

An aerial photograph of a large, lush green plantation. A winding stream flows through the center of the plantation, surrounded by dense rows of trees. The background shows a mix of green forest and some cleared areas.

The unfolding story of *Teratosphaeria* leaf blights in Australian Plantations

Treena Burgess

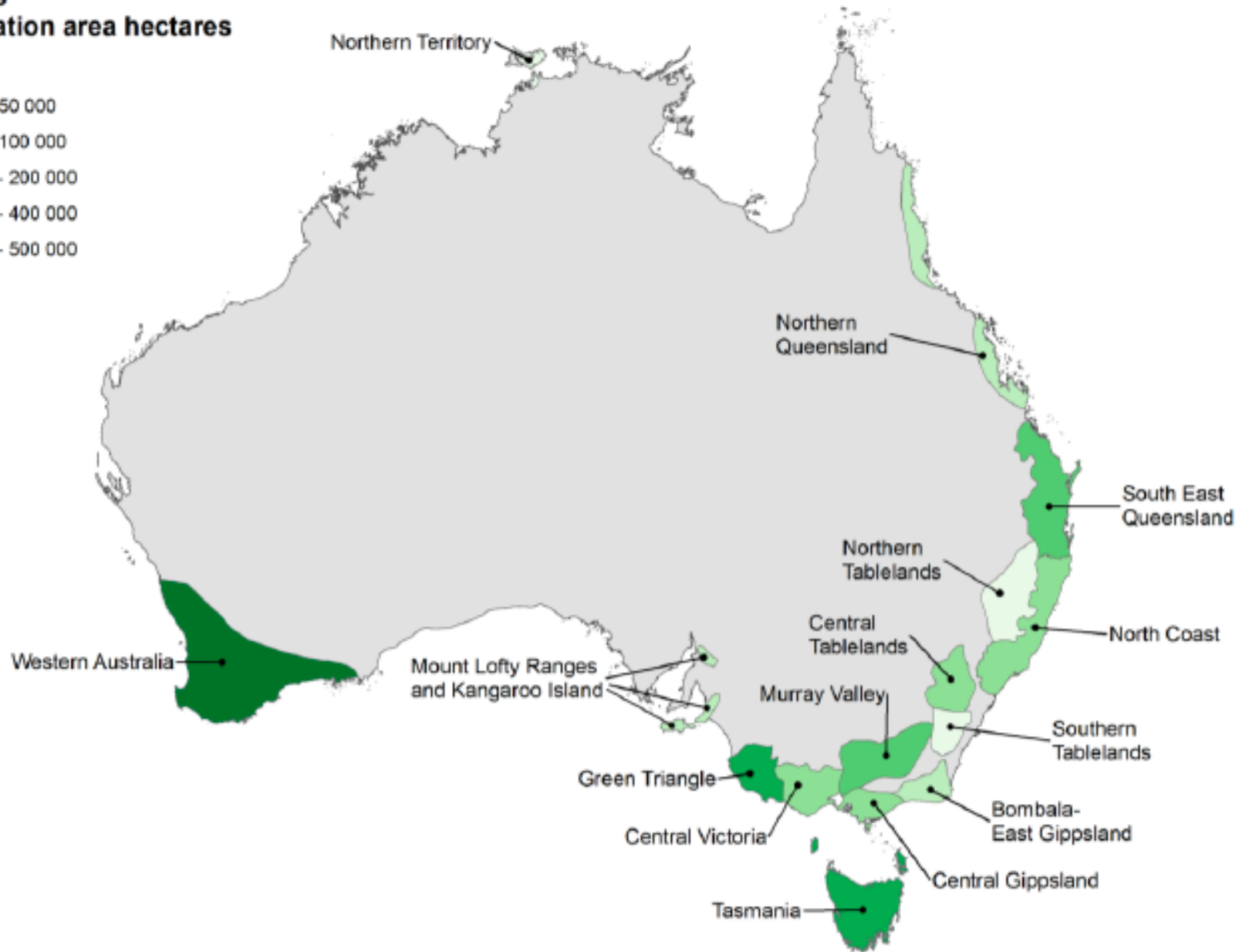
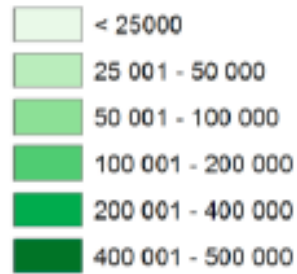


MURDOCH
UNIVERSITY
PERTH, WESTERN AUSTRALIA

Map 1 National Plantation Inventory regions

NPI regions

Total plantation area hectares



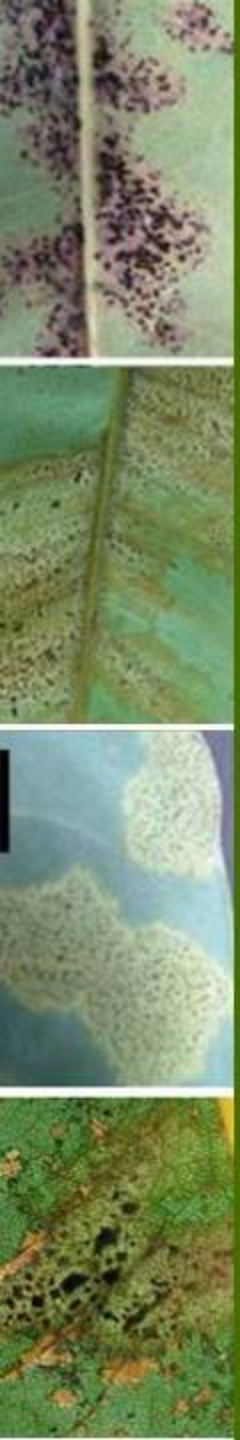


Figure 1 Total Australian plantation area, by type, 1995 to 2012

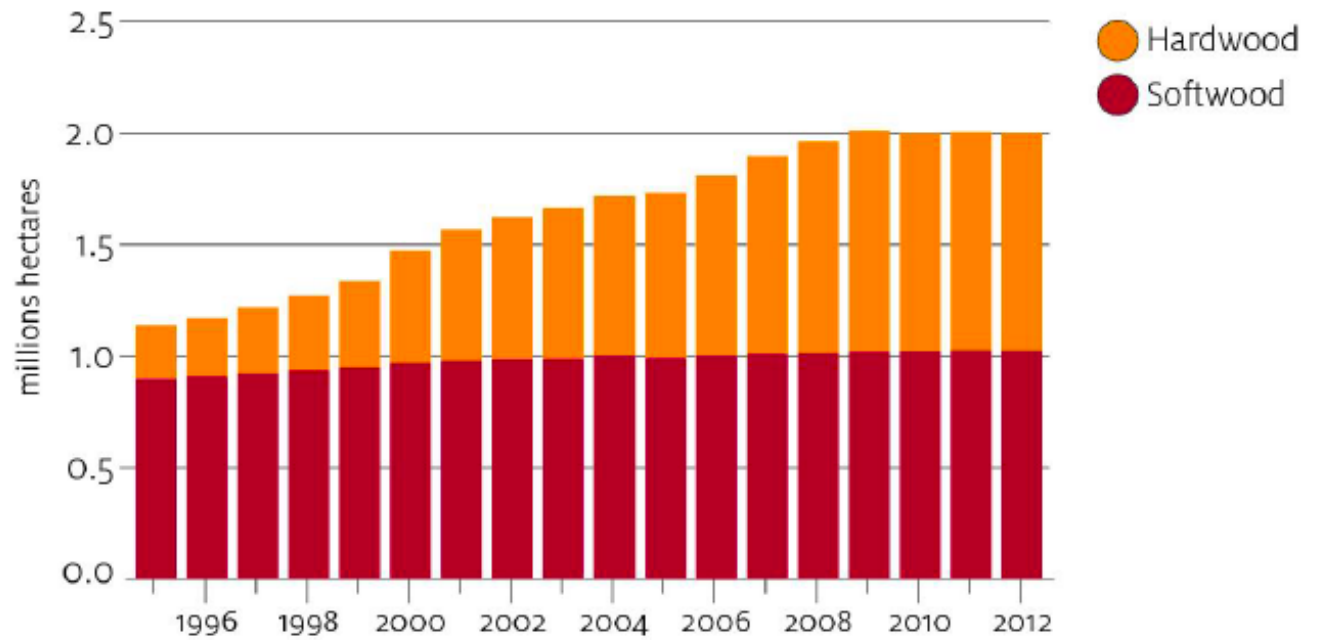
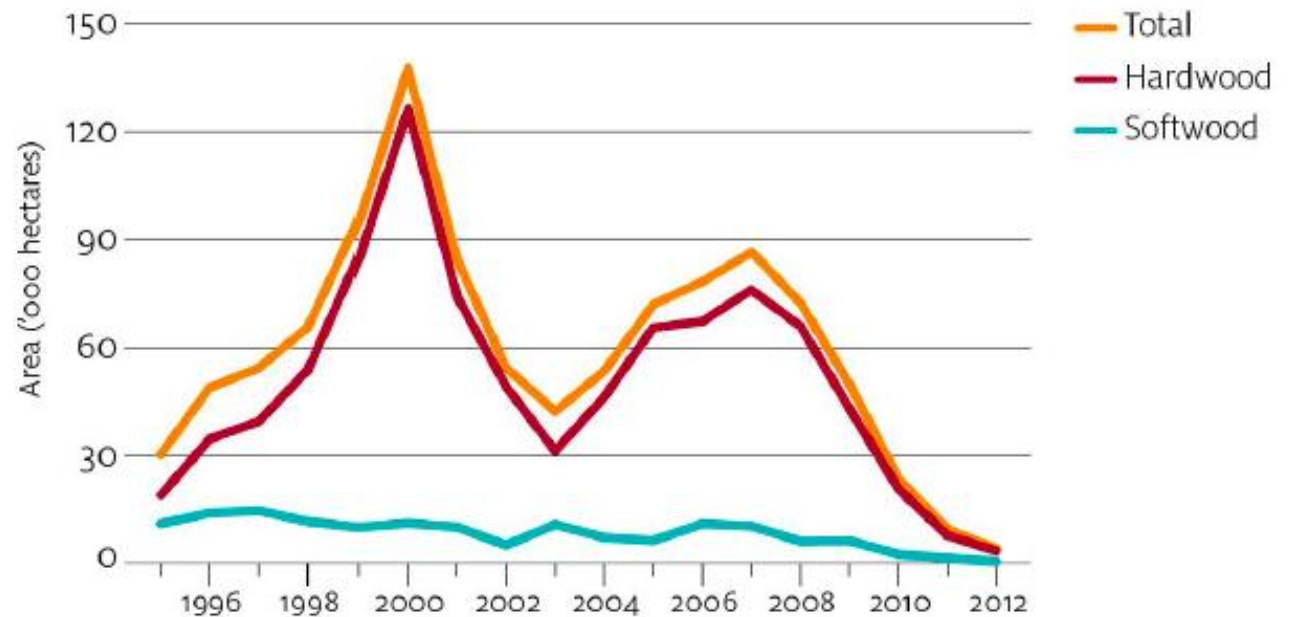
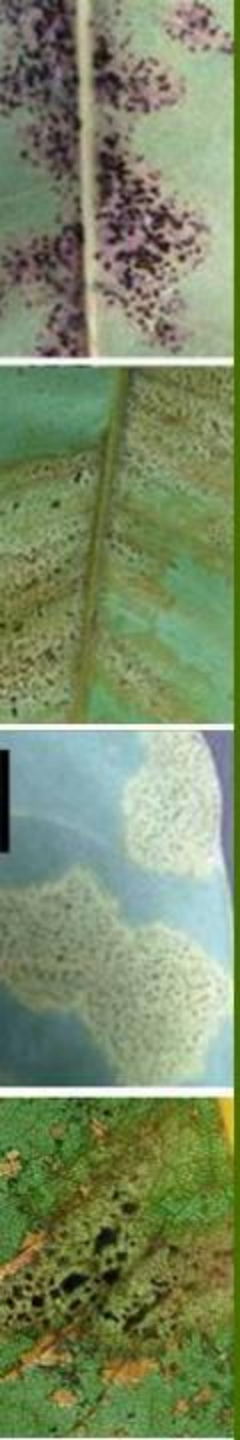


