

Puccinia psidii

20 μm

What next?

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Outline

- *Puccinia psidii* – a brief introduction
- Biosecurity system in Australia
- Australian biosecurity preparedness and response to *P. psidii*
- What next?



Photo: Angus Carnegie, NSW I&I

A brief introduction

- *Puccinia psidii*, first described from guava in Brazil in 1884 by Winter.
- Several other rusts on Myrtaceae also described by Winter and others in South America.
- Many of these considered synonyms of *P. psidii* by later workers.
- A new name provided for the anamorph by Simpson *et al* 2006 and two additional anamorphs described as distinct species.

A brief introduction

- A new strain contributed to the demise of the allspice industry in Jamaica in the 1930's.
- First described from *Eucalyptus* species in Brazil in 1940's.
- Reduces yield in guava orchards.
- Has become a major pest of *Eucalyptus* plantations in South America.
- Spread to Florida in the 1970's.

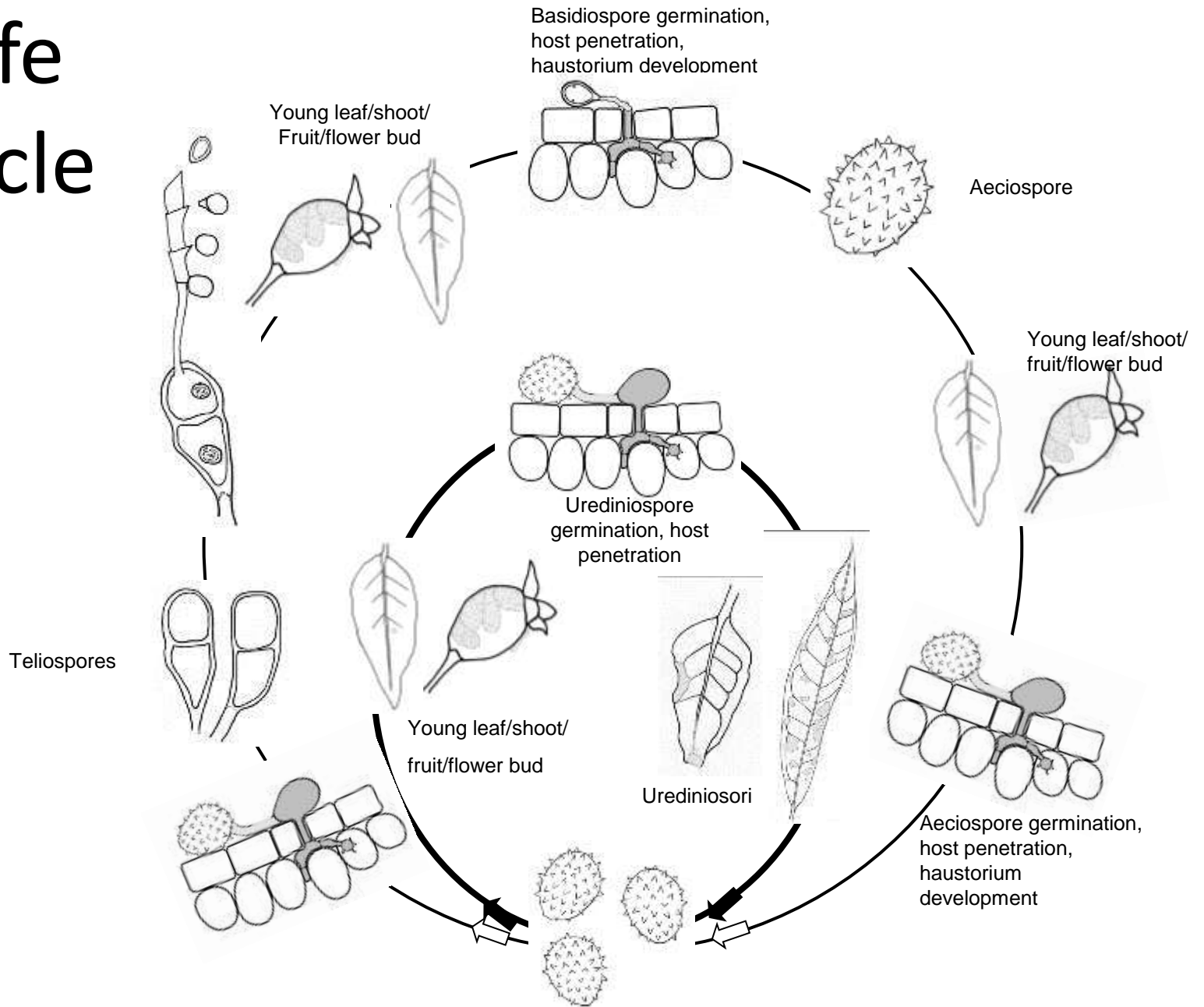
Global Distribution



Damage to hosts



Life Cycle



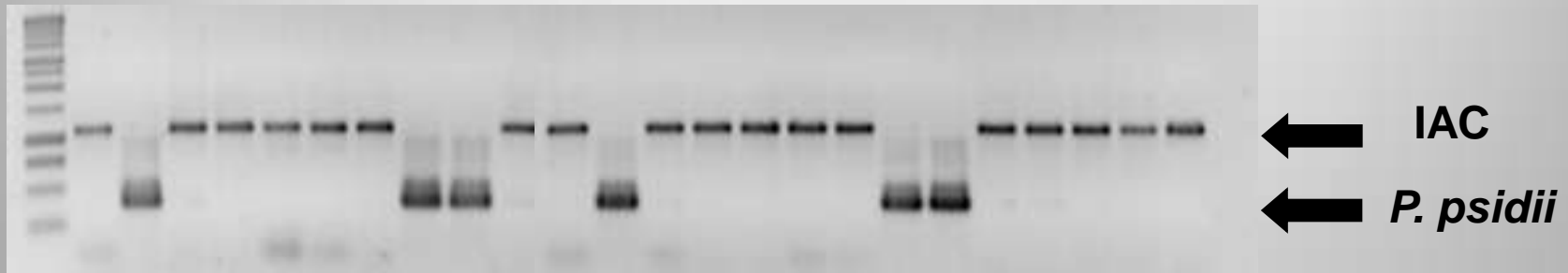


Preparedness in Australia



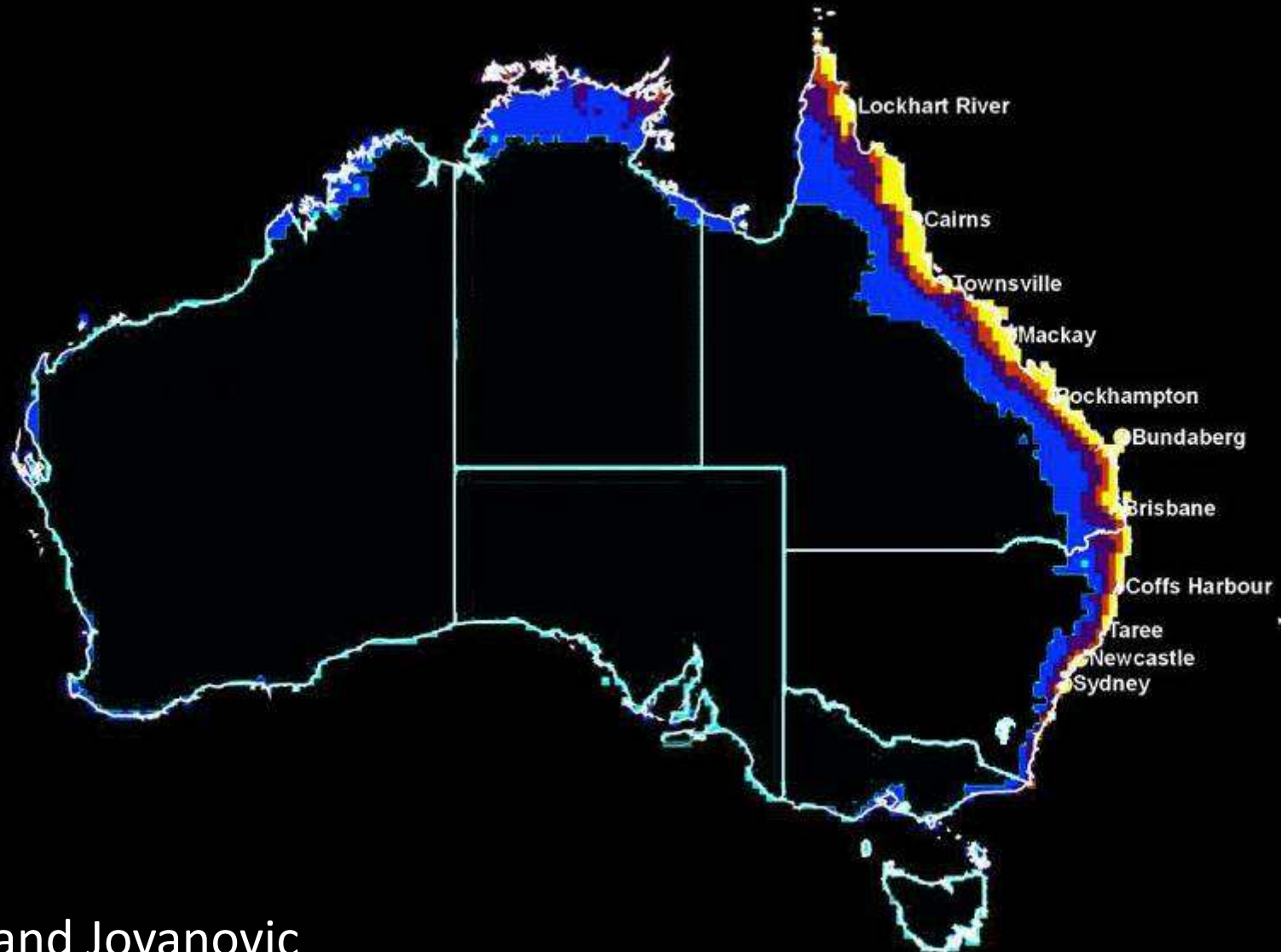
- Australia is centre of diversity for Myrtaceae
- Approx. half of the world's 147 genera and ~3,000 species
- ACIAR-funded project
 - Developed a DNA diagnostic test
 - Climate risk mapping for Australia
 - Susceptibility testing of Australian Myrtaceae species
- DAFF
 - Pathways risk analysis
 - Contingency plan

