The rust situation in the South African sugarcane industry

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Introduction

- Brown rust (*Puccinia melanocephala*) widespread in SA
- Trials demonstrated ~26% yield loss in severely infected cane
- Varietal resistance used effectively to manage brown rust until release of variety N29
- Alternative management methods required


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Fungicide trials

Trial details

Fungicides used

1) pyraclostrobin (62.5 g/) : epoxyconazole (62.5 g/l) – 1.6L/ha
2) azoxystrobin (200 g/l) : difenoconazole (125 g/l) – 500 ml/ha

Treatments : Untreated control
: Fungicides applied once
: Fungicides applied twice (applications 28 days apart)

Assessments : % leaf area affected
stalk counts
height and diameter
yield and juice analysis

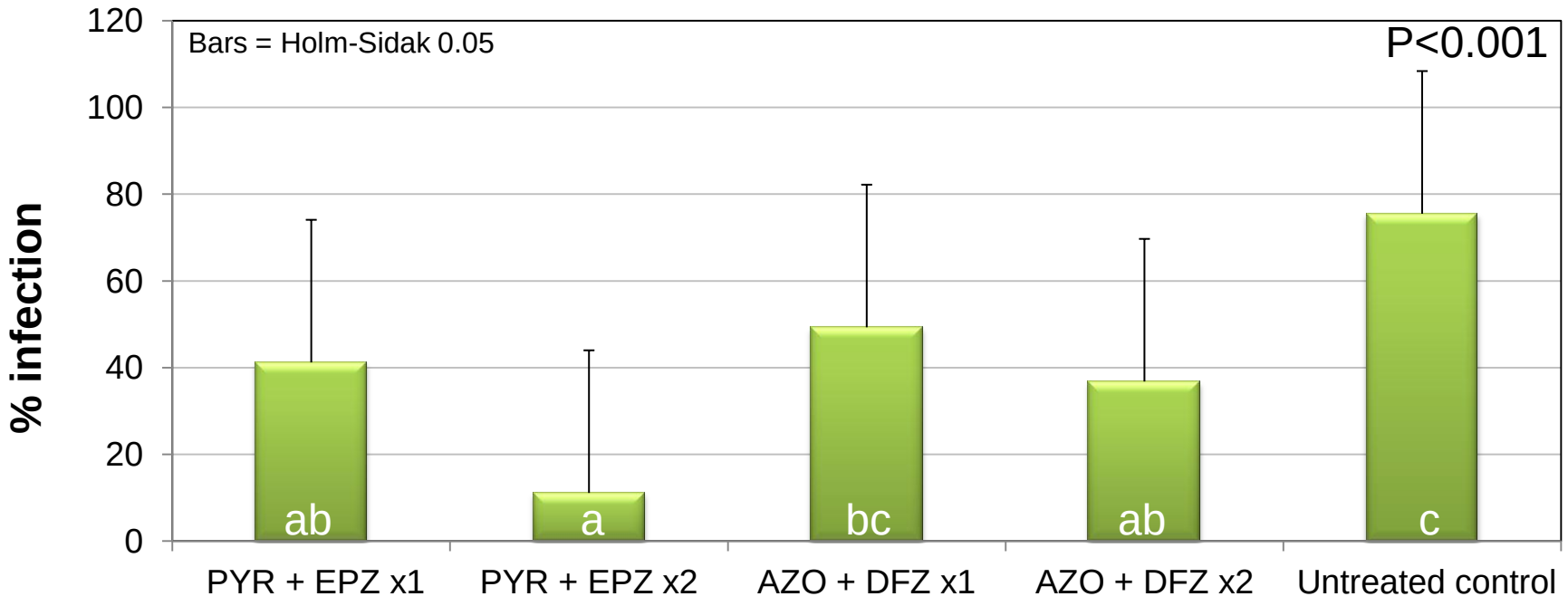
Severe brown rust at time of fungicide application





Conditions highly favourable for brown rust development in spring-summer 2009 and extremely dry conditions followed in 2010.

Brown rust severity two weeks after second application



PYR + EPZ = pyraclostrobin + epoxyconazole
AZO + DFZ = azoxystrobin + difenoconazole