Figure 4 New plantations, 1995 to 2012



Growth of *Eucalyptus globulus* plantation industry

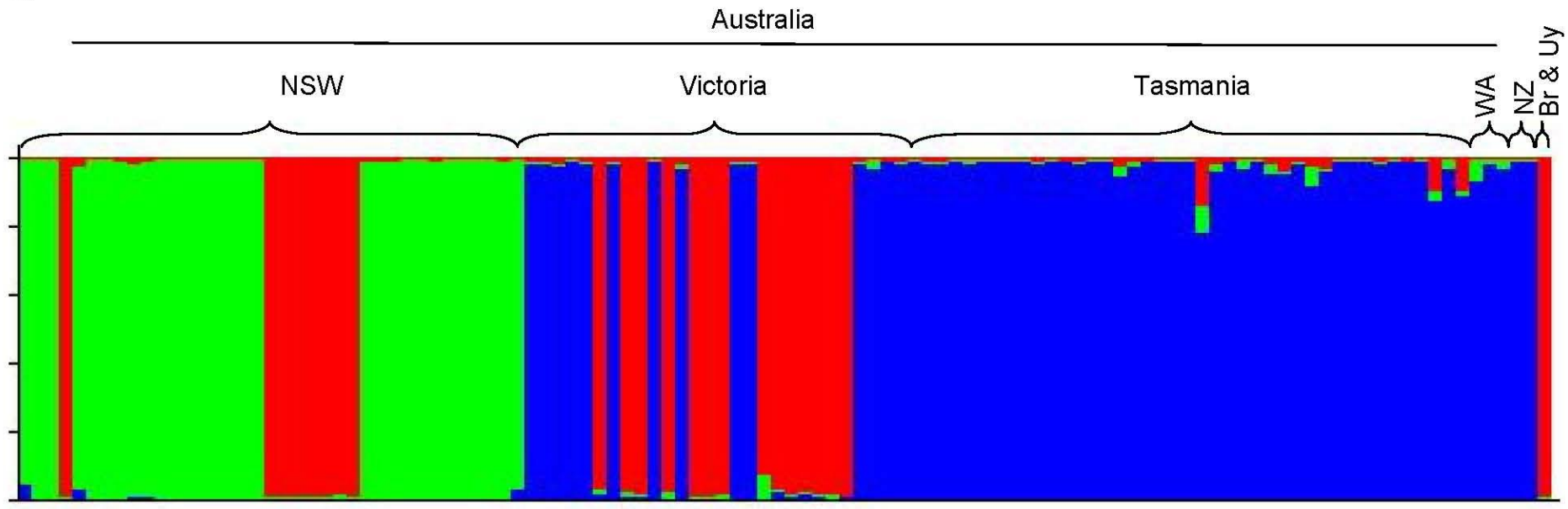
- Prior to 1990 all eucalypt plantation holdings were predominantly experimental
- The main expansion of the estate boomed with the expansion in Managed Investment Schemes (MIS) in the late 1990s and 2000s.
- Unfortunately, these schemes have proven not to be financially sustainable and almost all the promoters are now in Receivership or have been sold on.
- there is now very little money to spare, employment is minimal and the industry needs to recover
- for most part problems are economic; high Australian dollar and being left out of the government's carbon tax and carbon farming legislation



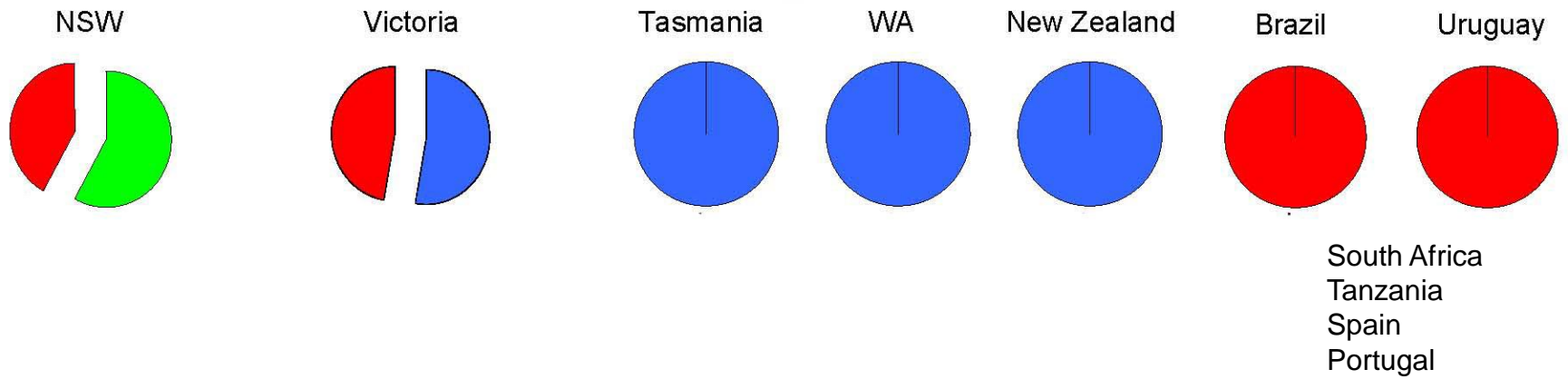




(a)



(b)



Pérez G, Slippers B, Wingfield MJ, Wingfield BD, Carnegie AJ, Burgess TI (2012) Cryptic species, native populations and biological invasions by a eucalypt forest pathogen. *Molecular Ecology* 21: 4452-4471.

Australasian Plant Pathol. (2014) 43:67–77

DOI 10.1007/s13313-013-0245-8

***Teratosphaeria pseudonubilosa* sp. nov., a serious *Eucalyptus* leaf pathogen in the *Teratosphaeria nubilosa* species complex**

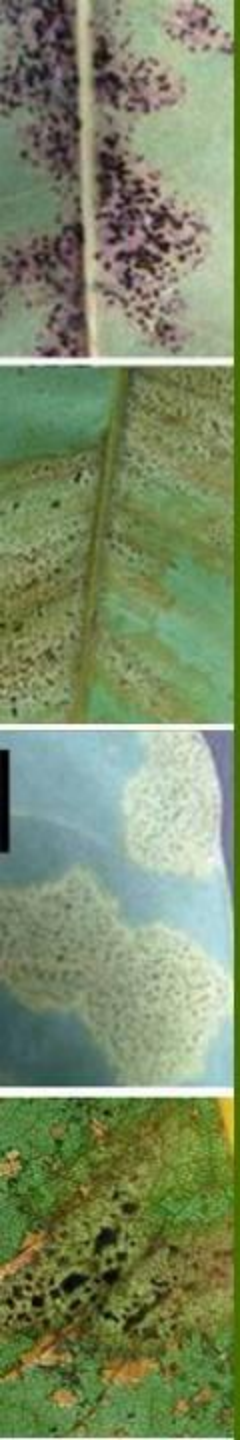
Guillermo Pérez • Treena I. Burgess • Bernard Slippers •

Angus J. Carnegie • Brenda D. Wingfield •

Michael J. Wingfield

Tasmania

- 236,000 ha
- Initially *E. globulus* was planted within the forest estate and very quickly succumbed to *T. nubilosa* and *T. cryptica*
- As plantings started on ex-farmland silviculture and management better and there was a switch in most areas from *E. globulus* to *E. nitens*
- MLD is still the main issue in these plantations, but provided they get a good start, it is no longer considered a major problem
- breeding program for selection of resistance to *T. nubilosa* and *T. cryptica*





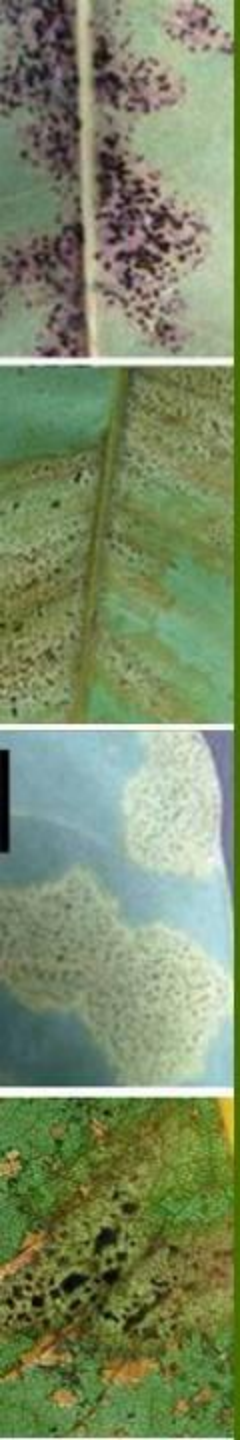
NPI region boundary	Towns/Cities
Hardwood	Plantation wood processing plants
Softwood	Ports
LGA	Major roads

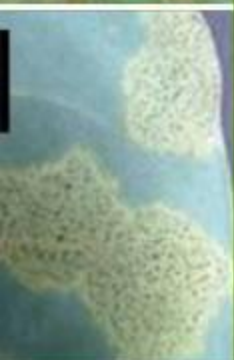
Source: National Plantation Inventory, 2006.

Kilometres
0 20 40 60 80 100

Western Australia

- 301,000 ha
- *E. globulus* in Western Australia is effectively an exotic species
- as plantation estate expanded there was also an increase in the number of fungal introductions
- lots of concern about *Teratosphaeria* in the earlier days and lots of research was conducted
- MLD and TLD now the least of the concerns
- major limitation in Western Australia is water





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Source: National Plantation Inventory, 2006.

