An emerging needle blight disease of *Pinus radiata* in Chile

R. Ahumada, A. Duran, B. Slippers, M. Gryzenhout, B.D. Wingfield, A. Rotella, F. Flores and M.J. Wingfield

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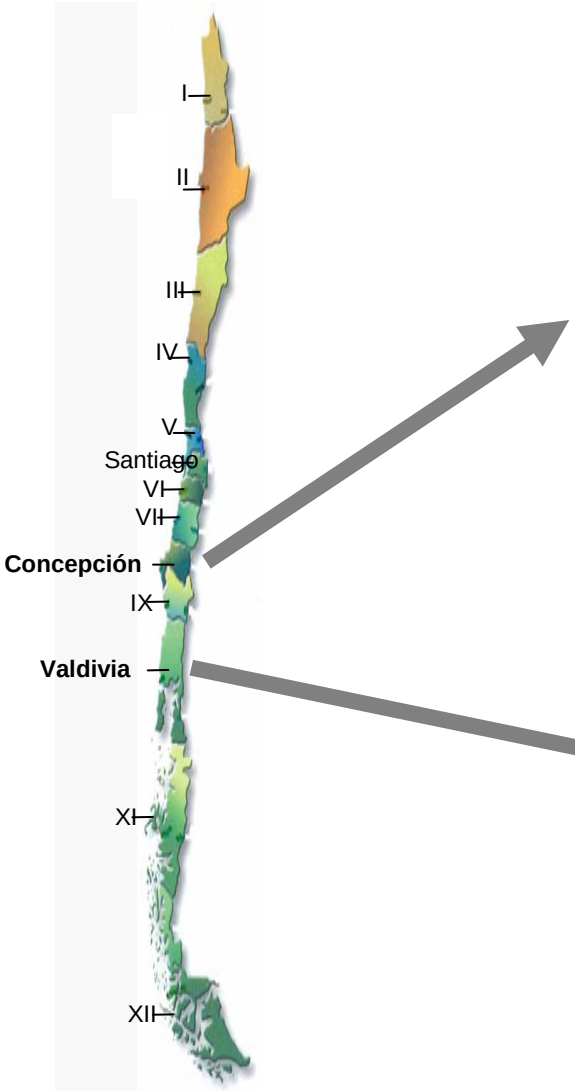
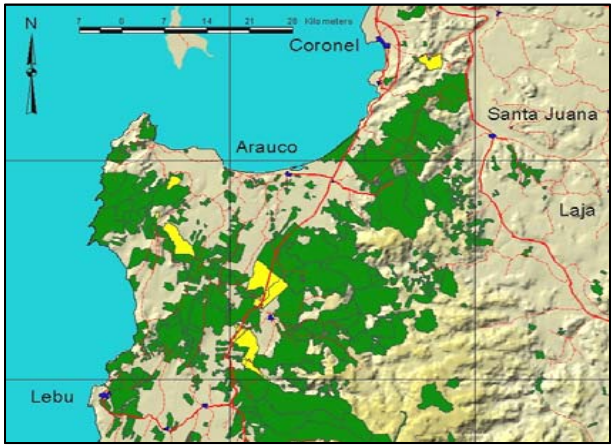
Distribution of DFP (Daño Foliar del Pino)



Arauco Area



Valdivia Area

- First detection in the Arauco area 2004

- Spread to other adjacent areas

- Similar symptoms in the Valdivia area in 2005

- The major incidence was in 2006 with 60 000 ha of damage

- Low incidence in 2007, possibly due to weather conditions

Durán A, Gryzenhout M, Slippers B, Ahumada R, Rotella A, Flores F, Wingfield BD, Wingfield MJ, 2008. *Phytophthora pinifolia* sp. nov. associated with a serious needle disease of *Pinus radiata* in Chile. *Plant Pathology* **57**: 715-27.