Disease severity *(2 weeks after second spray)*

Untreated control



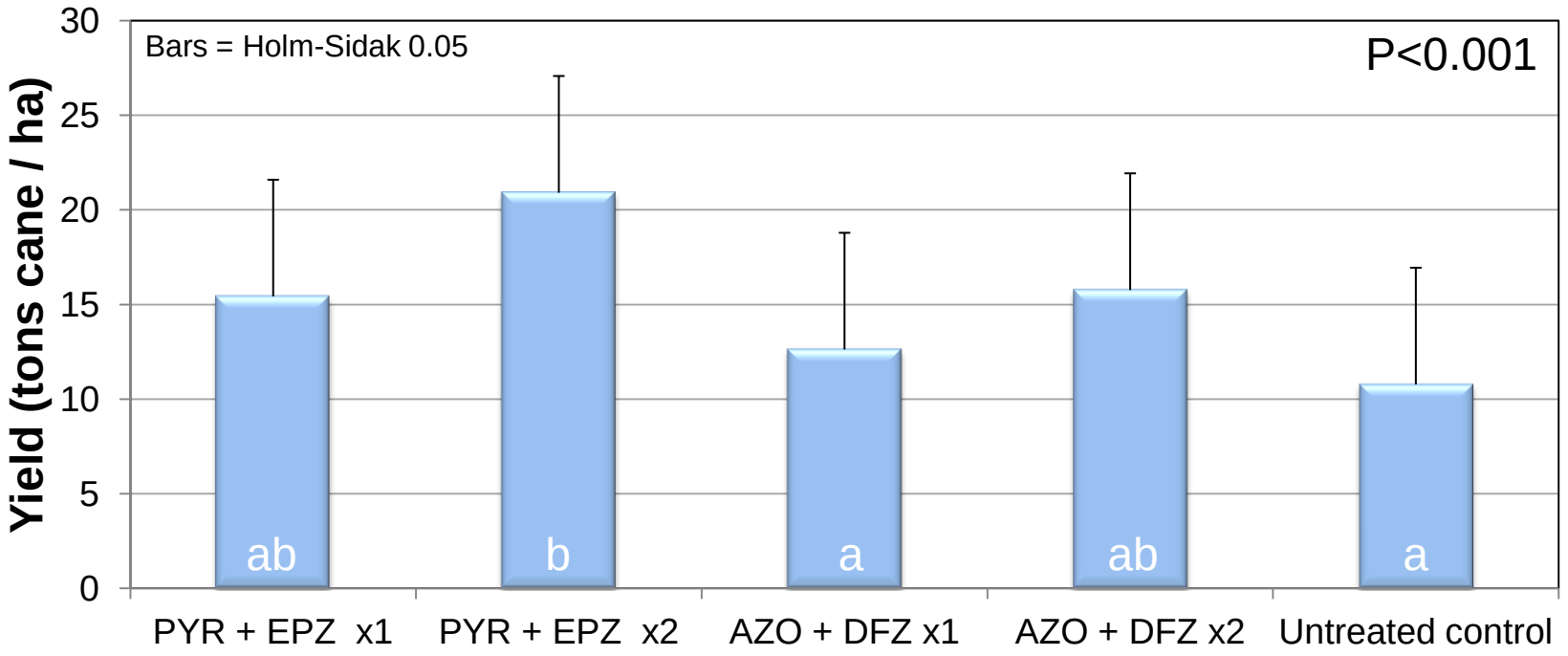
PYR + EPZ
(one application)



PYR + EPZ
(two applications)



Effect of fungicides on cane yield of variety N29



Note: *Difference in stalk height but not diameter, stalk number or purity between treatments*

Conclusions – fungicide trials

- PYR+EPZ - better brown rust control then AZO + DFZ, greater increases in yield

- When conditions favoured brown rust development in the early stages of growth and drought affected the later stages:
  - two applications of PYR + EPZ reduced brown rust infection by 85%
  - a 94% increase in yield (tc/ha) was recorded in plots treated twice with PYR + EPZ

- When brown rust infection was mild, improvement in yield of ~ 9% in PYR + EPZ treated plots

- Fungicide (Abacus® - BASF) has received conditional registration for use against brown rust

Rust risk model

Objectives

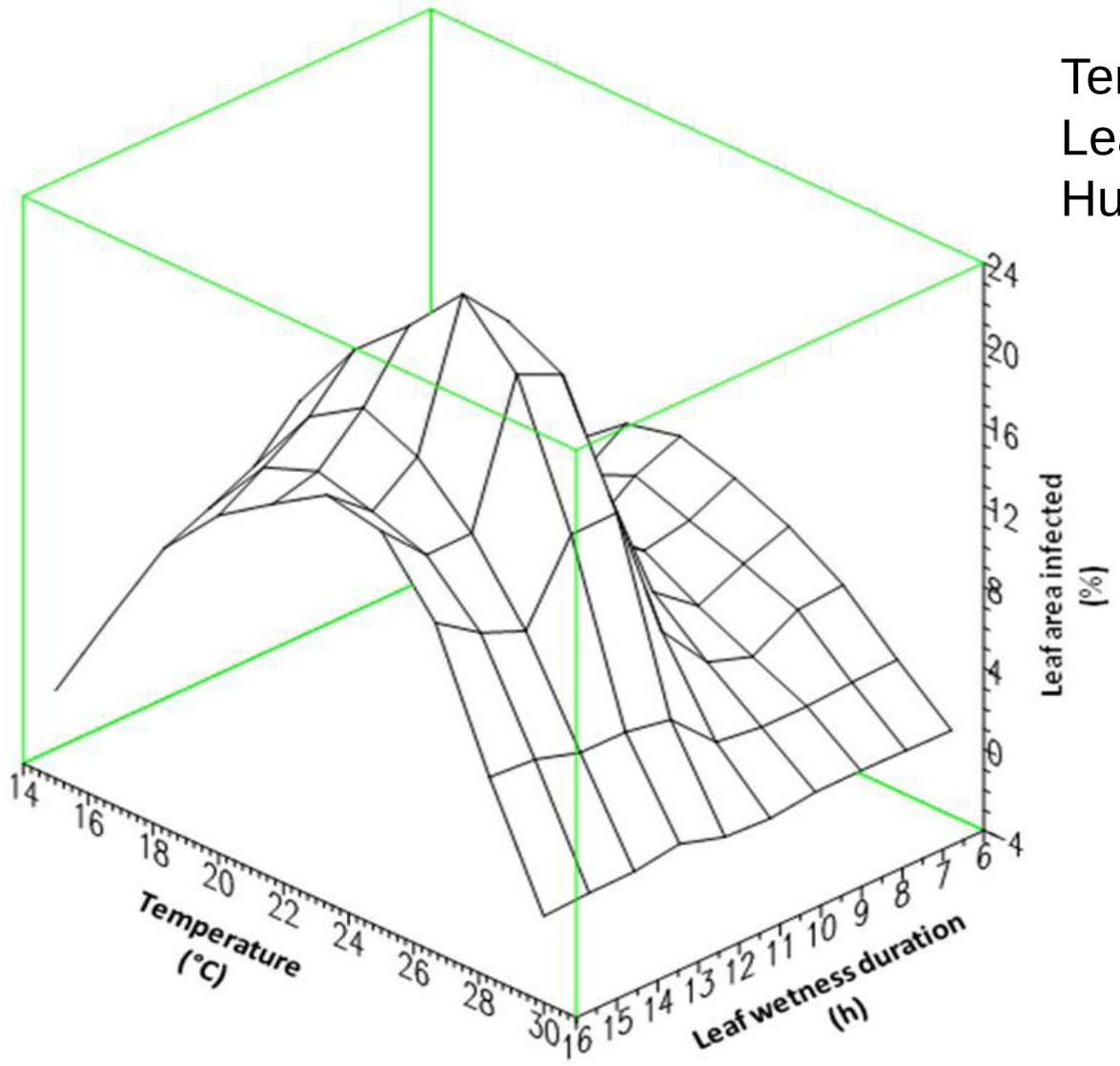
- to identify the conditions necessary for brown rust infection to occur
- to develop a model based on findings