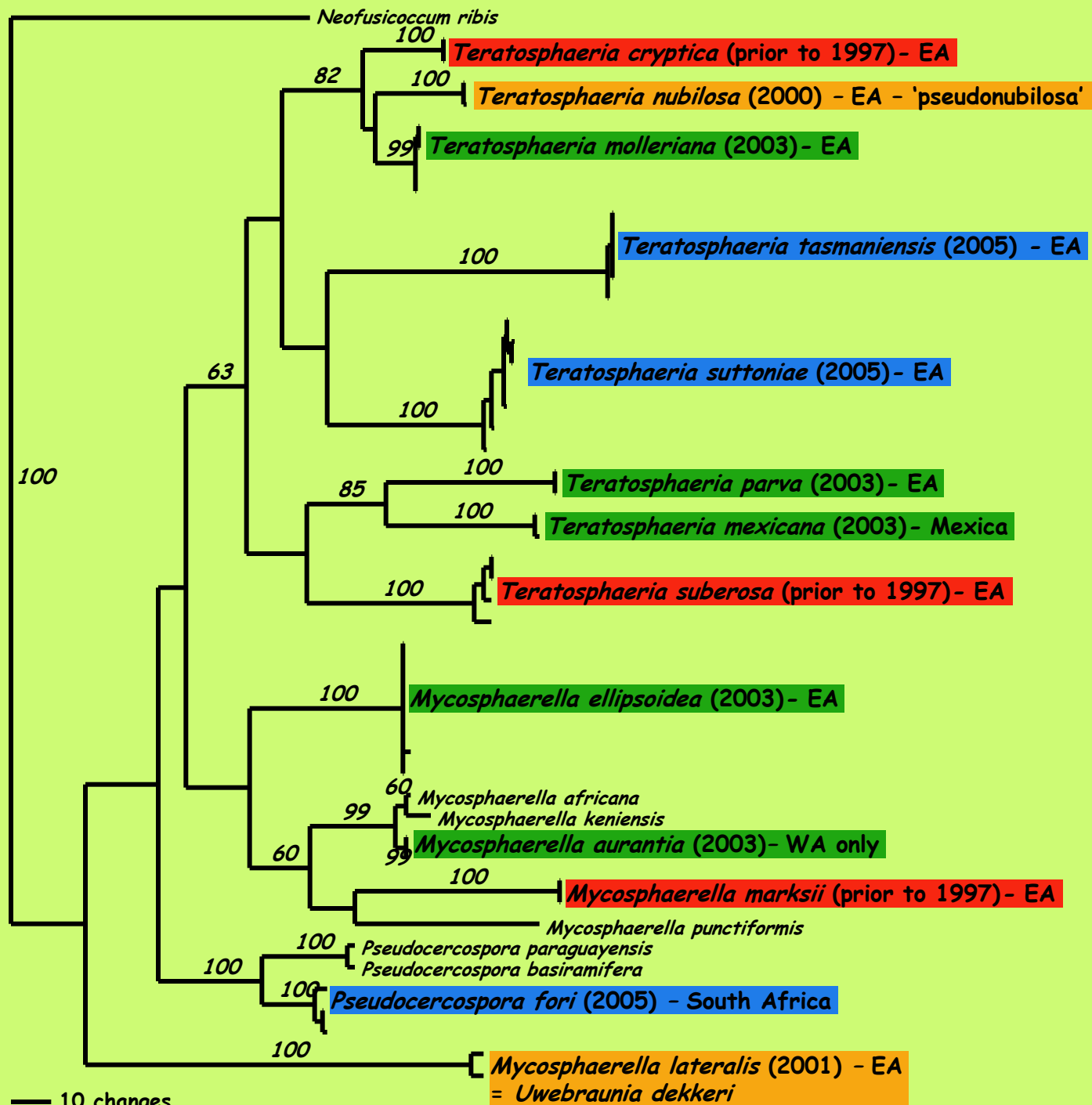
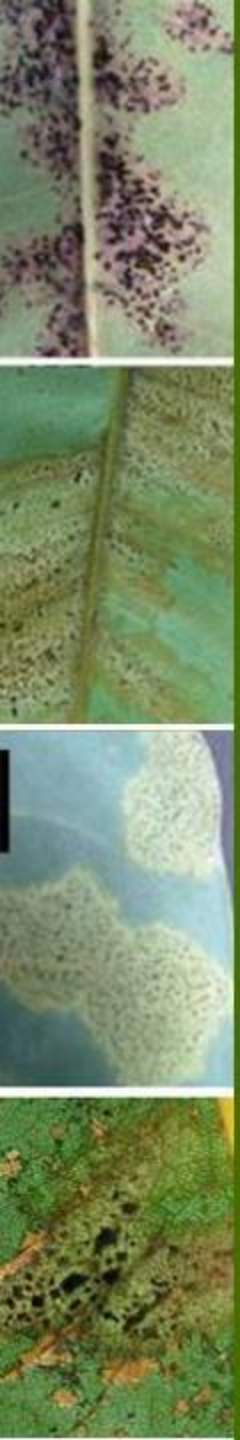
Note: Inset plantations have been enhanced for clarity.

Kilometres
0 20 40 60 80 100

Legend:

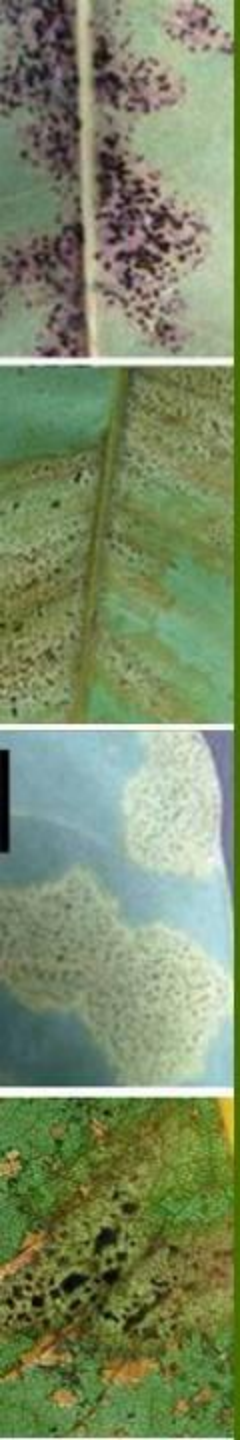
- NPI region boundary
- Hardwood
- Softwood
- Mixed
- Unknown
- LGA
- Towns/Cities
- Plantation wood processing plants
- Ports
- Major roads

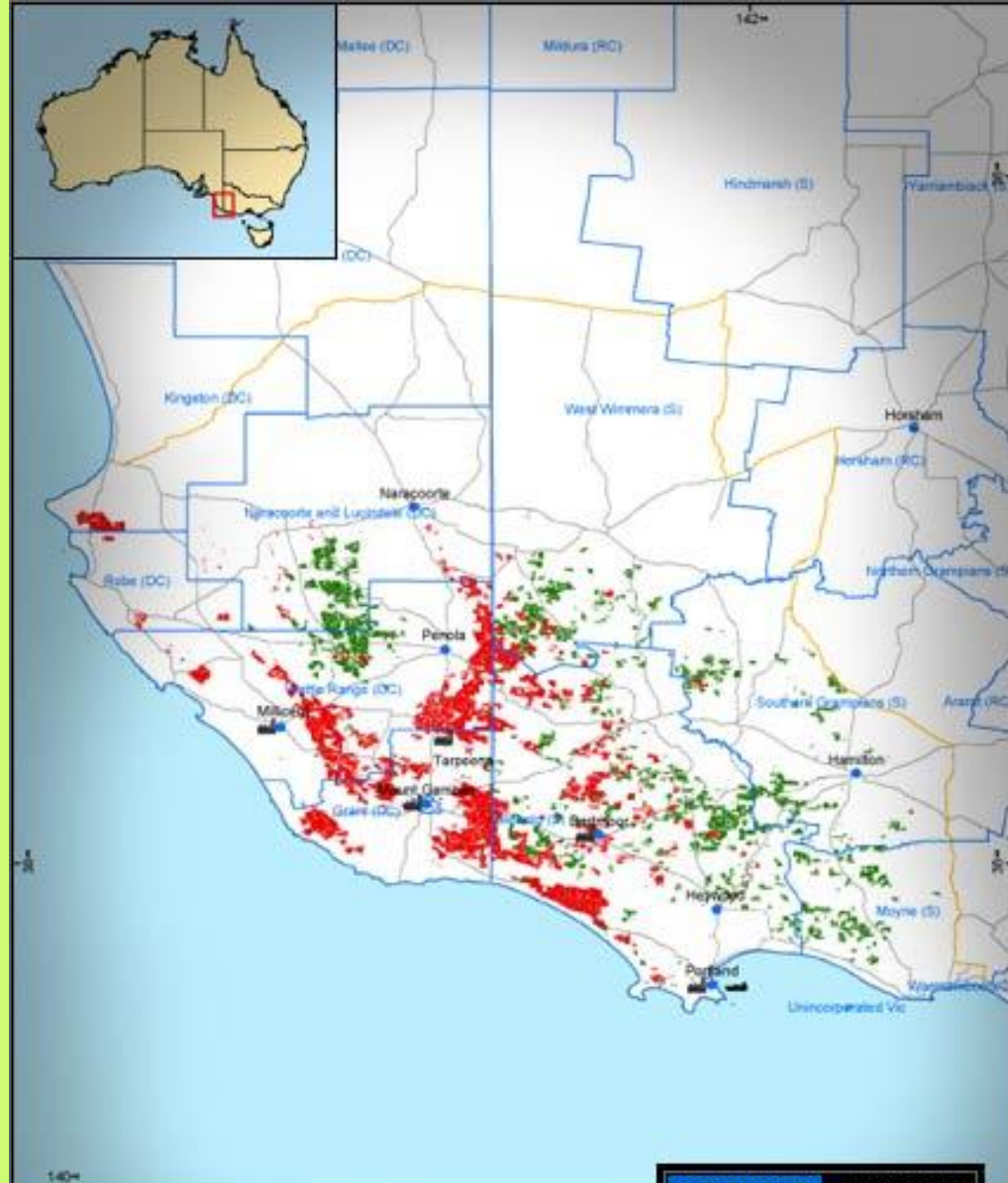




Green Triangle

- 171,000 ha
- *E. globulus* is also the dominant species planted in this region
- *E. globulus* is endemic close by and MLD and TLD can on occasion be very severe
- Industry has persisted with *E. globulus* and improved site selection and preparation and silviculture



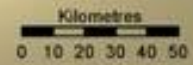


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- NPI region boundary
- Hardwood
- Softwood
- LGA
- Towns/Cities
- Plantation wood processing plants
- Ports
- Major roads

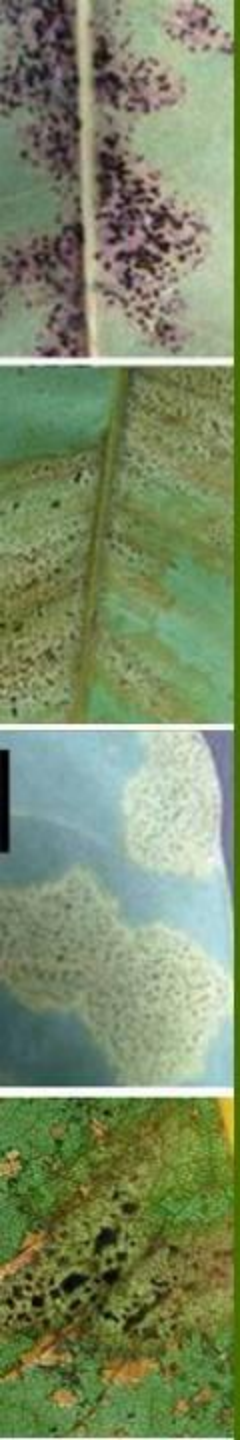


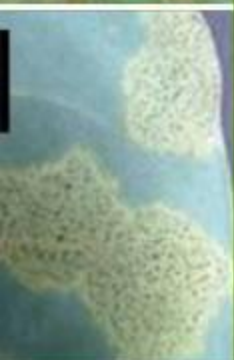
Source: National Plantation Inventory, 2006.