DFP Pattern

DFP Pattern

Symptoms

Needle mortality on the lower sides of branches

Mature needle death

Older tree death

Symptoms

Shoot death

Mortality of seedlings

Mortality of natural regeneration

Symptoms

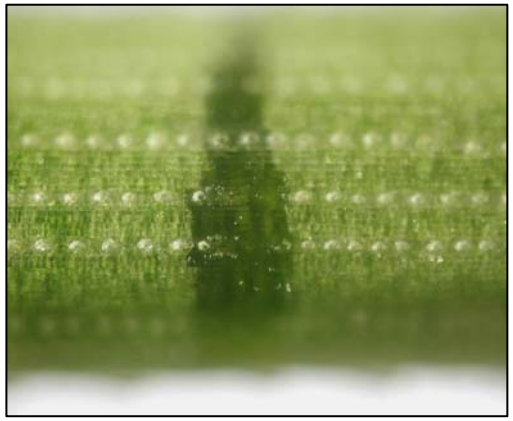
Infections on needle bases

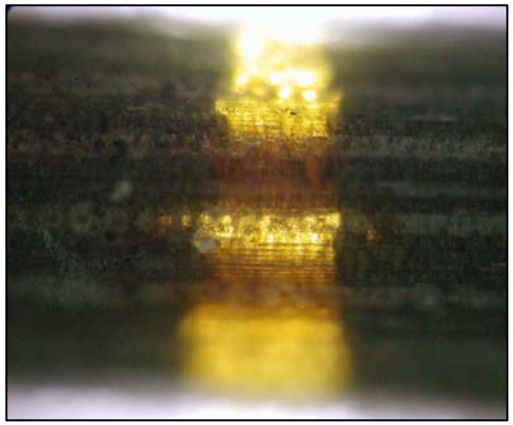
Necrotic areas at the insertion point of the brachiblasts

