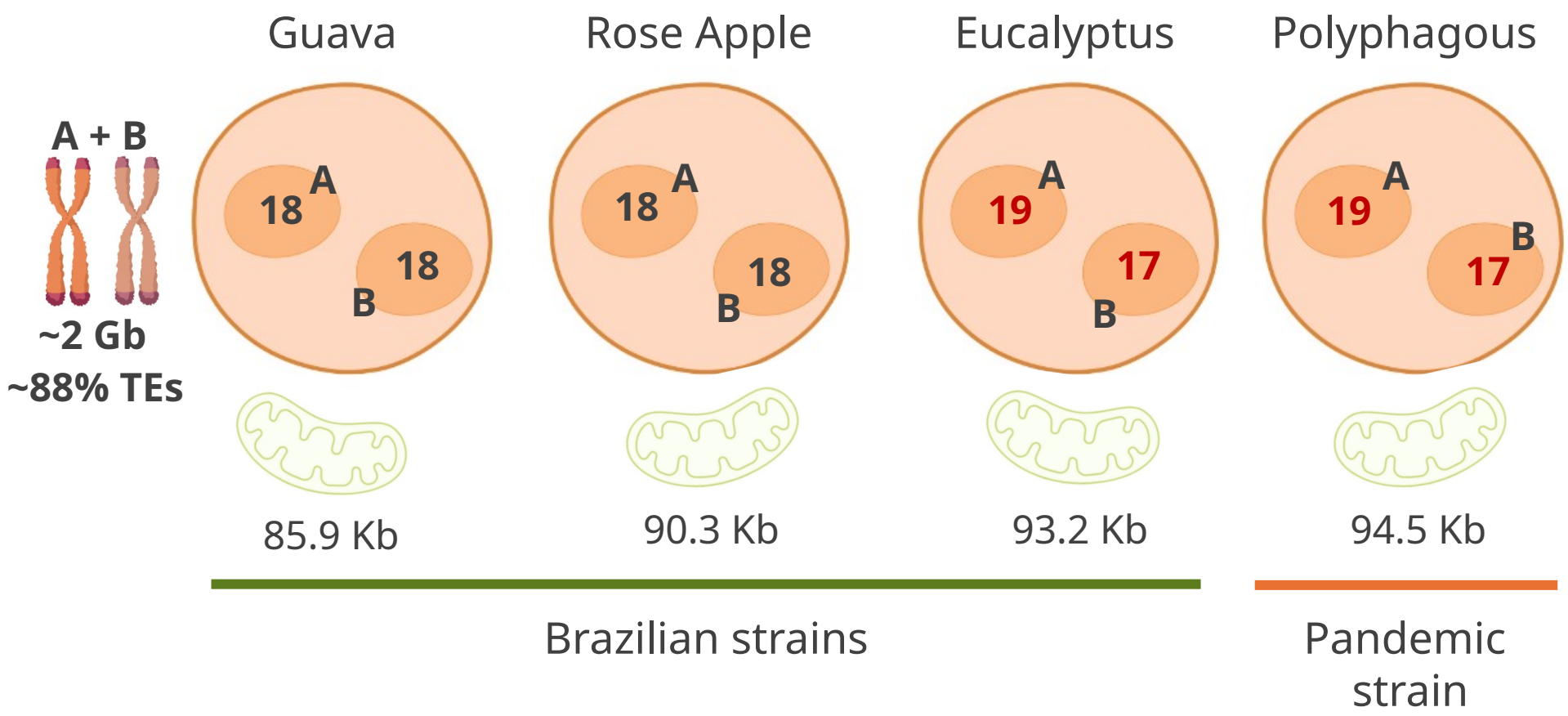
Phased chromosome level assemblies



Brazilian strains

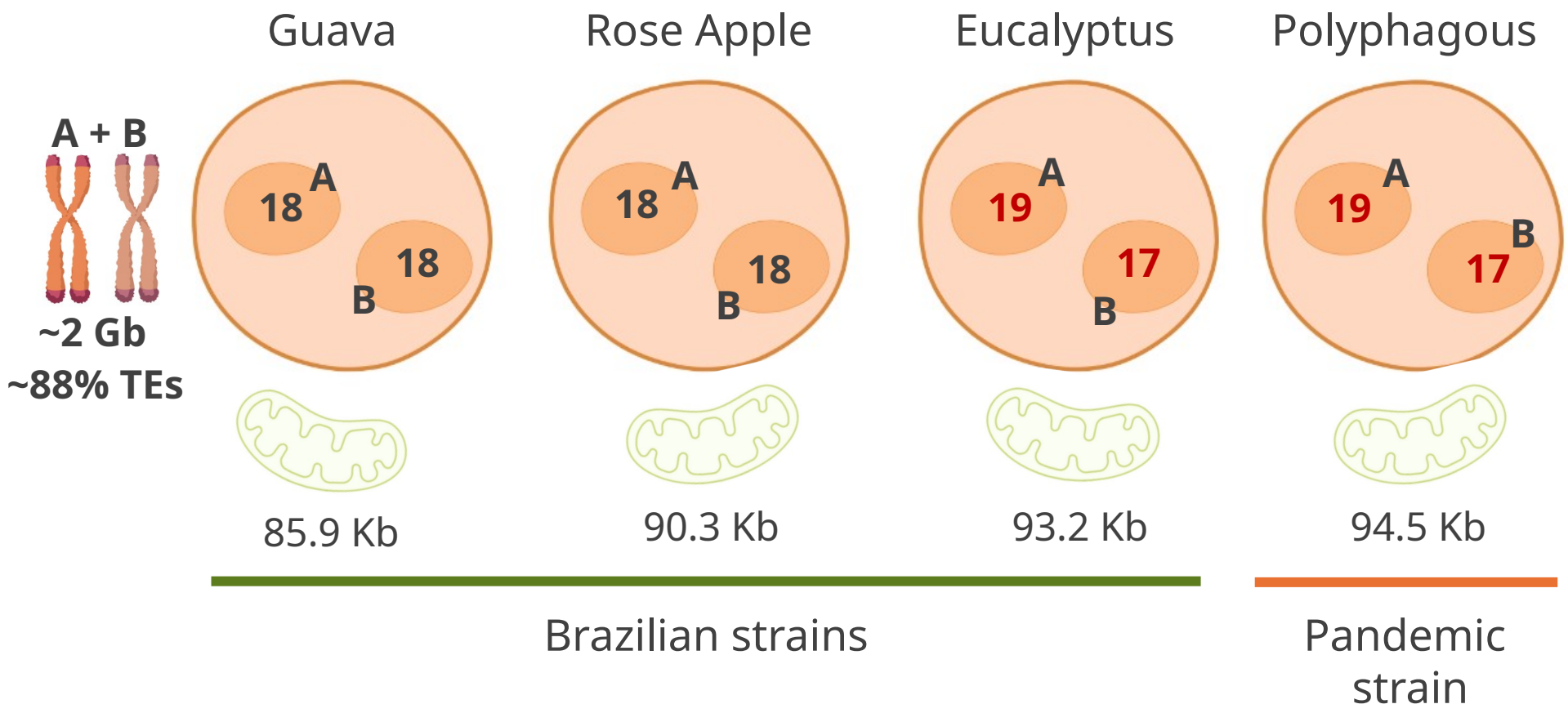
Pandemic strain

Phased chromosome level assemblies



Phased chromosome level assemblies

Representing the four largest fungal genomes assembled thus far



Eucalyptus MT genome: Ferrarezi et al., (10.1371/journal.pone.0248054); Pandemic biotype assembly: Edwards et al., (10.1101/2022.04.22.489119)