sub-tropical forestry

- 83,000 ha NSW, 31,000 ha QLD
- Many trials in northern NSW and Queensland for many years
- *Corymbia* selected for saw logs and in northern NSW plantations established for timber production
- plantations for pulp production started only in late 1990's in southern and central Queensland
- *E. grandis*, *E. dunnii*, *E. camaldulensis*, hybrids and clones tested
- first few years in drought and no disease
- AND THEN



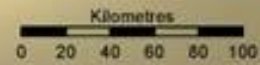


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- NPI region boundary
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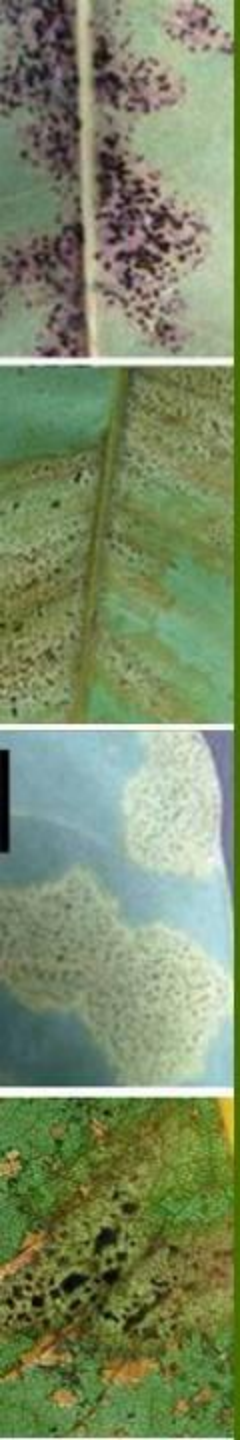


Source: National Plantation Inventory, 2006.



Teratosphaeria spp. with Kirramyces-like spores (2002)

- Several *Teratosphaeria* spp. had been described in Australia, but had seldom caused significant disease
- *T. suttonii* was known to cause a leaf blight of *E. grandis* planted off-site in northern NSW
- *T. eucalypti* was considered a major pathogen of various eucalypt species in NZ
- *T. destructans* was not known to be in Australia and considered serious biosecurity threat (=A1)



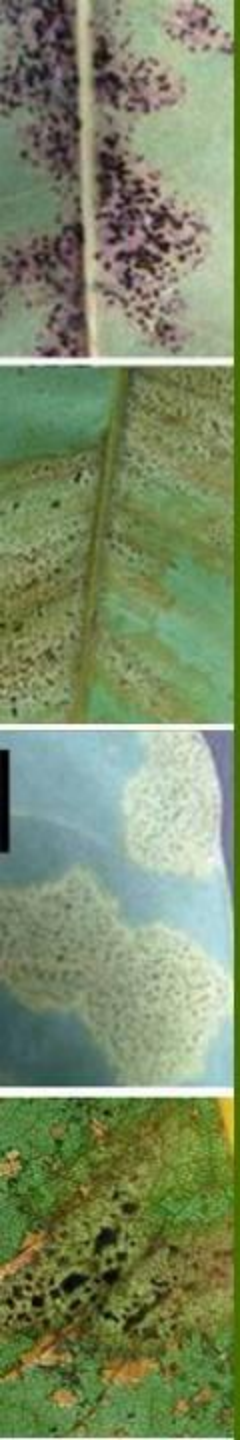




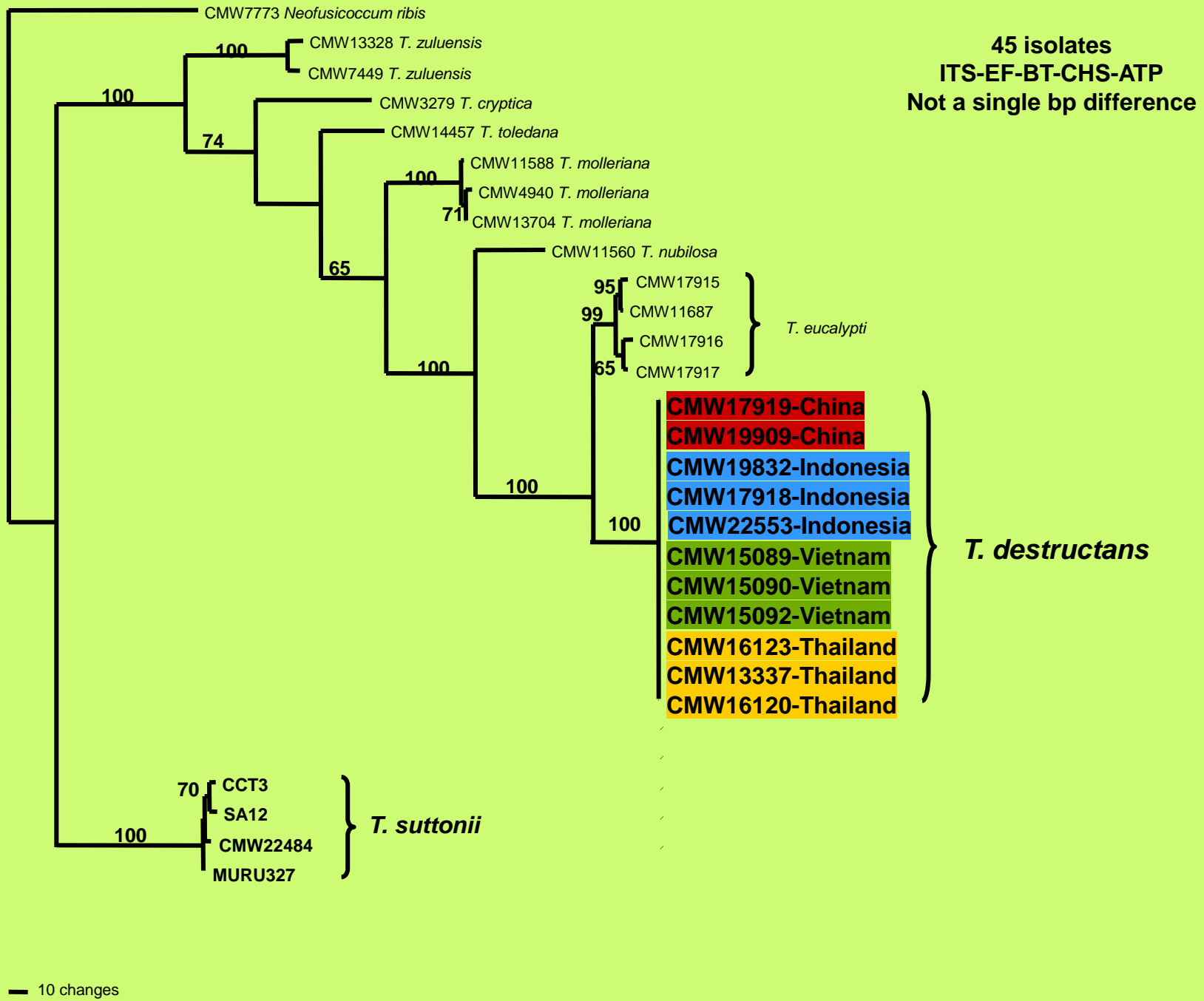
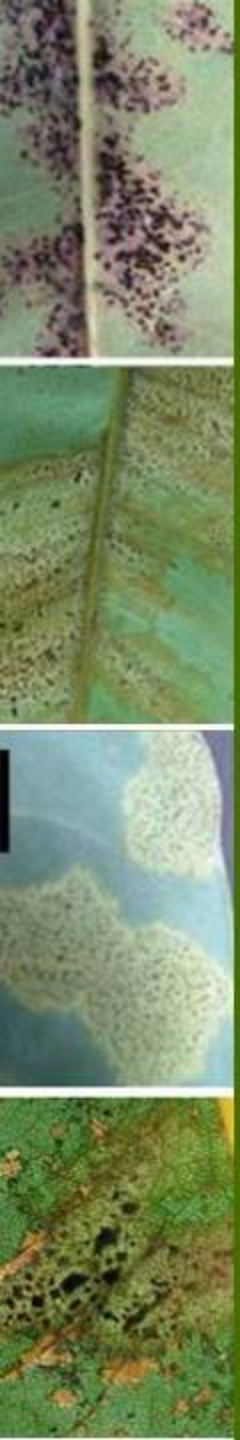