Highly sensitive nested PCR test

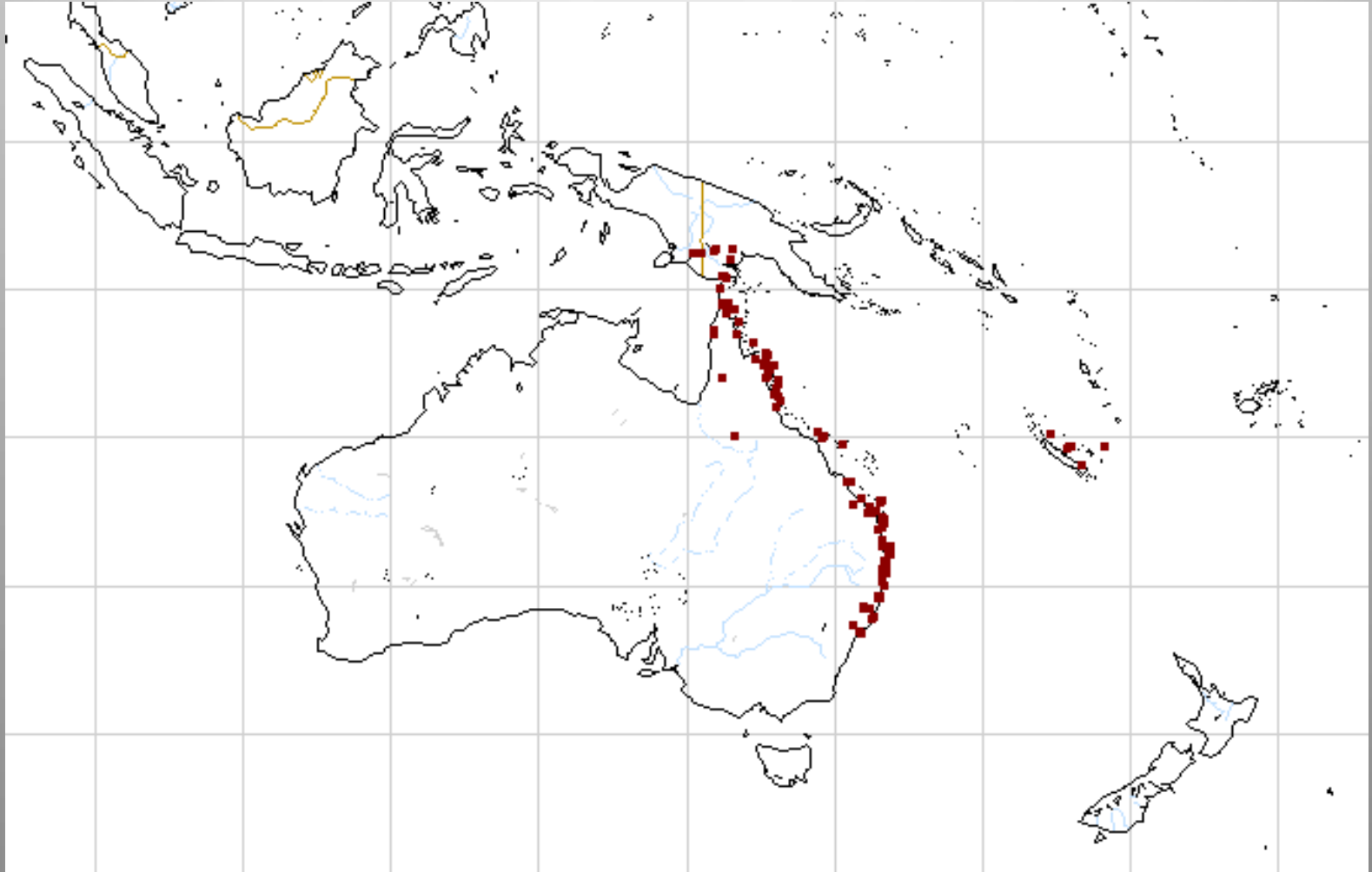


- The nested PCR can detect as few as 4 spores on a leaf sample.
- Spores have been detected:
 - In commercial pollen
 - On personal effects of plantation visitors, including clothing, cameras and spectacles
 - On container and timber surfaces
 - In 2004, spores were detected on a shipment of timber from Brazil and identified as *P. psidii*

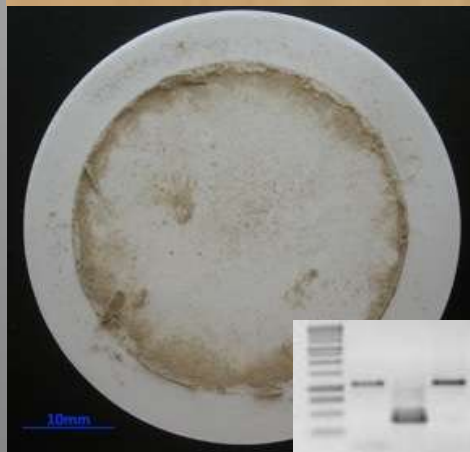
Climatic risk mapping



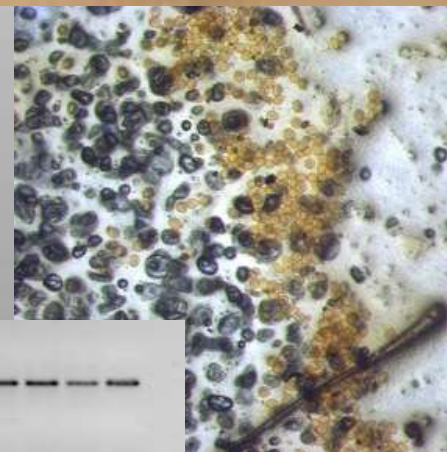
Distribution of the highly susceptible host *Melaleuca quinquenervia*
– an ecologically important riparian species
(locations based on herbarium specimens)



Rust Risk Pathways



DAFF-funded, ACERA led project



Plant Biosecurity in Australia

- Based on an agreement between plant industries and government.
- Peak industry bodies sign an agreement ('the DEED') and contribute funds.
- Not all plant industries have signed up.
- Industry liaison through Plant Health Australia (PHA).
- Forestry has not signed
 - Which peak body?
 - Industry in poor economic state.
 - Many state-owned forestry companies.
 - No specified limits to cost contribution for incursion response.

Incursion response in Australia

- Decisions made by CCEPP
 - Chaired by CPPO (DAFF, federal)
 - Representative from each state and territory
 - Representative from each affected industry
 - Observer from PHA
- Cost sharing based on pest categorisation
 - Category 1 – 80% industry/20% government
 - Category 2 – 50% industry/50% government
 - Category 3 – 20% industry/80% government
 - Category 4 – 100% government
- Managed by state agency.