Uses

- predict weather conditions that are conducive to outbreaks of the disease – decision support tool for fungicide application
- identify areas where varieties with some susceptibility should not be grown

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Dew chamber studies



Temperature 20-25ºC
Leaf wetness duration >9 hours
Humidity >98%

Model takes into account:

- duration of period when temperature and leaf wetness conducive
- average temperature during the conducive period
- average leaf wetness during the conducive period

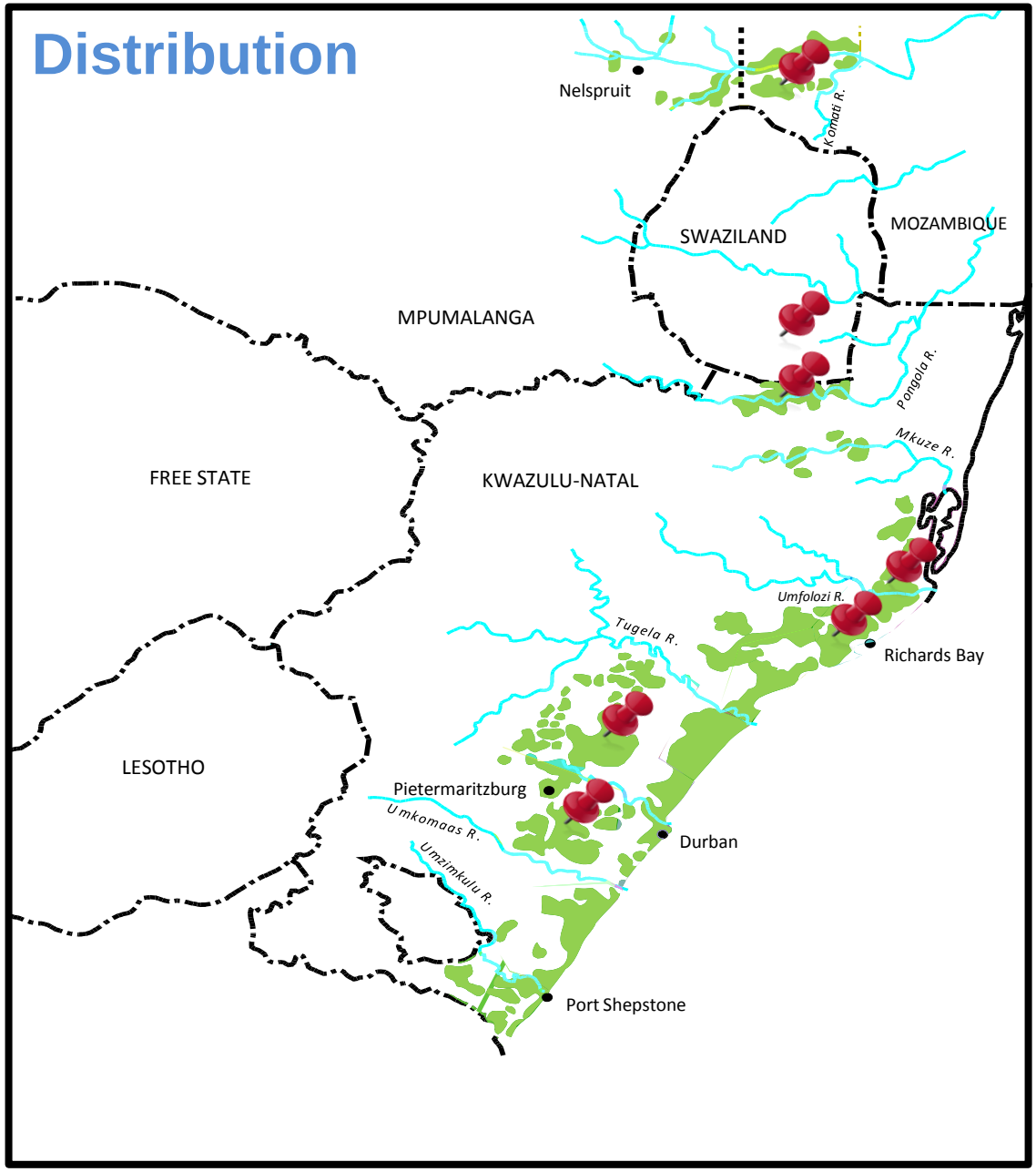
Further developed to use relative air humidity rather than leaf wetness