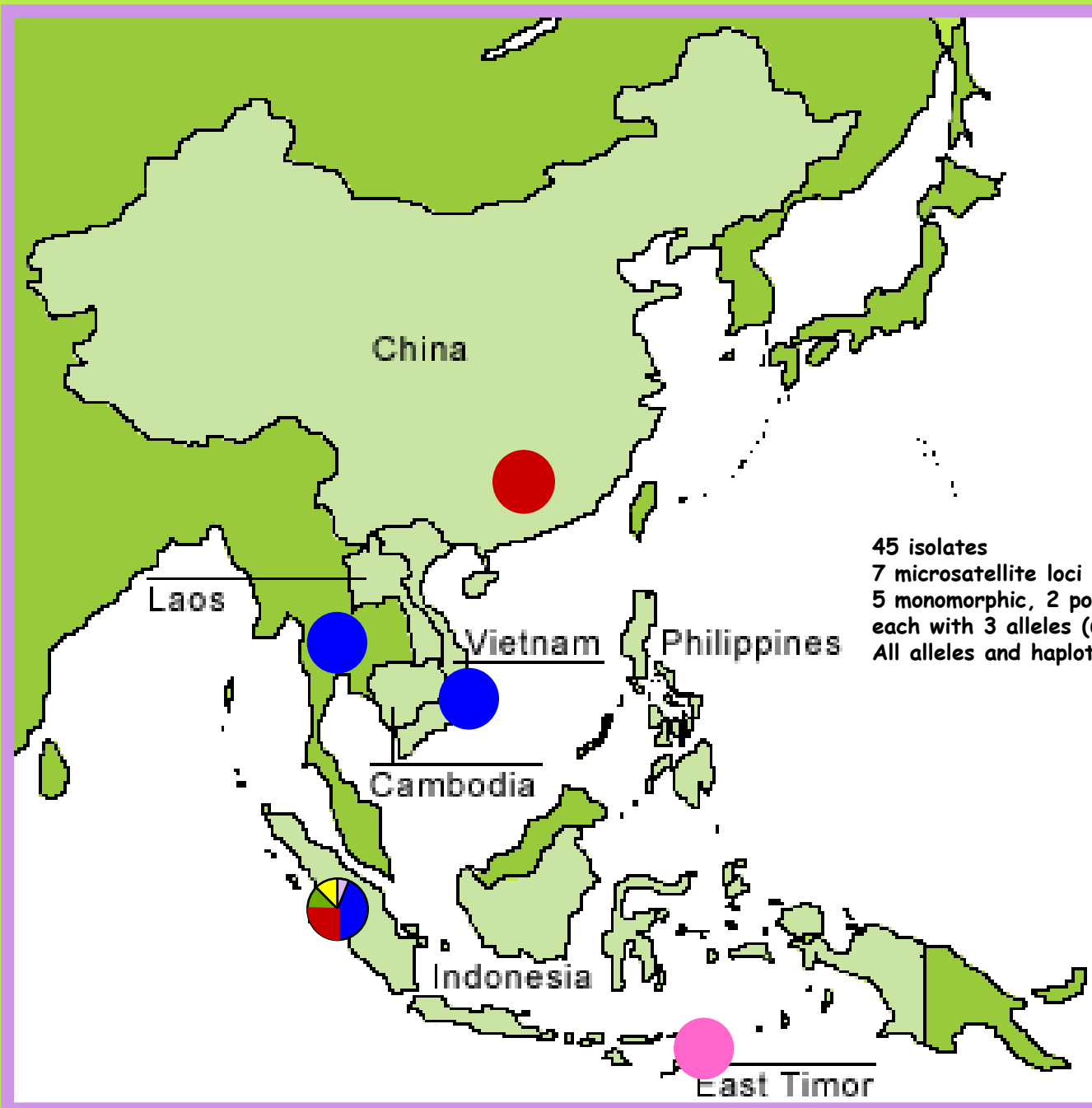
Teratosphaeria destructans

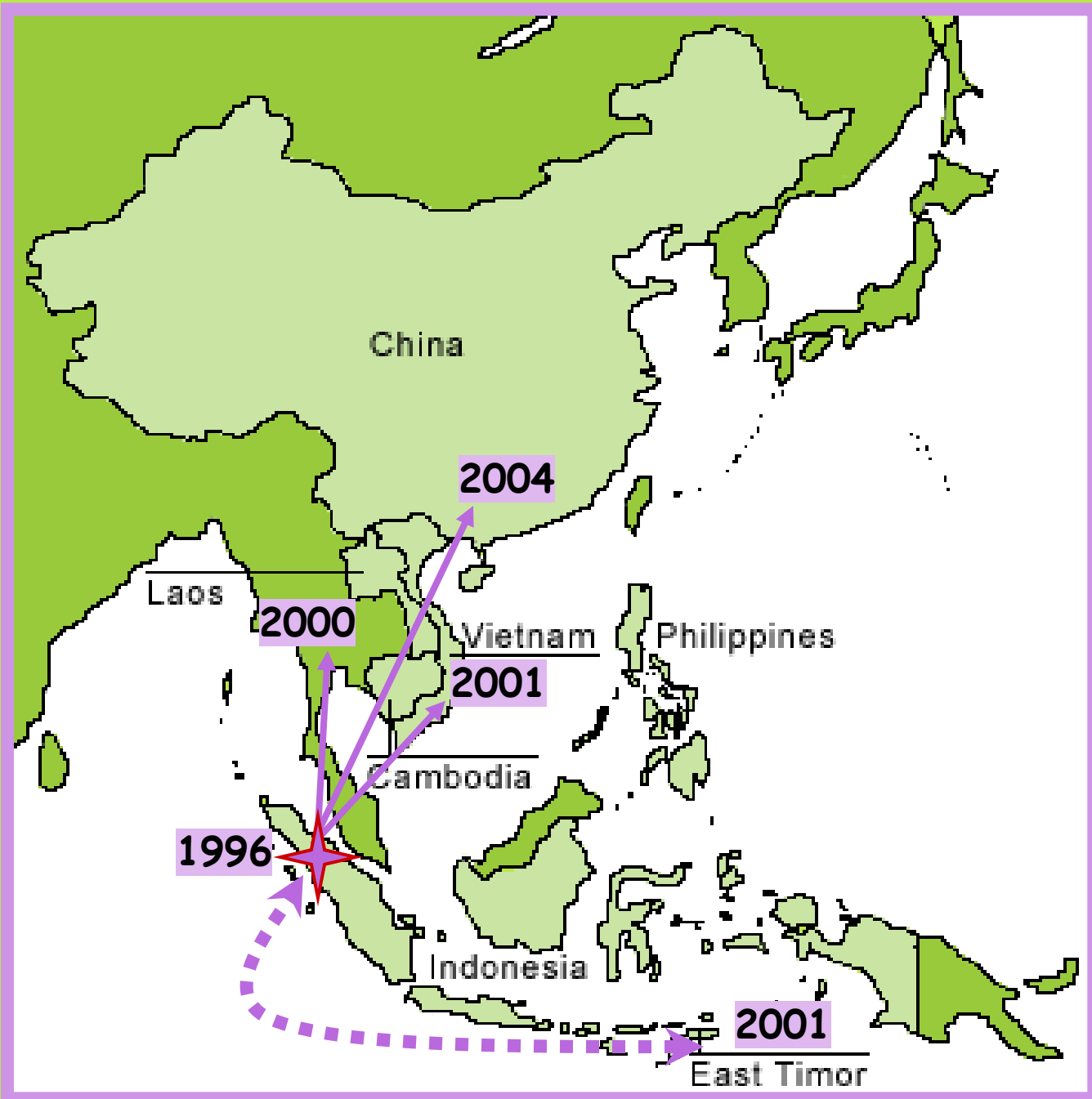
- Devastating eucalypt leaf pathogen first described by Wingfield & Crous (1996) from 1-3 years old *Eucalyptus grandis* in Sumatra, Indonesia.
- Since then *T. destructans* has been reported from nurseries and young plantations in Thailand and Vietnam in 2001
- In 2004 we found *T. destructans* in China
- Also reported from native *E. urophylla* in East Timor in 2001. Identification has been confirmed and this could be the origin of this species.











Eur J Plant Pathol (2011) 131:49–58

DOI 10.1007/s10658-011-9786-2

Plants for planting; indirect evidence for the movement of a serious forest pathogen, *Teratosphaeria destructans*, in Asia

Vera Andjic • Bernard Dell • Paul Barber •

Giles Hardy • Michael Wingfield • Treena Burgess

Teratosphaeria destructans (2006)

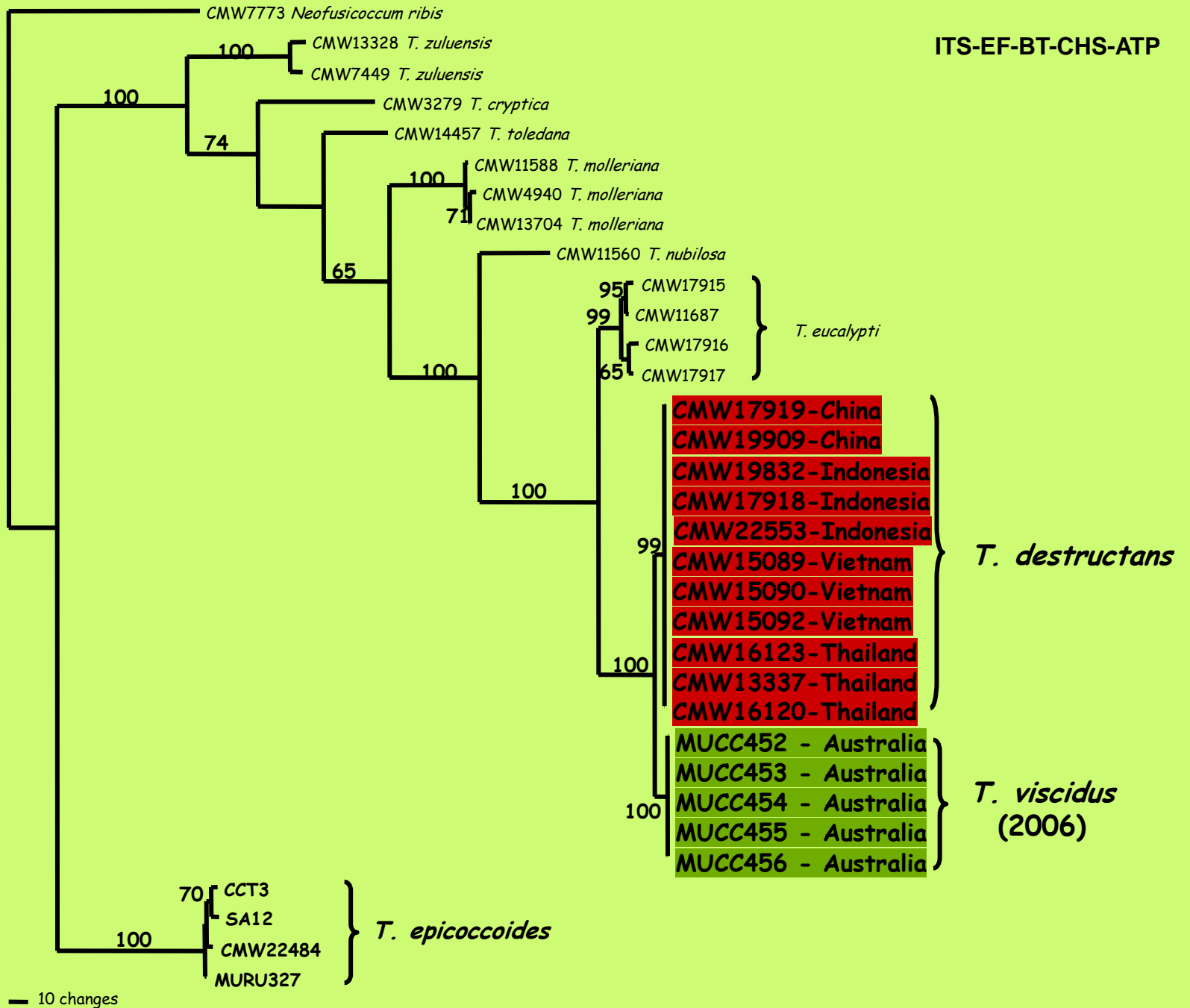
- First reports of disease are from Indonesia and based on molecular data this is the probable source of all introductions in South-East Asia and China.
- Considered a major threat to biosecurity of Australia's eucalypts and productivity of plantations, but could it have originated in Australia?







ITS-EF-BT-CHS-ATP



Kirramyces viscidus* sp. nov., a new eucalypt pathogen from tropical Australia closely related to the serious leaf pathogen, *Kirramyces destructans

V. Andjic^A, P. A. Barber^A, A. J. Carnegie^B, G. S. Pegg^C, G. E. St. J. Hardy^{A,E}, M. J. Wingfield^D and T. I. Burgess^{A,D}

^ABiological Science, Murdoch University, South Street, Murdoch, WA 6150, Australia.

^BForest Resources Research, NSW Department of Primary Industries, PO Box 100, Beecroft, NSW 2119, Australia.