Stem cankers

Symptoms

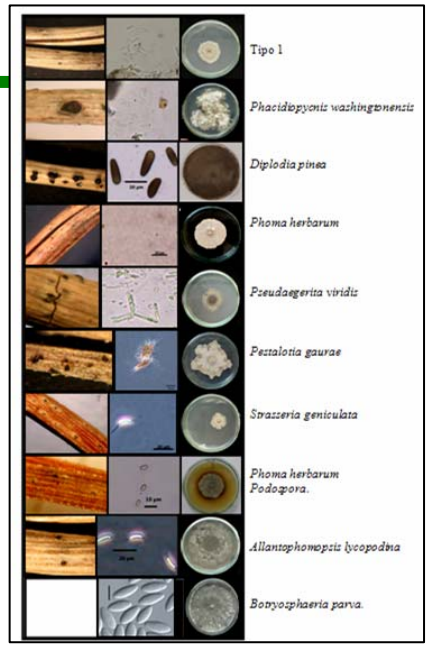
Resinous bands on needles





Isolation

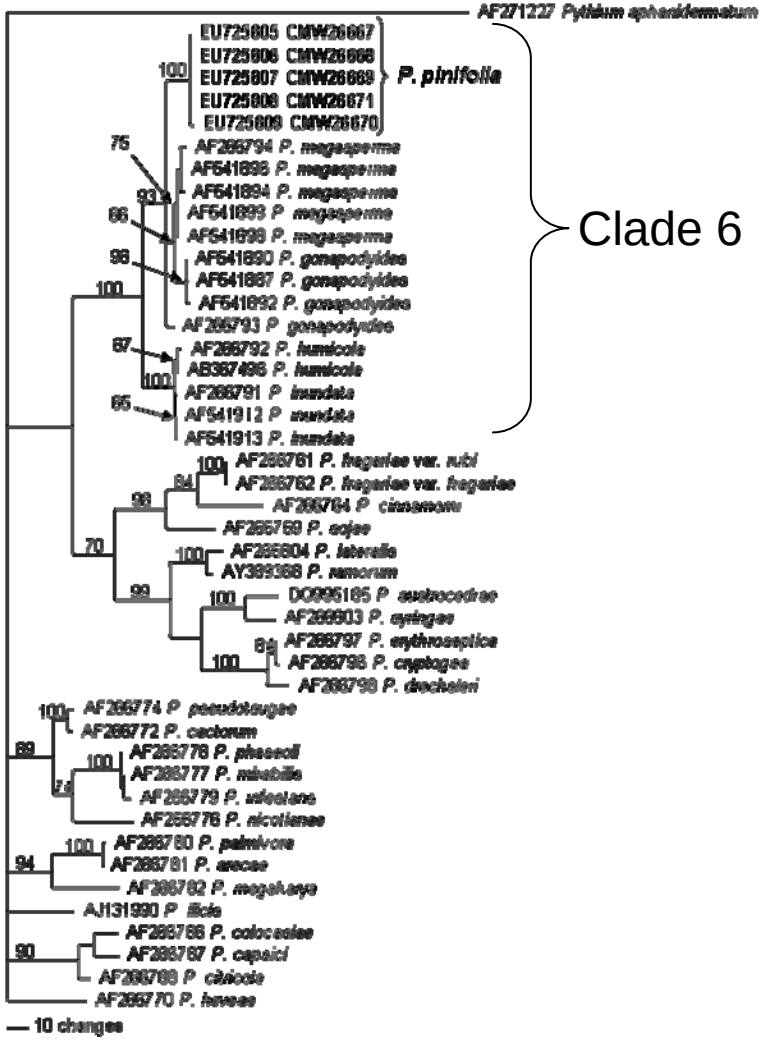
PDA & MEA



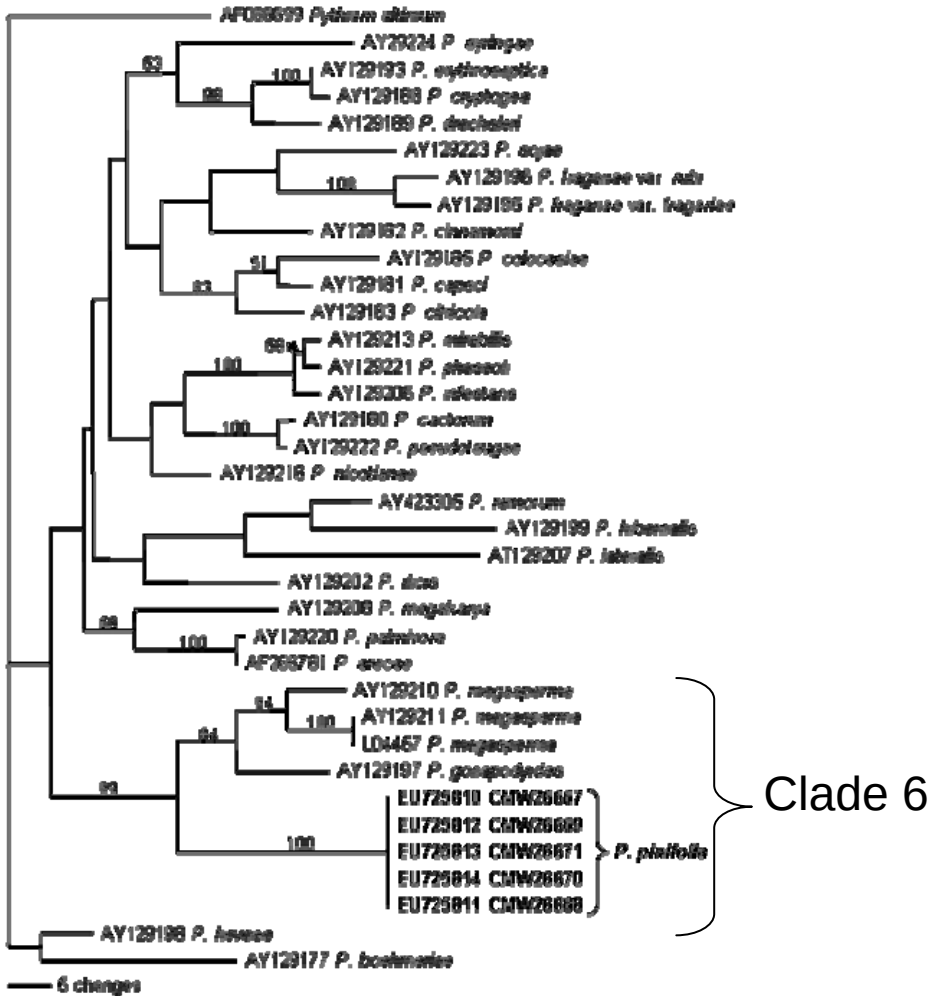
CMA-NARPH

Phylogenetic analysis to support the new species

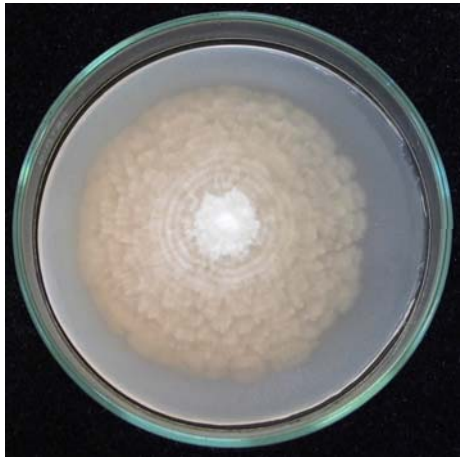
ITS

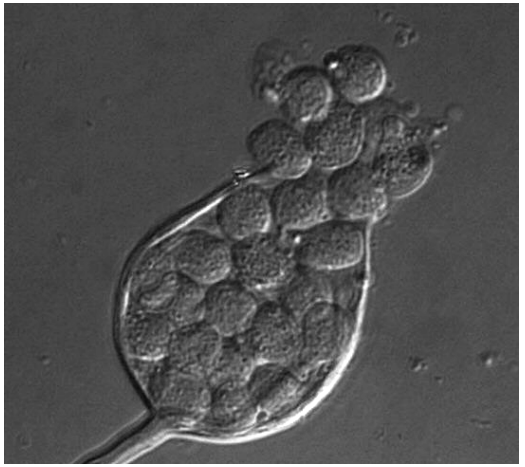


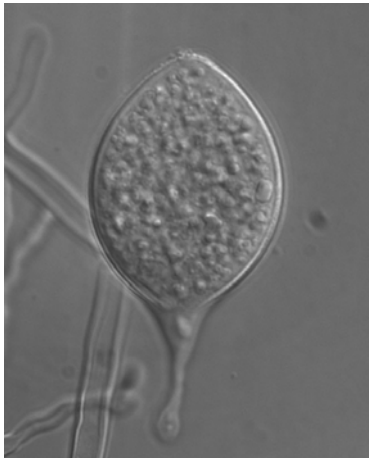
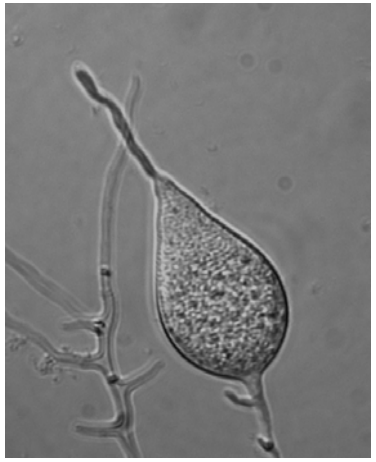
cox II



Morphological analysis to support the new species




Morphology and habitat comparison with other species in Clade 6

Characteristics	***Phytophthora pinifolia***	***Phytophthora gonapodyides***	***Phytophthora humicola***	***Phytophthora inundata***	***Phytophthora megasperma***
Habitat	Aerial parts of *Pinus radiata*	Soil, root	Soil	Soil, root, river water or from pond debris	Soil, root
Occurring on *Pinus*	Yes	No	No	No	No
Sporangial proliferation	None	Internal or internal nested or external proliferation	Mostly internal proliferation	Internal proliferation	Internal proliferation
Sporangium	Non–papillate	Non–papillate	Non–papillate	Non–papillate	Non–papillate
Hyphal swellings	Yes	No	Yes	No	Yes
Hyphal swelling morphology	Spherical, radiating hyphae	n/a	Spherical, radiating hyphae	n/a	Rounded or angular, in chains or clusters
Sexuality	unknown	Heterothallic	Homothallic	Partially heterothallic	Mostly homothallic

From: Erwin DC & Ribeiro OK. 1996. *Phytophthora* disease worldwide.
Brasier CM, Sanchez–Hernandez E, Kirk SA. 2003. *Mycological Research* **107**, 477–484.
Gallegly ME & Hong Ch. 2008. *Phytophthora*: identifying species by morphology and DNA fingerprints.

Habitat comparison with other species in Clade 6

	River water and riparian or wetland soils	Forest soils	Woody horticultural crops and amenity trees	Agricultural crops	Aerial part of *P. radiata*