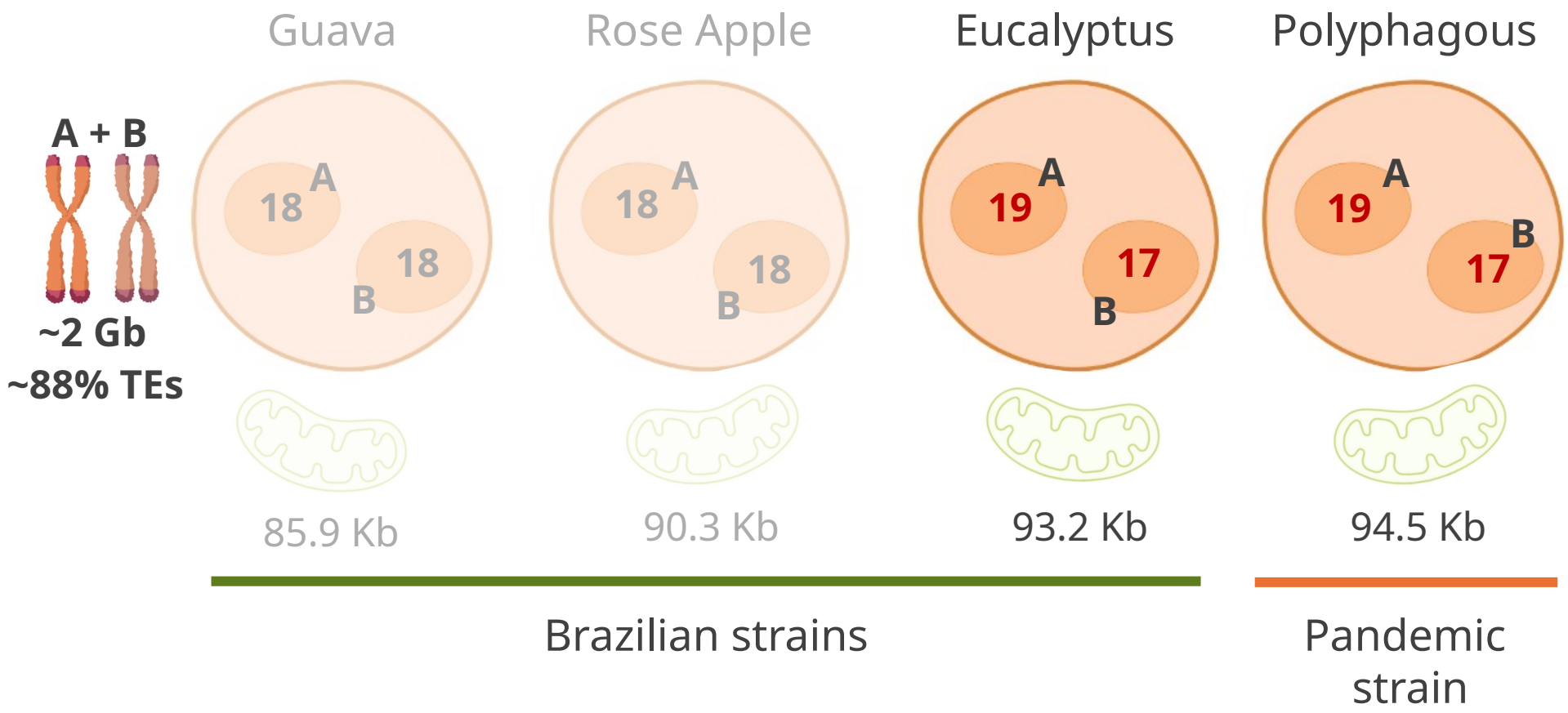


ADVANCES AND FUTURE DIRECTIONS

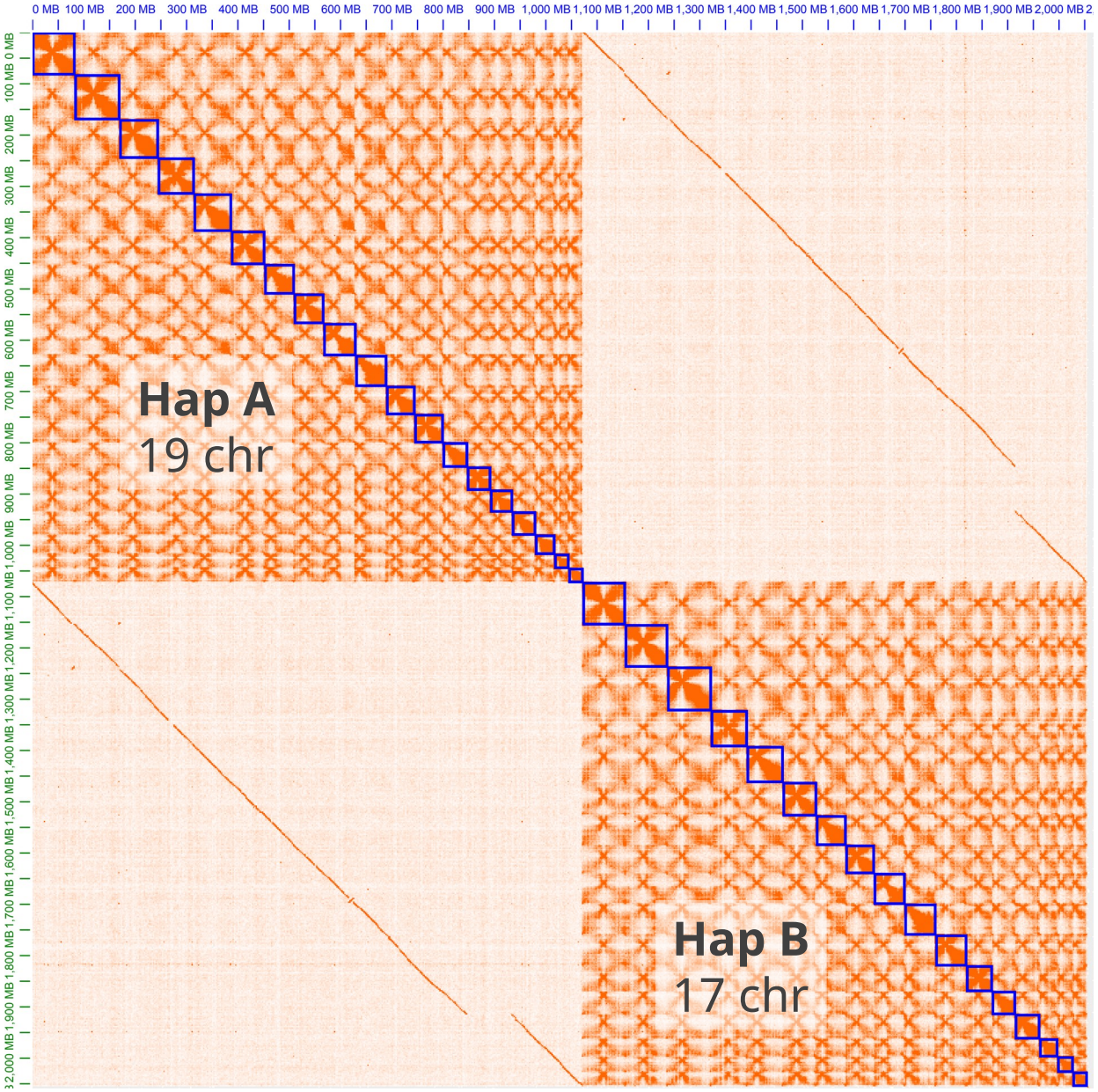
FAPESP Week CHINA 2024, June 28 - 29

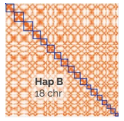
his new resources may allow us to answer fundamental questions in fungal biology...