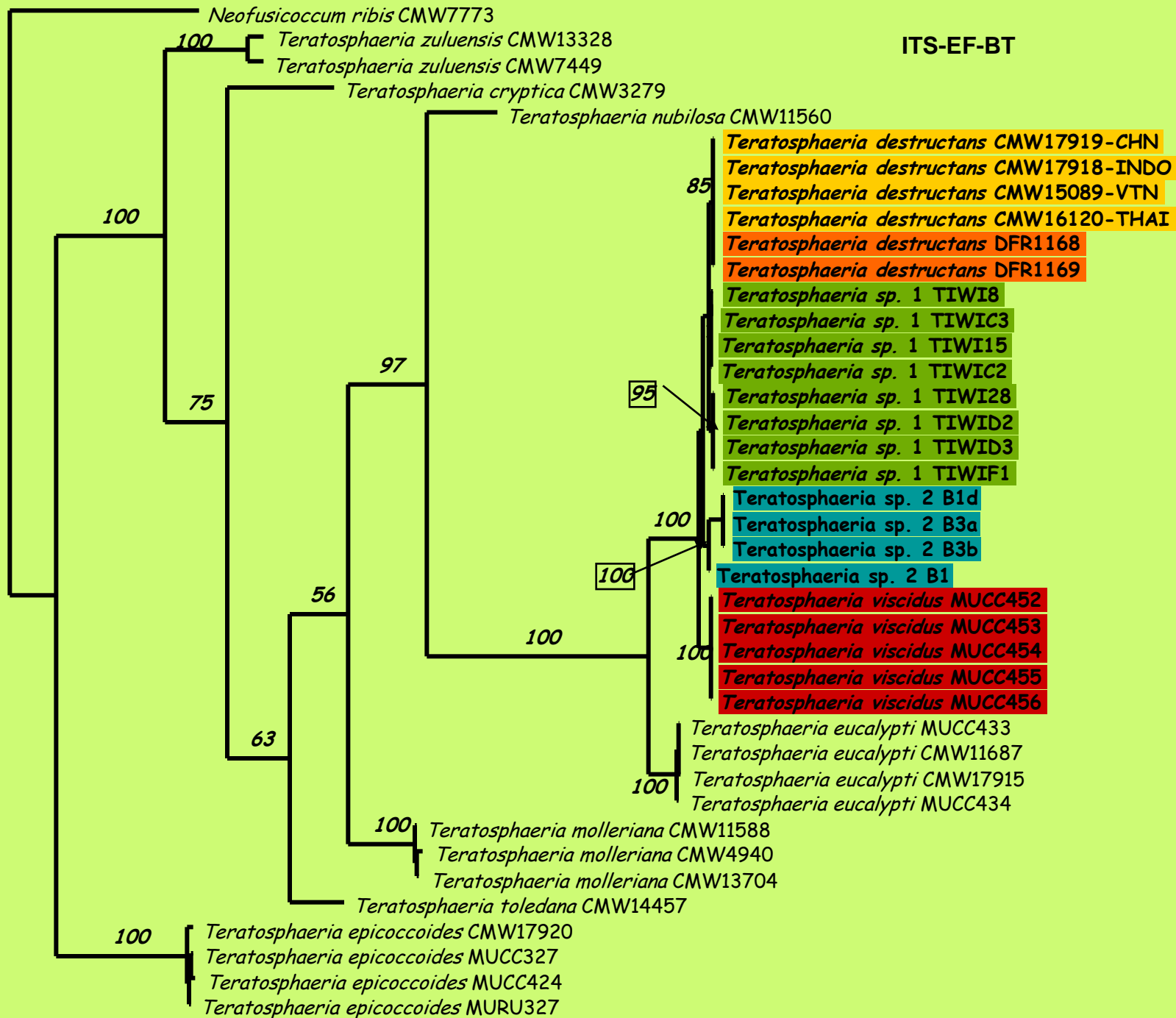
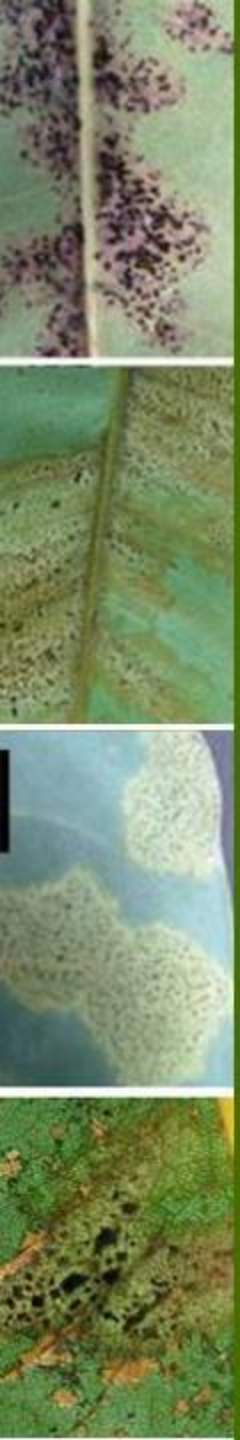
^CDepartment of Primary Industries and Fisheries, Horticulture and Forestry Science, Indooroopilly, Qld 4068, Australia.

^DForestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa.

^ECorresponding author. Email: g-hardy@murdoch.edu.au

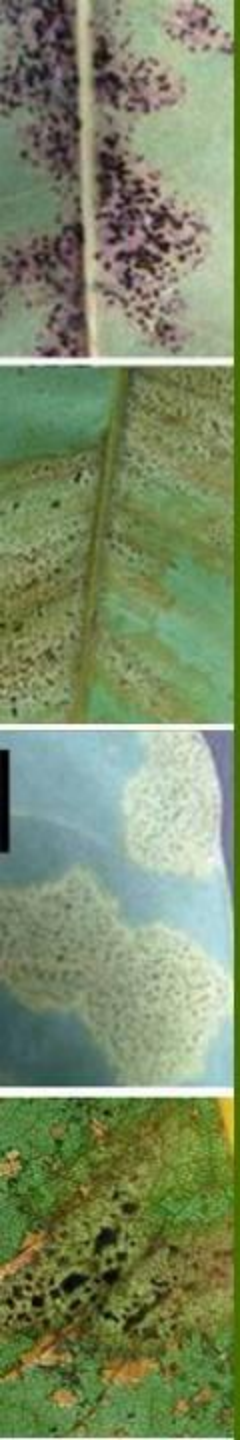






Teratosphaeria leaf blight in Australia (2008)

- There is no commercial eucalypt plantations in Far North Queensland and the Northern Territory where *T. destructans* and *T. viscidus* are found.
- There are commercial plantations in central and southern QLD and northern NSW
- Eucalypt plantations in sub-tropics have has many disease problems and species selection very important
- In taxa trials and plantations in the sub-tropics, *Teratosphaeria* leaf blight becoming a major problem
- What *Teratosphaeria* species are involved?