Model needs to be refined and validated




New rust

Distribution



Varieties affected

N25
N31
N41
N43
N46
N53

Range of unreleased genotypes

Symptoms



Lesions :

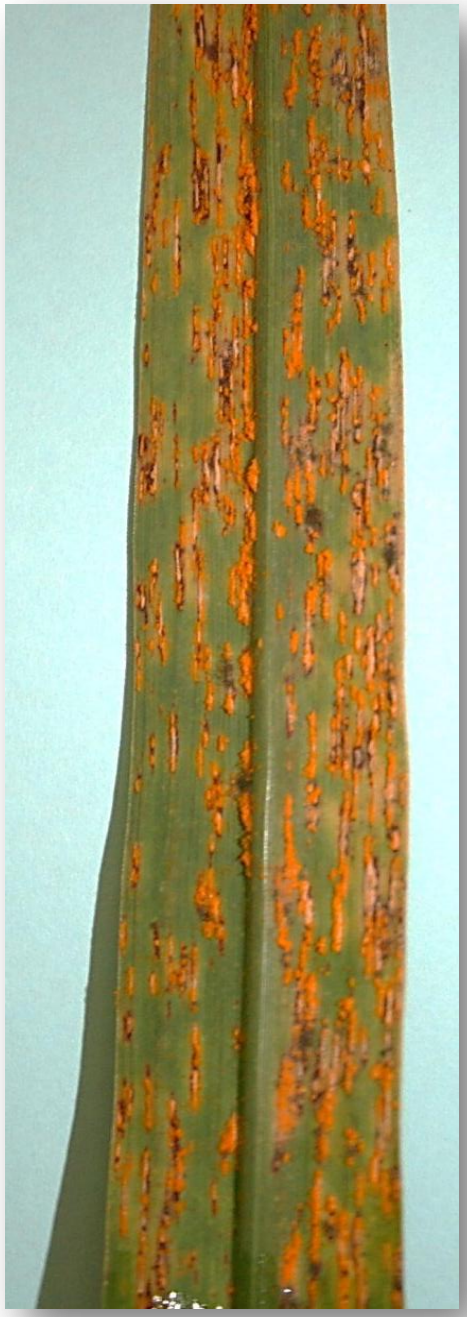
- reddish-brown
- similar in size to brown rust
- more severe towards leaf tip

Spores:

- orange when fresh, profuse
- also occur on upper leaf surface

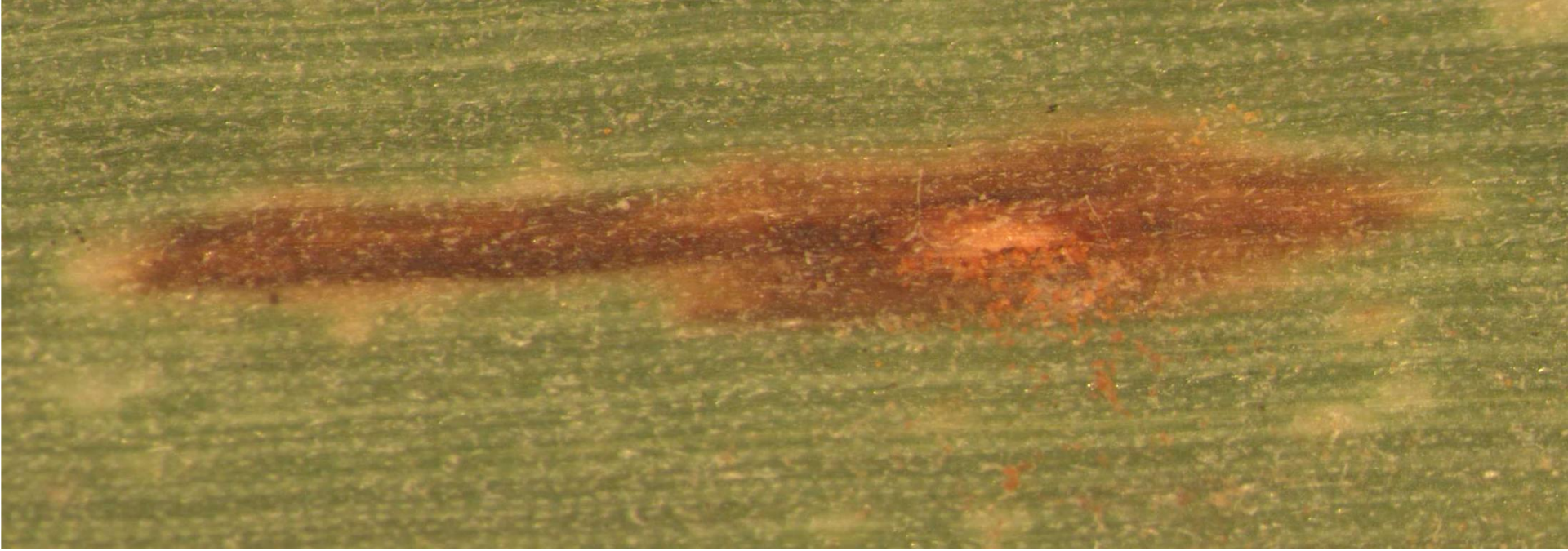
Appears to be favoured by cool, moist weather