Phased chromosome level assemblies



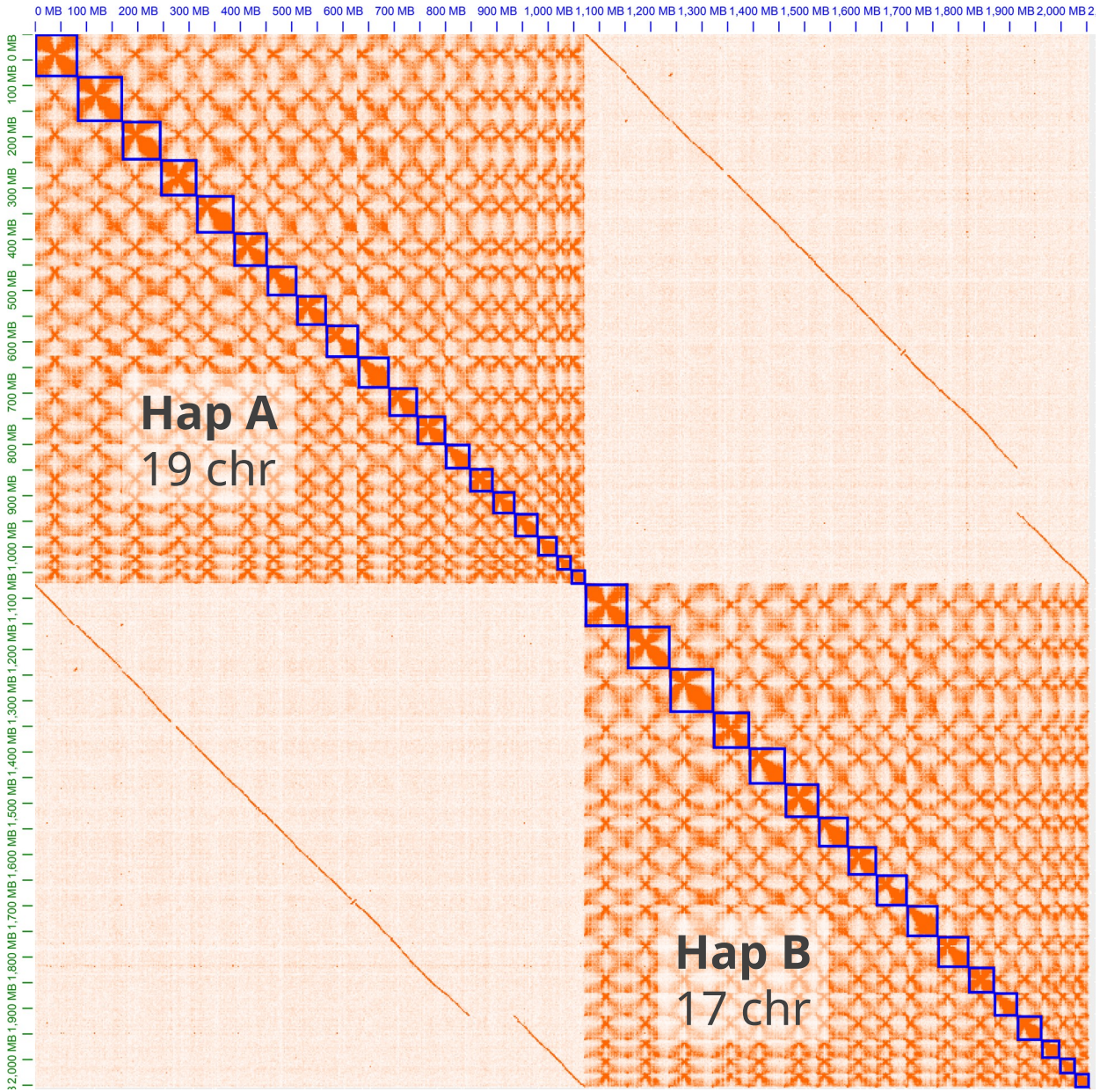
Pandemic

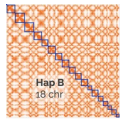




Each orange square represents a **nucleus**

Pandemic

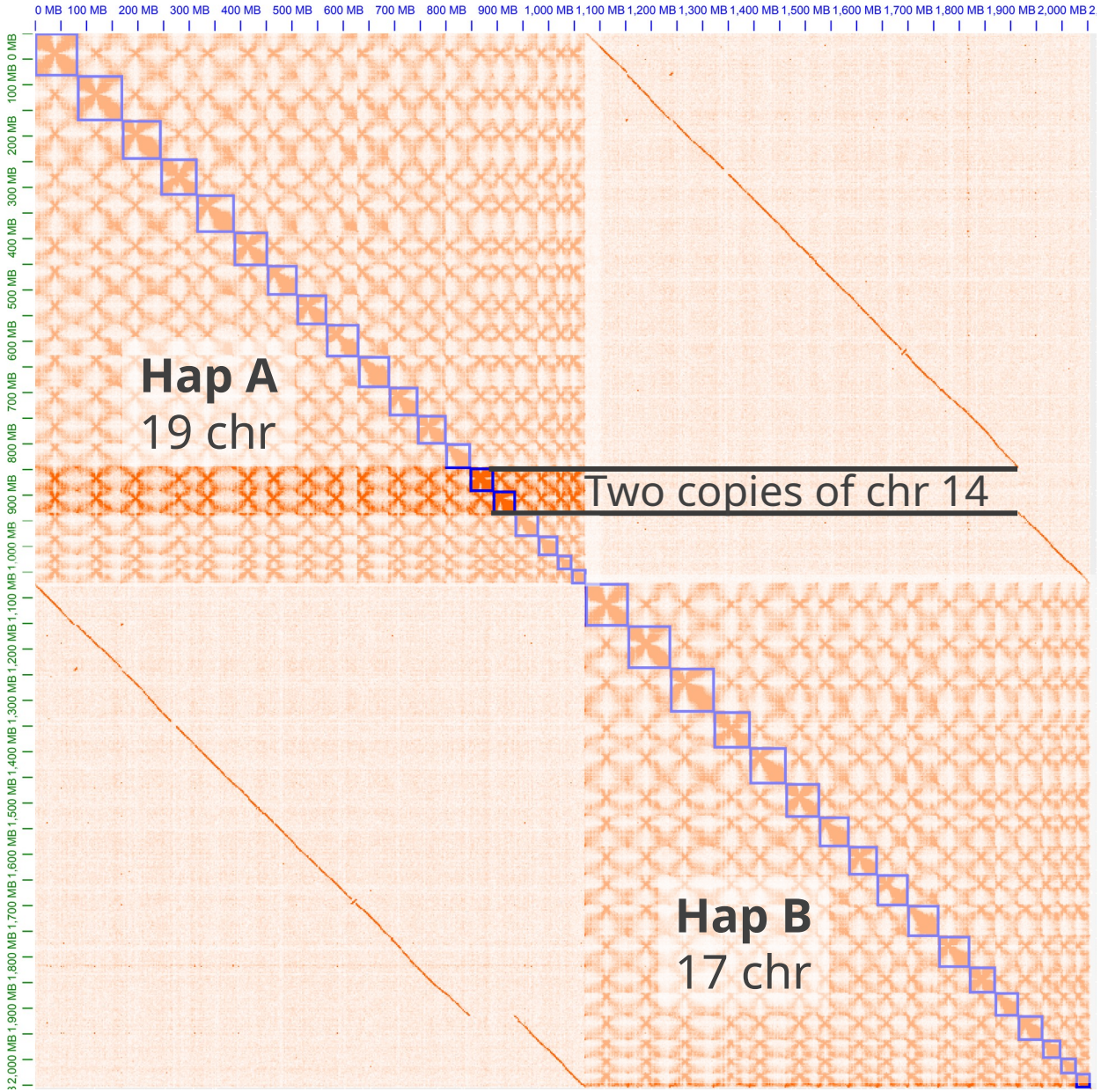