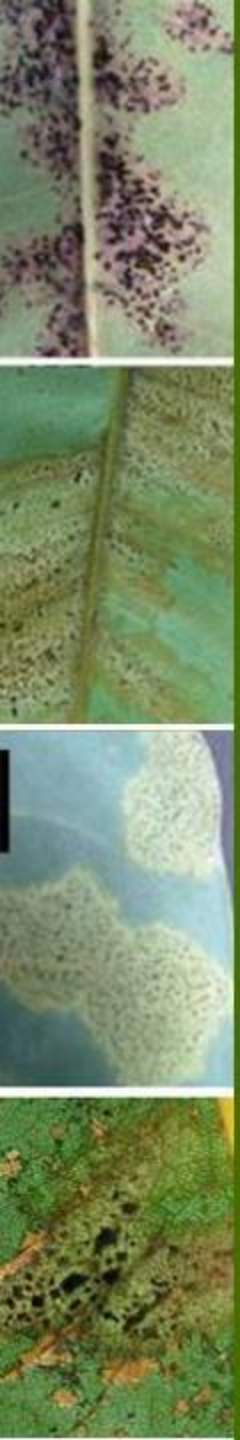




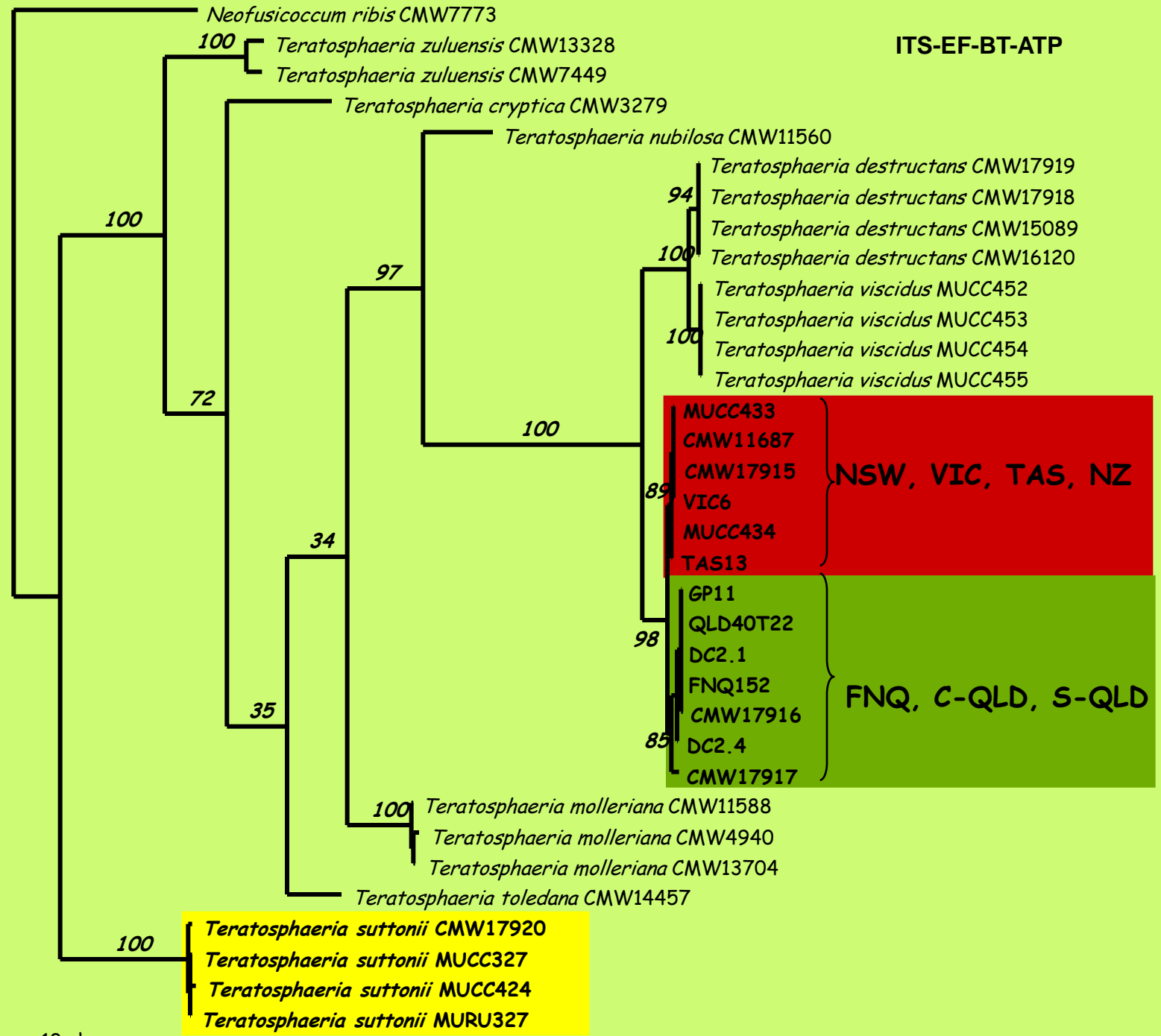
29 8 2007





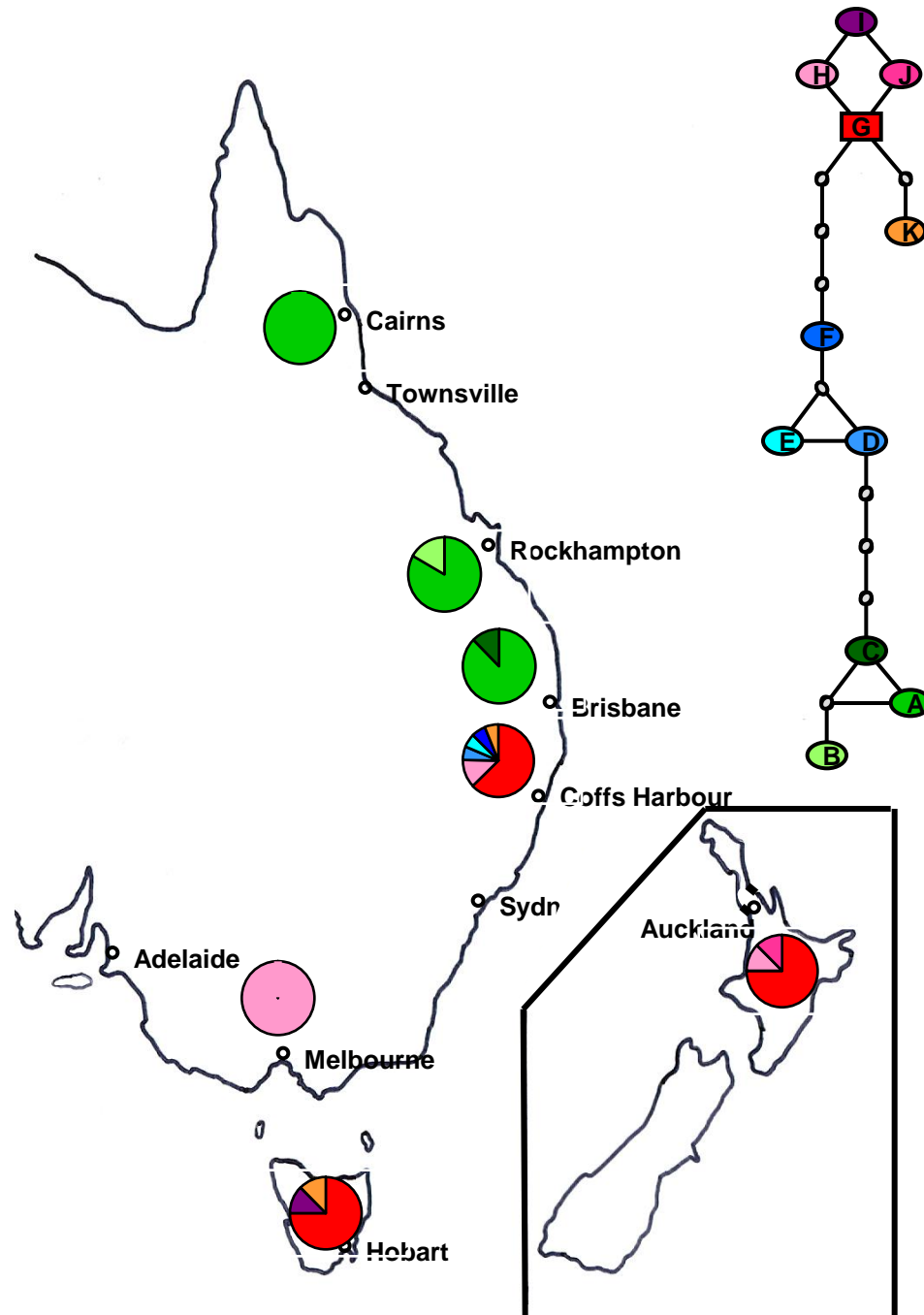
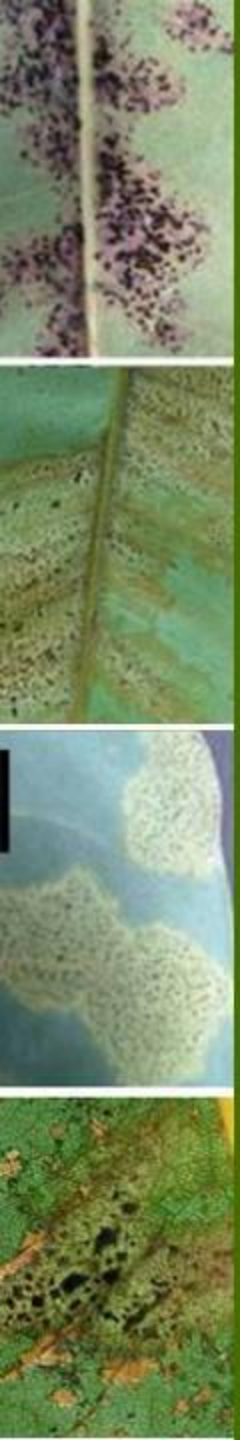


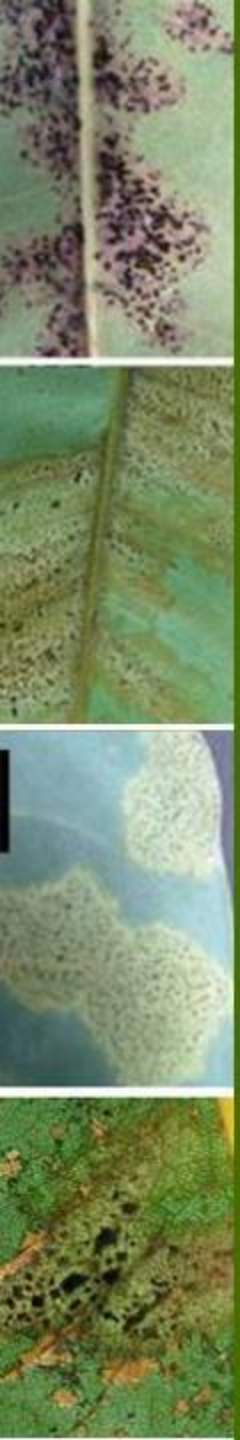
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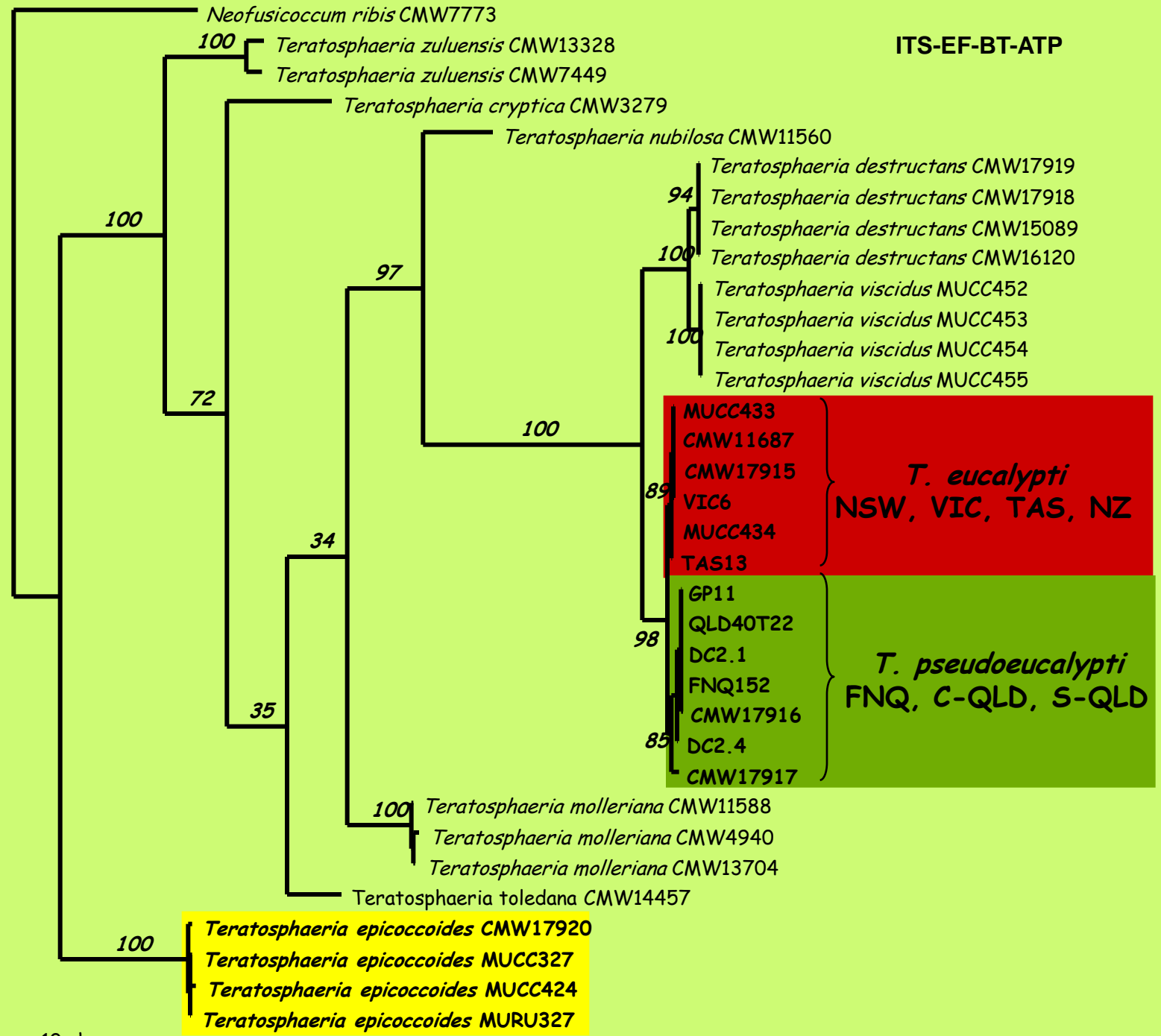
— 10 changes