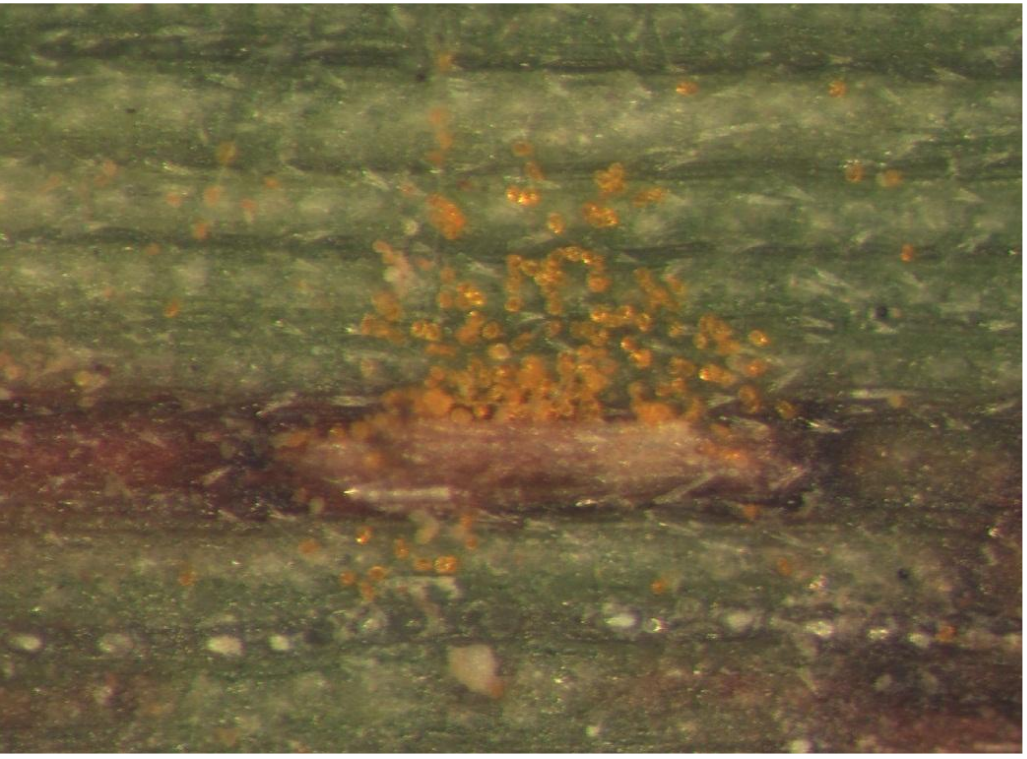
Observed on cane from 3 to 10 months

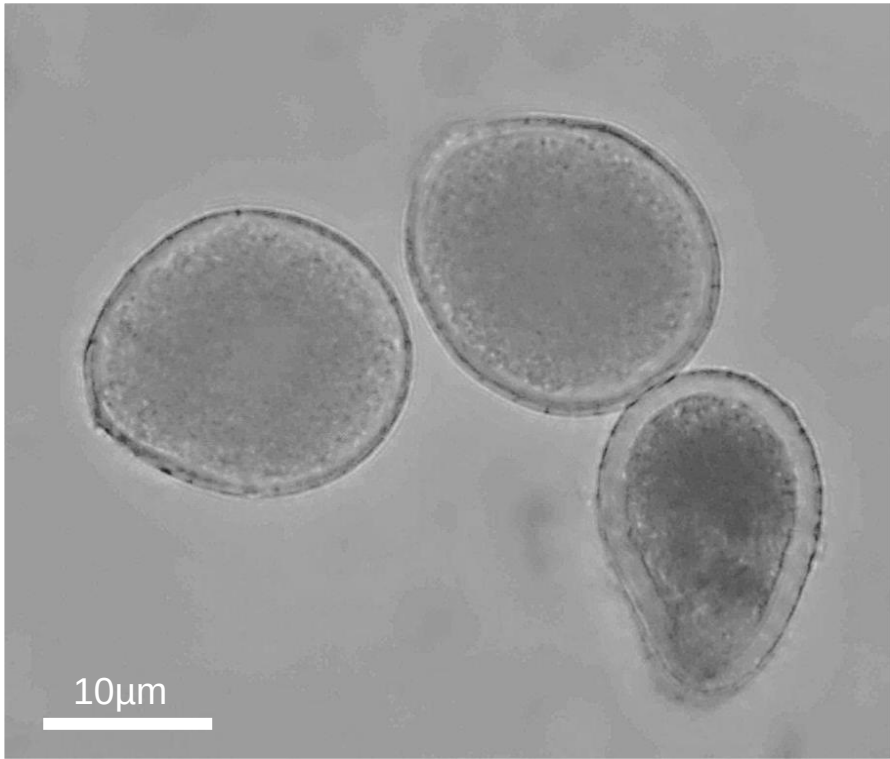






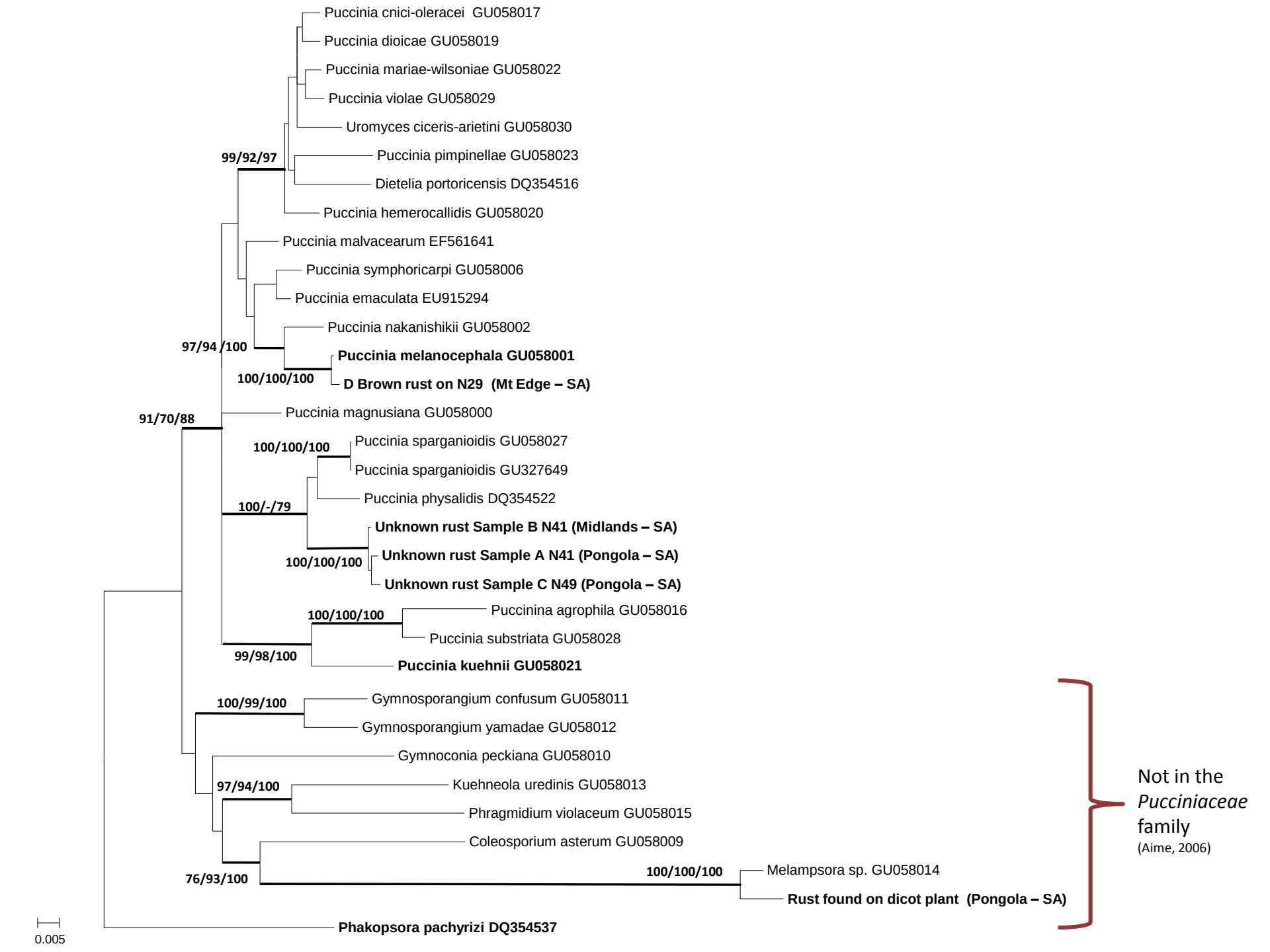


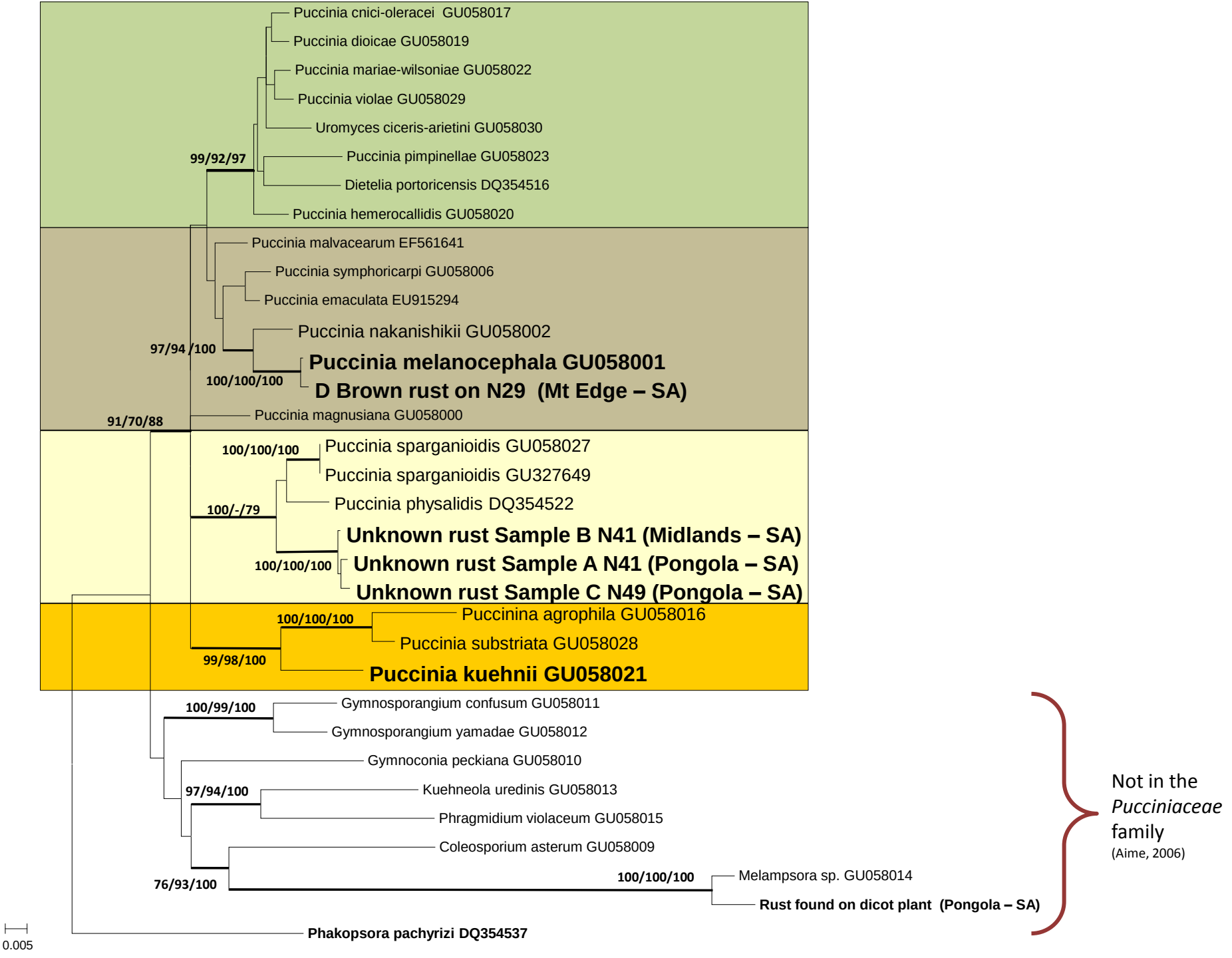


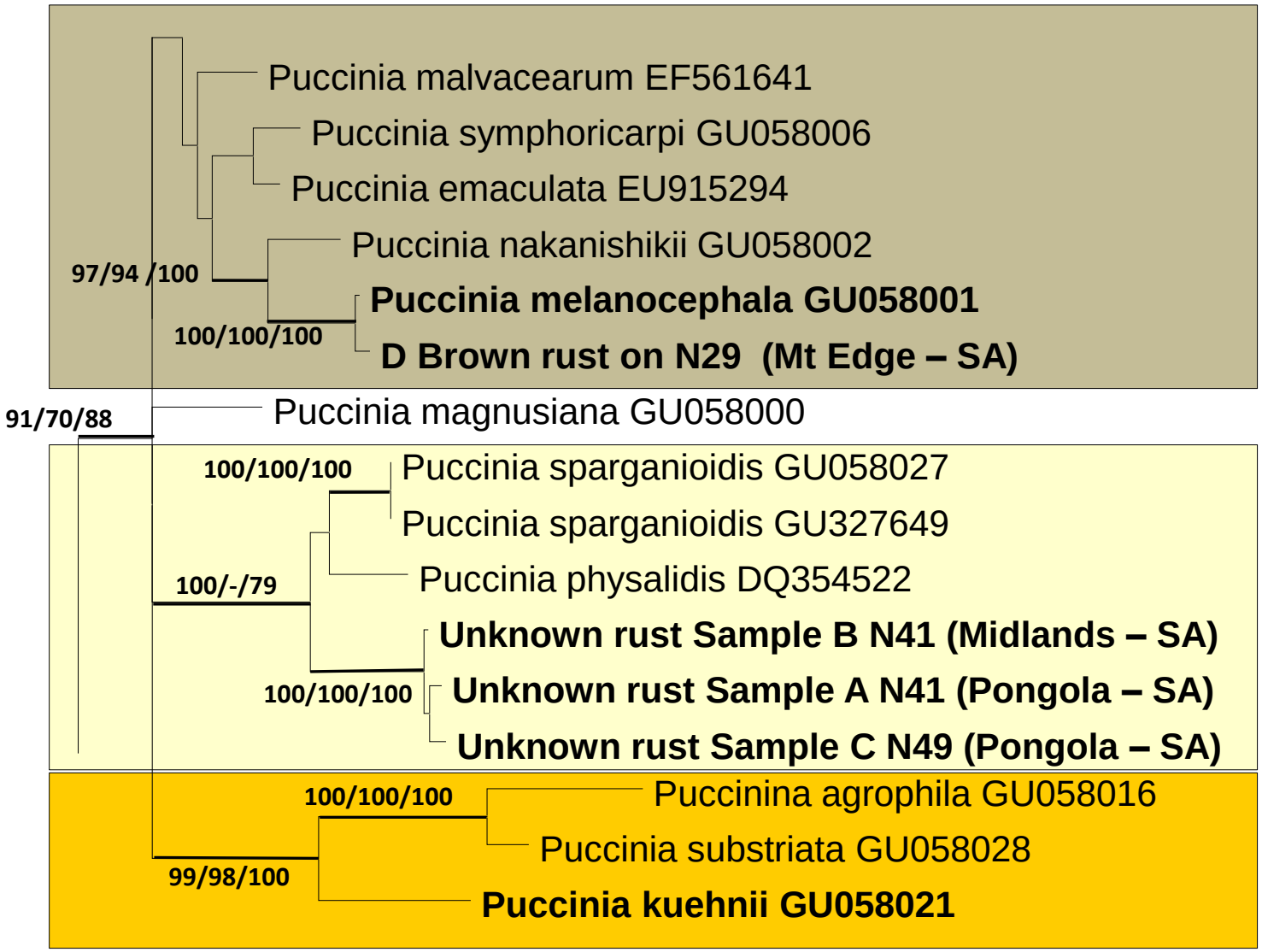

10µm

Molecular analysis

- Used Rust2Inv and LR6 primers (Aime, 2006)
- Generated ~1 450bp sequences of ribosomal repeat region including part of 5.8S subunit, ITS-2 and large subunit (28S)
- Replicated sample sequences aligned, consensus sequences generated
- Ends of alignments trimmed to ~1 000bp (rDNA ITS2 and part of nLSU deleted due to high variability)


Puccinia cnici-oleracei GU058017
Puccinia dioicae GU058019
Puccinia mariae-wilsoniae GU058022
Puccinia violae GU058029
Uromyces ciceris-arietini GU058030
99/92/97
Puccinia pimpinellae GU058023
Dietelia portoricensis DQ354516
Puccinia hemerocallidis GU058020