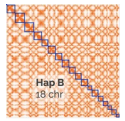


Each orange square represents a **nucleus**

Each blue square represents a **chromosome** within the nuclei

Pandemic





Each orange square represents a **nucleus**

Each blue square represents a **chromosome** within the nuclei

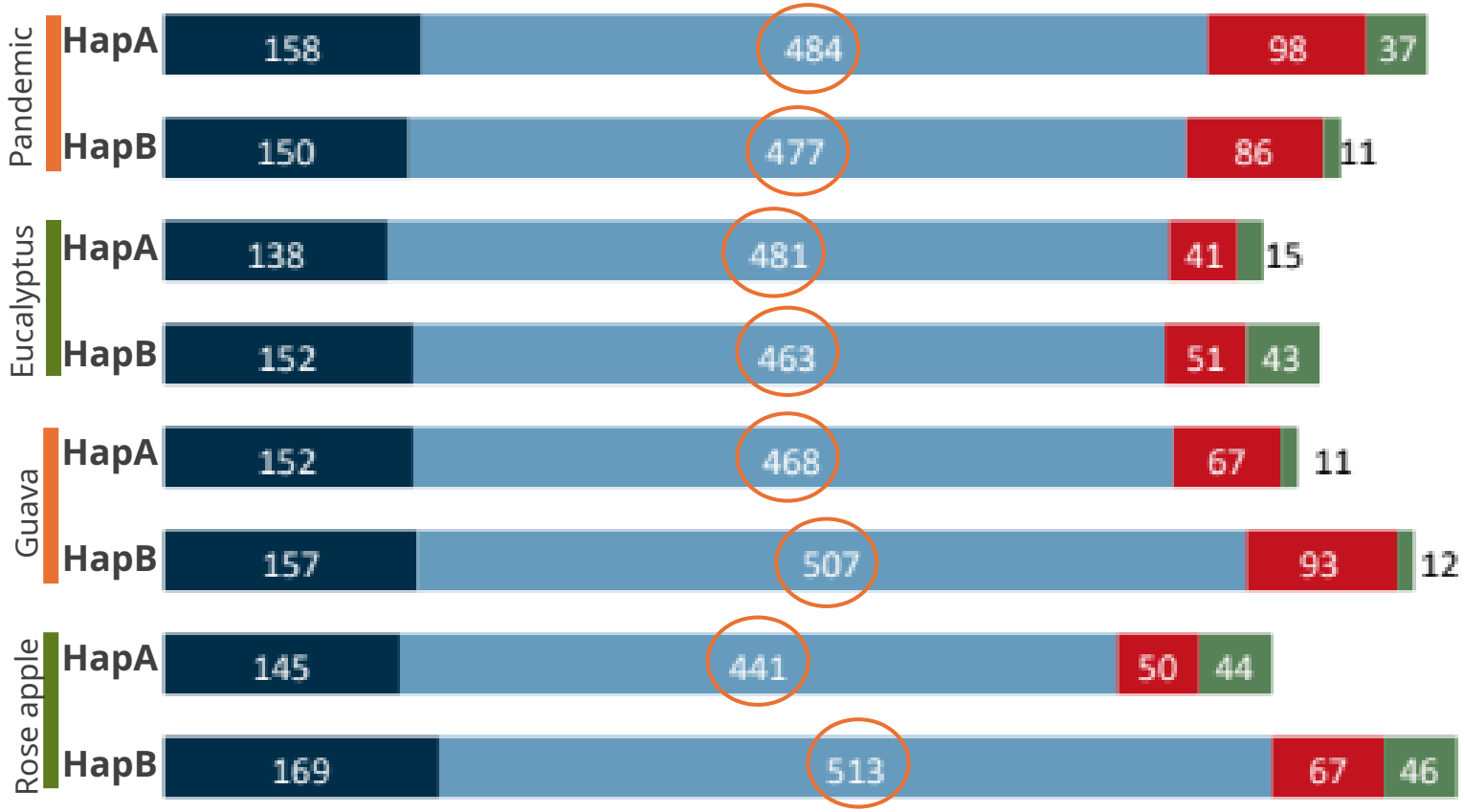
Diagonal lines represent the linkage between the homologous chromosomes in different nuclei