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— 10 changes



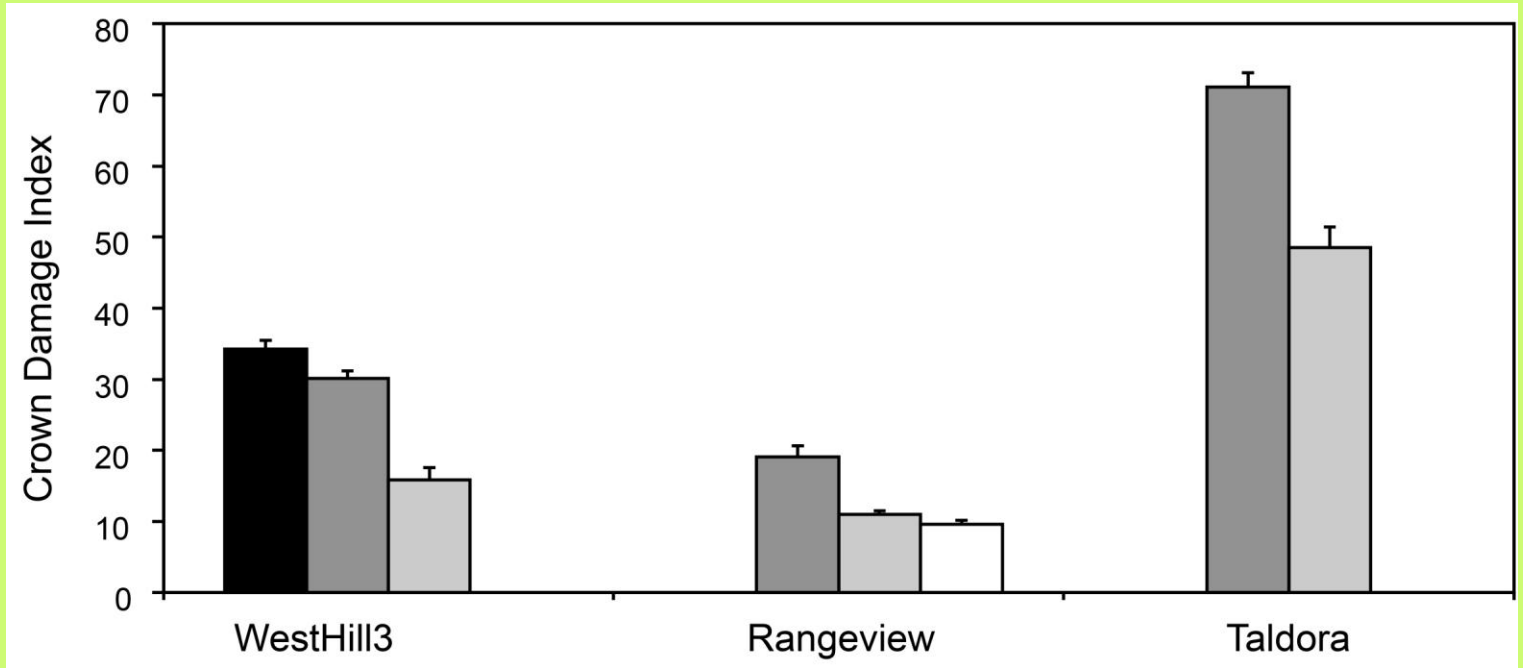
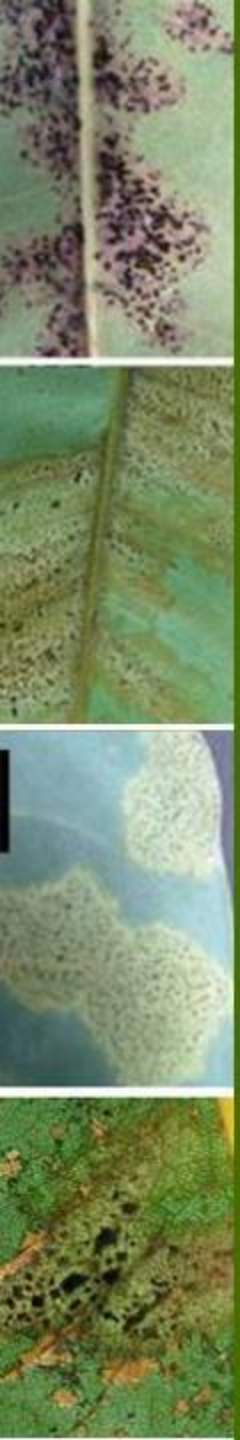
Plant Pathology (2010) 59, 900–912

Doi: 10.1111/j.1365-3059.2010.02308.x

***Teratosphaeria pseudoeucalypti*, new cryptic species responsible for leaf blight of *Eucalyptus* in subtropical and tropical Australia**

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and T. I. Burgess^a

^aBiological Science, Murdoch University, South St, Murdoch 6150; ^bTree Pathology Centre, The University of Queensland/Department of Primary Industries, Indooroopilly, Qld 4068; ^cForest Resources Research NSW Department of Primary Industries, PO Box 100, Beecroft, NSW 2119; and ^dDepartment of Forest and Ecosystem Science, The University of Melbourne, Water St, Creswick, VIC, Australia



Average crown damage index scores for 10 *E. camaldulensis* × *E. globulus* clones (black bar), 19-26 *E. grandis* × *E. camaldulensis* or *E. camaldulensis* × *E. grandis* clones (dark grey bars), 7-24 *E. grandis* × *E. urophylla* or *E. urophylla* × *E. grandis* clones (light grey bars) and 5 *E. grandis* × *E. pellita* or *E. pellita* × *E. grandis* clones (white bar) at three trial sites in Central Queensland. Error bars are standard errors.

An even more seismic change, however, is that Queensland is about to lose 40% of its hardwood plantation estate. Elders Forestry, the state's second largest plantation grower, has recently decided to disinvest ~90% of the company's 25,000ha of established native hardwood pulp plantations in central Queensland as a result of a significant disease problem, Kirramyces leaf blight, which has negatively affected their commercial performance.

An endemic fungus disease, Kirramyces leaf blight has affected a range of commercial plantation tree varieties in central Queensland since first being identified by Queensland Government Forestry Science in 2007. Elders Forestry's central Queensland plantation estate consists mostly of *Eucalyptus* GC hybrids (*Eucalyptus grandis* x *E. camaldulensis*) sourced from South America, which were deemed at the time by the former ITC Limited, as the best available commercial option for central Queensland. This plantation tree variety, however, is vulnerable to Kirramyces leaf blight.

Queensland Government Forestry Science worked with Elders Forestry in conducting infestation surveys and training to Elders Forestry staff to identify, survey, and monitor the disease, but every year it affected more and more plantation area. With no commercially known treatments available and significant productivity losses, Elders Forestry, with the added advice of an independent review, made the decision to cut its losses and abandon its plantations.



Elders Forestry 8yo old teak plantation near Cooktown: the company will continue to have a presence in north Queensland.

news is that the market sees most of these plantation projects as commercially robust. To date, the management of Great Southern's pulpwood plantations in central Queensland has been taken over by Gunns, and their teak plantations in north Queensland



Close-up of Kirramyces leaf blight, which is devastating Elders Forestry's Queensland plantations.

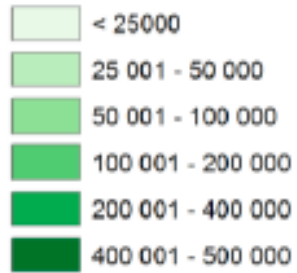
Elders Limited [ASX:ELD] announces that the Review of Forestry Assets as advised to the ASX on 26 March 2010 has been completed. The Board initiated the Review to provide an externally reviewed and comprehensive examination of the implications for asset values arising from recent forestry sector developments and the anticipated receipt of the yield forecast reports.

The review has confirmed the Company's current property values across the plantation estate, with the exception of Central Queensland which will be subject to a material writedown. Forecast yields from Central Queensland and Esperance have been reduced materially with consequent writedown to accrued income attributed to these areas. Yields and property values in other regions (which include Albany, the Green Triangle, Bunbury, Kununurra, Tasmania, and North Queensland) are unaffected.

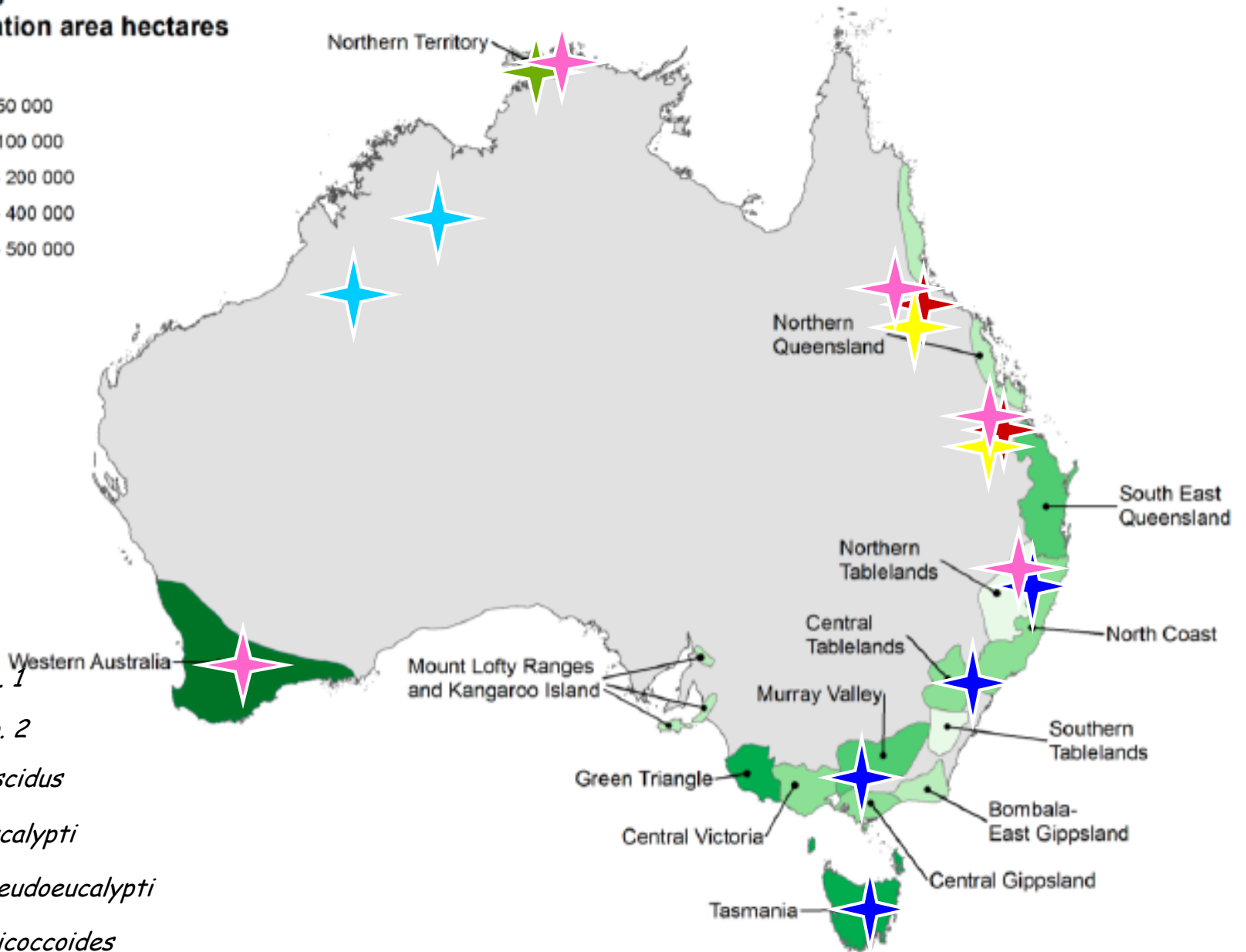
Map 1 National Plantation Inventory regions

NPI regions

Total plantation area hectares



- T. sp. 1*
- T. sp. 2*
- T. viscidus*
- T. eucalypti*
- T. pseudoeucalypti*
- T. epicoccoides*



Conclusions

- Teratosphaeria Leaf Disease (TLD) and Teratosphaeria Leaf Blight (TLB) are serious forest pathogens that can result in the death of trees
- at the time of the epidemic in central Queensland there was some evidence for resistance among hybrids, but as the inoculum level increased all trees succumbed
- the only possible control for this pathogen (group of pathogens) is to breed for resistance