Puccinia malvacearum EF561641
Puccinia symphoricarpi GU058006
Puccinia emaculata EU915294
Puccinia nakanishikii GU058002
97/94 /100
Puccinia melanocephala GU058001
100/100/100
D Brown rust on N29 (Mt Edge – SA)
91/70/88
Puccinia magnusiana GU058000
100/100/100
Puccinia sparganioidis GU058027
Puccinia sparganioidis GU327649
Puccinia physalidis DQ354522
100/-/79
Unknown rust Sample B N41 (Midlands – SA)
100/100/100
Unknown rust Sample A N41 (Pongola – SA)
Unknown rust Sample C N49 (Pongola – SA)
100/100/100
Puccinina agrophila GU058016
Puccinia substriata GU058028
99/98/100
Puccinia kuehnii GU058021
100/99/100
Gymnosporangium confusum GU058011
Gymnosporangium yamadae GU058012
Gymnoconia peckiana GU058010
97/94/100
Kuehneola uredinis GU058013
Phragmidium violaceum GU058015
Coleosporium asterum GU058009
76/93/100
100/100/100
Melampsora sp. GU058014
Rust found on dicot plant (Pongola – SA)
Phakopsora pachyrizi DQ354537
0.005
Not in the
Pucciniaceae
family
(Aime, 2006)


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Pairwise differences = 100 - pairwise identity:

Matrix	Isolate A	Isolate B	Isolate C	P. spargan	P. physalid	P. melano	P. kuehnii	Phakops
Isolate A	0							
Isolate B	1.1	0						
Isolate C	0.5	0.8	0					
P. sparganioides	5.4	4.2	4.8	0				
P. physalidis	5.7	4.5	5.2	3.6	0			
P. melanocephala	8.8	7.9	8	6.9	8.2	0		
P. kuehnii	11.7	11	11.6	11.1	11.5	11.2	0	
Phakopsora	14.2	13.5	14	12.7	13.4	13.2	16.3	0

Future work

- Describe and name rust
- Conditions favouring development – observation plots adjacent to AWS, laboratory studies
- Fungicide trials – use to estimate yield loss
- Screening – natural infection, leaf whorl inoculation
- Identification of resistance genes
- Specific PCR

BROWN RUST



Lesions (marks) on leaf:
- cinnamon brown to dark brown
- up to 20 mm long
- more severe towards leaf tip

Spores:
- brown when fresh
- usually only on the lower leaf surface

Favoured by cool nights, warm days

Tends to occur on young crops (< 6 months)

A COMMON DISEASE IN SOUTH AFRICA

NEW RUST



Lesions (marks) on leaf:
- orange to reddish-brown
- similar in size to brown rust
- more severe towards leaf tip

Spores:
- orange when fresh, profuse
- also occur on upper leaf surface

Appears to be favoured by cool, moist weather

Has been observed on cane of up to 10 months

ORANGE RUST



Lesions (marks) on leaf:
- orange to reddish brown
- up to 4 mm long
- more severe towards leaf base

Spores:
- orange when fresh
- usually only on the lower leaf surface

Favoured by humid, warm conditions

Tends to occur on mature crops (>6 months)

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