P. psidii in Australia

- Detected on a cut-flower property, 23rd April, 2010
 - Usual diagnostic channels not used
 - Identified as *Uredo rangelii* based on morphology
 - *P. psidii* contingency plan removed from DAFF website
- CCEPP meeting on 30th April declared it ineradicable
 - Forest industry not represented
 - Environmental agencies - represented
 - Delimiting surveys not completed
 - DNA analysis not undertaken
 - Presumptions about behaviour based on experience with cereal rusts
 - Cut flower industry had not signed DEED – precedent?



Photo: Angus Carnegie, NSW I&I

P. psidii in Australia



- NSW agency continued efforts to contain but with limited resources.
- Industry lobbying led to reinstatement of emergency response in July.
- Infected plants had been moved through nursery trade.
- Rust detected in native forests.
- Emergency response called off in December 2010.
- Rust found in a Queensland nursery, December 2010.

Host range

- 125 host species from 35 genera in Australia
 - Host species in Australia now outnumber those in the rest of the world.
- Host testing indicates several *Eucalypt* species are susceptible, but most have some genetic resistance.
- Inoculation tests unsuccessful for *Psidium guajava*, but infected guavas subsequently found.

Impact

Severe on:

- *Choricarpia leptopetala*
- *Melaleuca quinquenervia*
- *Rhodamnia rubescens*
- *Rhodomyrtus psidioides*
- *Agonis flexuosa*
- *Gossia* (= *Austromyrtus*)
inophloia
- *Syzygium anisatum*
- *S. jambos*



Photos: Angus Carnegie, NSW I&I



Queensland funding

- Susceptibility of key Queensland eucalypt species to *Puccinia psidii*
- Epidemiology
 - Factors influencing spread and impact of disease
- Host range
 - Variability within species
- Pathogen variability
 - Are there differences in isolate pathogenicity?
 - Is the pathogen changing over time?

DAFF (federal) funding

- Identification of resistance genes
- Fungicides
- Phylogenetic position of *P. psidii*
- Phenotyping
- Genomic sequencing