...and also may allow us to find

The genetic traits associated with the rapid global dissemination and establishment of the pandemic biotype of *A. psidii.*

A. psidii specific effector candidates –

Potentially related to the specificity the Mirtaceae family



Shared with other rust species

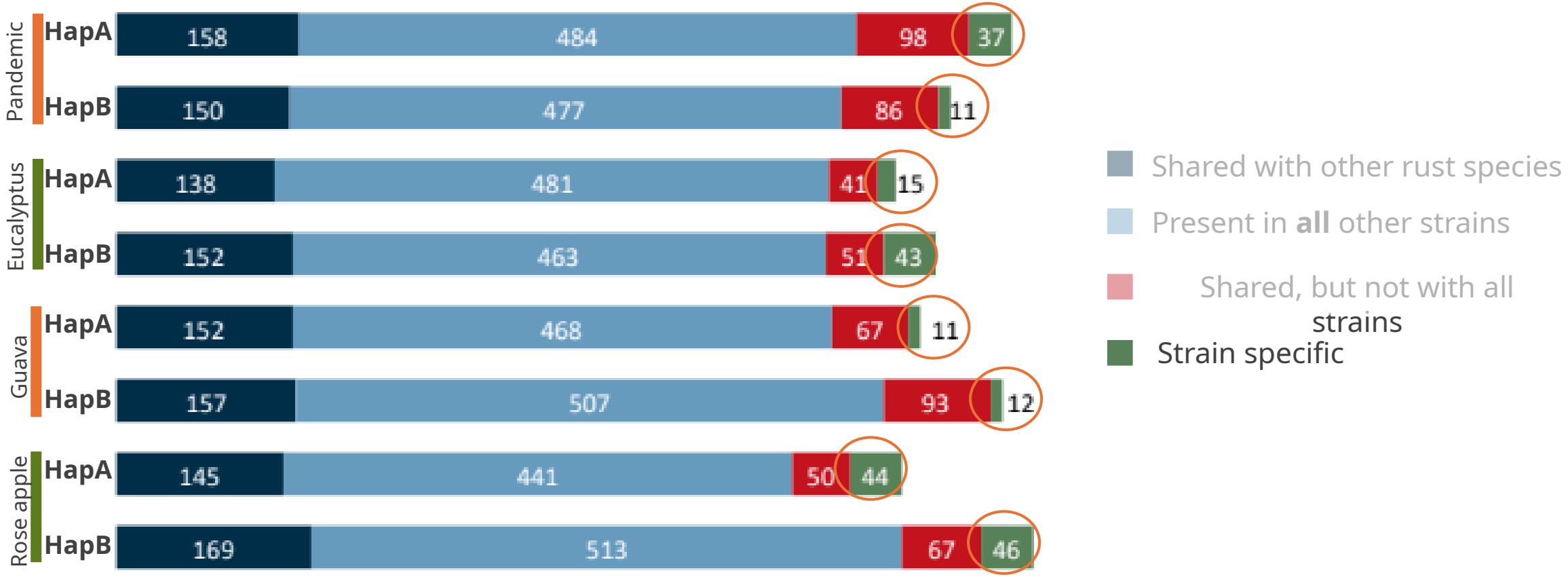
Present in **all** other strains

Shared, but not with all strains

Strain specific

Strain specific effector candidates –

Potentially related to the preference to different host species



NEXT QUESTION

Can the eucalyptus phyllosphere's microbial communities be modulated under selection pressure from different *A. psidii* isolates to reduce rust severity?

We will know in the next two years...

FAPESP Week CHINA 2024, June 28 - 29

ESALQ
Luiz de Queiroz College of Agriculture
University of São Paulo

THANK YOU
谢谢
OBRIGADA

Thaís R. Boufleur, Professor
thaisboufleur@usp.br
ESALQ/USP

FAPESP
SÃO PAULO RESEARCH FOUNDATION

FAPESP Week CHINA 2024, June 28 - 29