Thank you for your attention



Photo G. Pegg



Photos G. Pegg

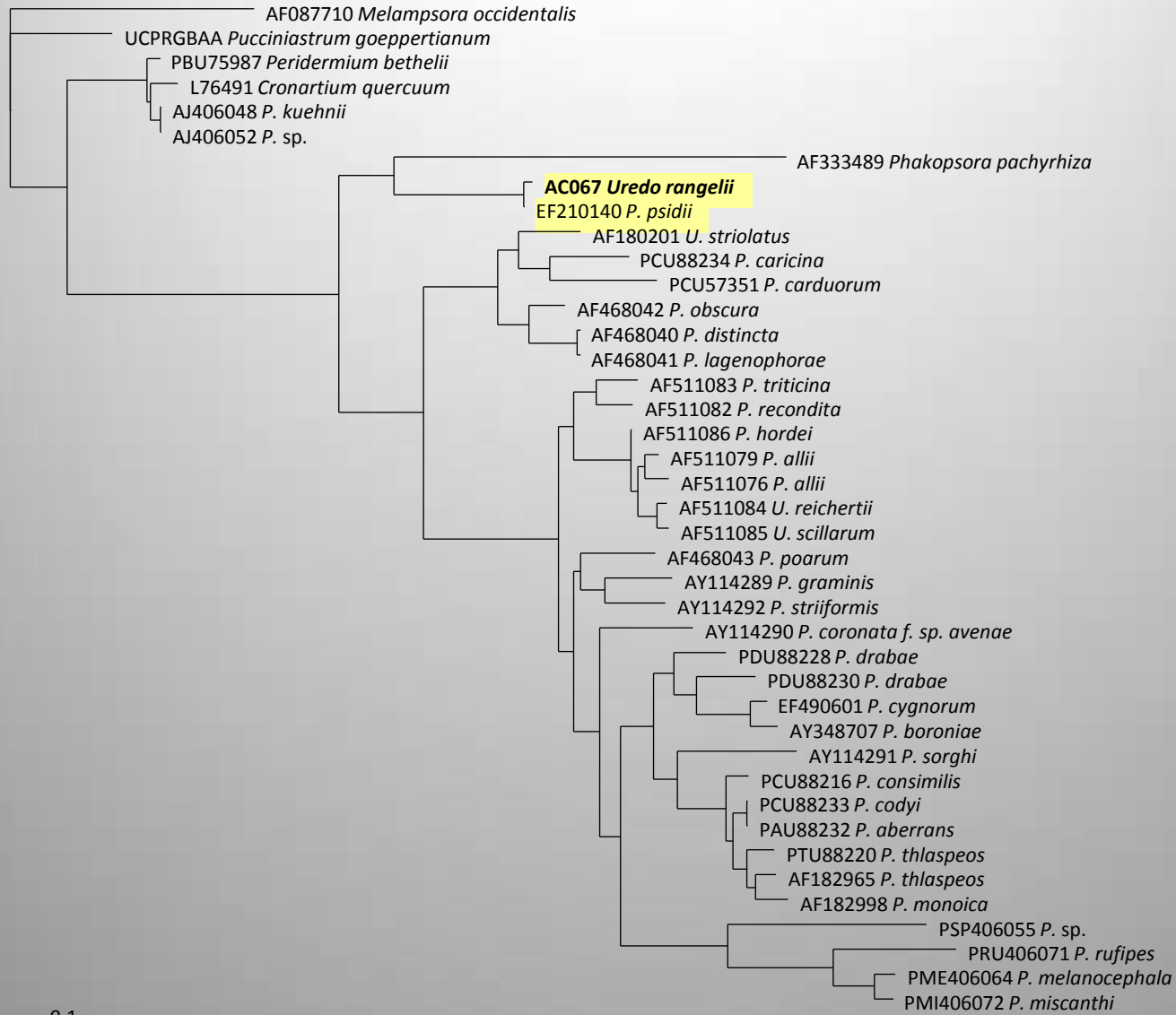


Impact on flower production – food source/regeneration



Microsatellite analysis

- A single MLG from 7 host species
 - *Agonis flexuosa*
 - *Metrosideros collina*
 - *Melaleuca quinquenervia*
 - *Rhodamnia rubescens*
 - *Syncarpia glomulifera*
 - *Syzygium australe*
 - *Tristania neriifolia*



Maximum Likelihood tree based on rDNA internal transcribed spacer sequences.
 Abbreviations: *P* = *Puccinia*, *U* = *Uromyces*

DQ354543 *P. podophyllii*

AC067 *Uredo rangelii*

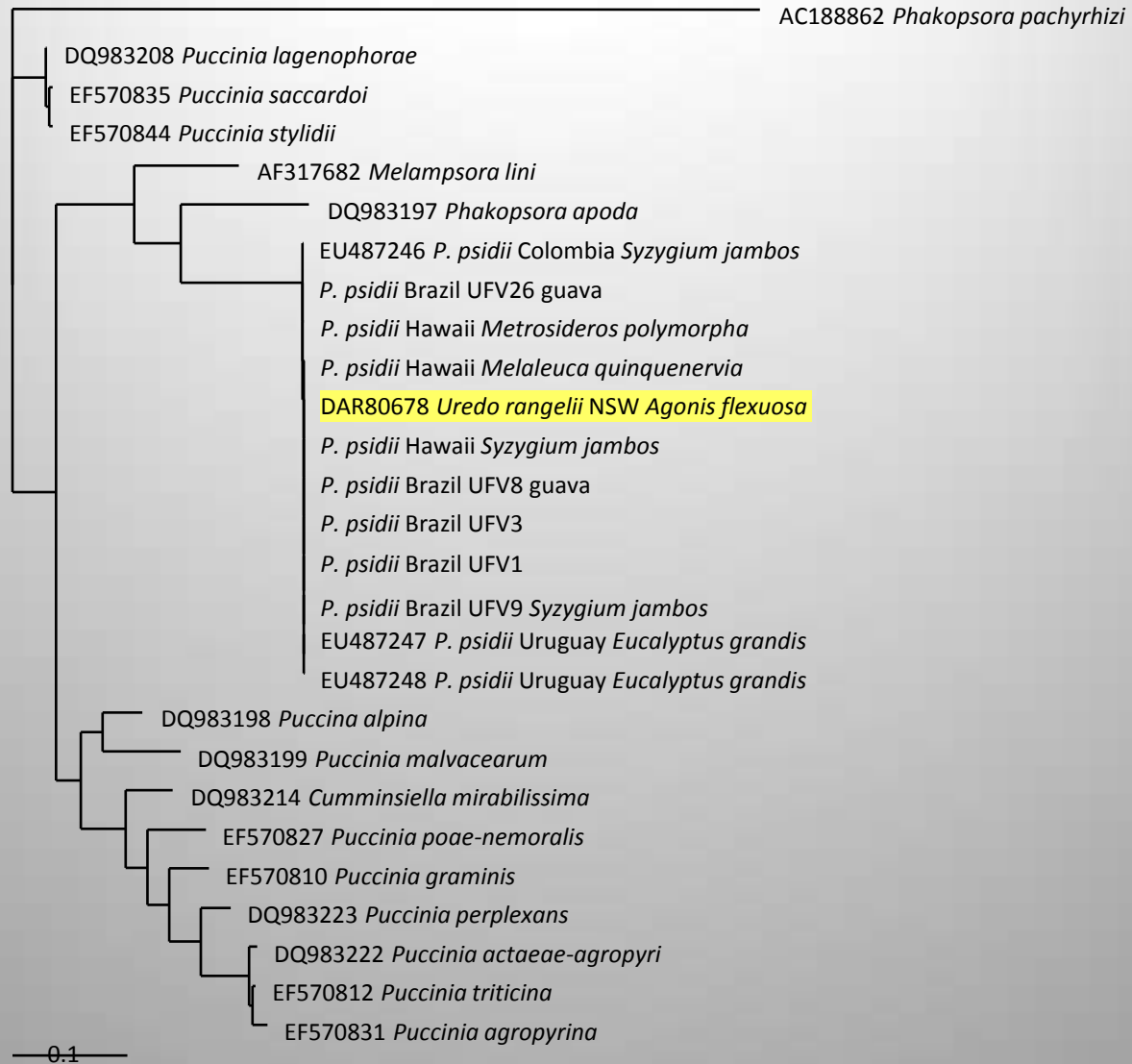
- EU348742 HNR Uruguay
- EU711422 HNR Uruguay
 - EF210143 *Eugenia uniflora*, Br?
 - EF210144 *Eugenia uniflora*, Br?
 - AJ421808 *S. jambos*, Viçosa, Br.
 - AJ421803 *E. grandis*, Viçosa, Br.
 - AJ535658 *M. quinquenervia*, Fl.
 - AJ421805 *Myrciaria cauliflora*, Viçosa, Br.
 - AJ536601 *Psidium guajava* Santa Catarina, Br
- EU348743 HNR Uruguay
 - EF210142 *S. jambos*, Viçosa, Br.
 - AJ535661 *Psidium guajava*, South Bahia
 - EU071048 HNR biotype 02
 - EU711421 *Metrosideros polymorpha* Hi.
 - EU071046 *M. quinquenervia* Hi.
 - EF210141 *Psidium guajava*, Viçosa, Br.
- EU439921 HNR Uruguay
 - EU439920 HNR Uruguay
 - EU711419 *M. quinquenervia* Fl.
 - EF599767 HNR Fl.
 - EU071045 *M. quinquenervia* Hi.
 - EU071047 HNR biotype 00
 - AJ421806 *S. jambos* Viçosa, Br.
- AJ535659 *Pimenta dioica* Fl.
- EU348744 HNR Uruguay
- AJ421801 *Eugenia uniflora* Viçosa, Br.
- AJ536603 *E. grandis* Bahia, Br.
- EU711423 *S. jambos* Colombia
- AJ535657 *S. jambos* Fl.
- AJ421802 *M. quinquenervia* Viçosa, Br.
- AJ421807 *S. jambos*, Viçosa, Br.
- AJ535660 *E. sp.* Br.
- AJ536602 *E. grandis* Bahia Br.
- AJ421800 *S. jambos*, Viçosa, Br.
- AJ421804 *E. grandis*, Viçosa, Br.
- EF599768 HNR Hi.
- EU711420 *S. jambos* Hi.

Puccinia psidii from various hosts and geographic locations

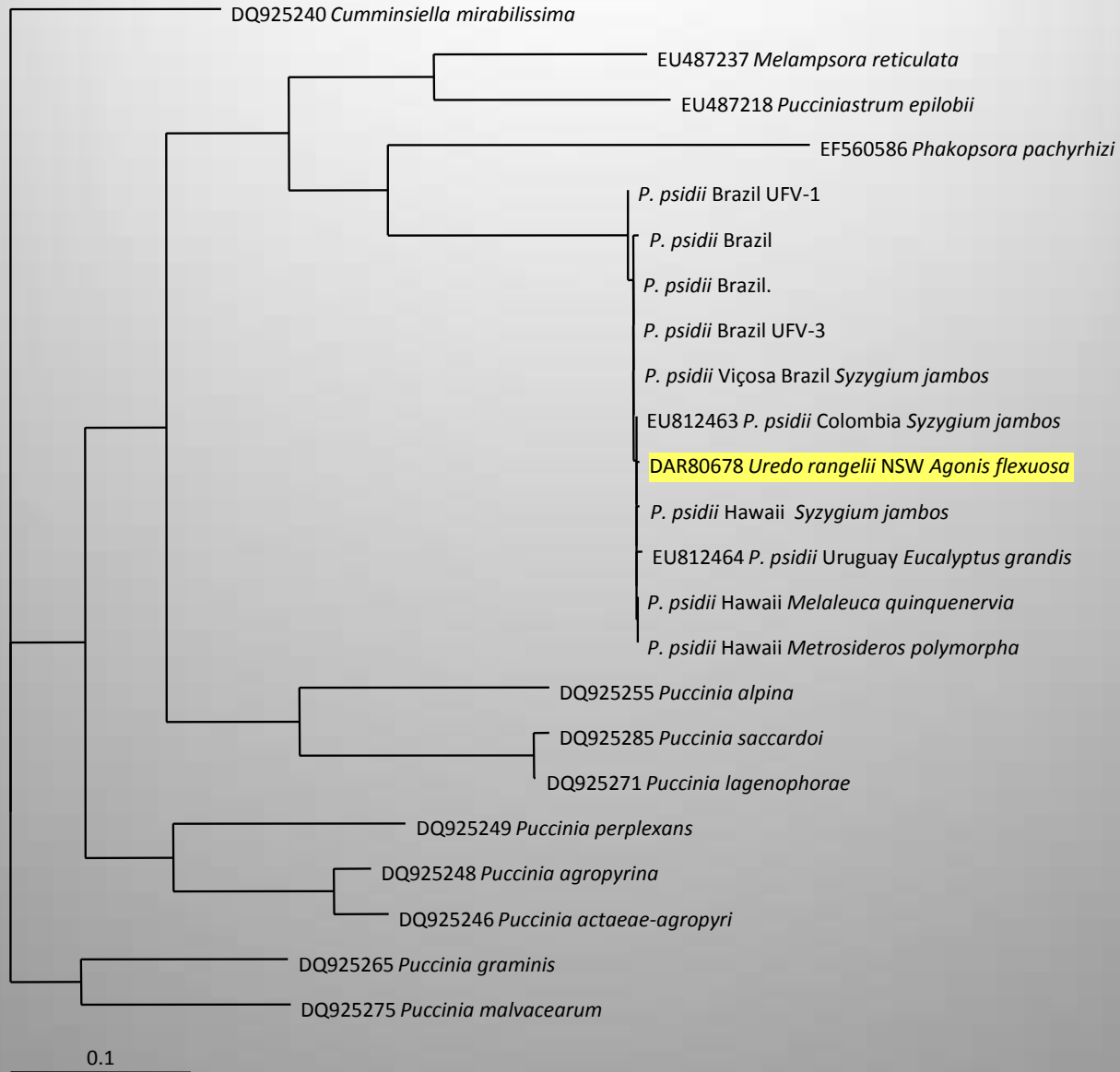
DQ021883 *Uredo baruensis*

0.1

Maximum Likelihood tree based on rDNA internal transcribed spacer sequences.
Abbreviations: Br. = Brazil, *E.* = *Eucalyptus*, Hi. = Hawaii
HNR = Host not recorded (in GenBank), *M.* = *Melaleuca*, *P.* = *Puccinia*, *S.* = *Syzygium*



Maximum Likelihood tree based on partial beta tubulin 1 sequences, bar represents expected nucleotide substitutions.



Maximum Likelihood tree based on partial translation elongation factor 1 sequences, bar represents expected nucleotide substitutions.