P. gonapodyides[a]	+++	++	+		
P. taxon Pgchlamydo[a]	++	++	+		
P. megasperma[a]	++	+	+++	++	
P. taxon Oaksoil[a]		+			
P. taxon Riversoil[a]	+				
P. taxon Raspberry[a]	+		+		
P. taxon Forestsoil[a]		+			
P. *inundata*[b]	++		++		
P. humicola[a]			nd*		
P. sp. Apple-cherry[a]			++		
P. taxon Walnut[a]			+		
P. pinifolia[c]					+++

+, rare; ++, occasional; +++, frequent or locally abundant.
*, ecological status of *P. humicola* unknown, but isolated from a citrus orchard (Ko & Ann 1985).

[a]Brasier CM, Cooke DEL, Duncan JM, Hansen EM. 2003. *Mycological Research* **107**: 277–290
[b]Brasier CM, Sanchez-Hernandez E, Kirk SA. *Mycological Research* **107**: 477–484
[c]Durán A, Gryzenhout M, Slippers B, Ahumada R, Rotella A, Flores F, Wingfield BD, Wingfield MJ. 2008. *Plant Pathology* **57**: 715-727.

Phytophthora spp. isolated from *Pinus* spp.

Species	Damage
P. boehmeriae	Root rot
P. cactorum	Seedling root rot
P. cinnamomi	Root rot
P. citricola	Root rot
P. citrophthora	Pre-emergence seedling disease / Root rot
P. cryptogea	Decline
P. drechsleri	Seedling disease
P. heveae	Root rot
P. megasperma	Root and stem rot
P. parasitica	Root rot
P. pinifolia	Needle cast / Canker

P. radiata

Conclusions

-DFP is caused by *P. pinifolia*

-The most serious disease of *P. radiata* in Chile, and potentially internationally

- Might stop the planting of *P. radiata* in some areas of Chile and possibly require quarantine restrictions for wood export internationally

-Causes different symptoms on adult and young trees

-*Phytophthora pinifolia* do not produce death of adult trees directly, where the death is promoted probably by opportunistic organism after several years of defoliation

- Death in young trees is produced by several cankers in the stem

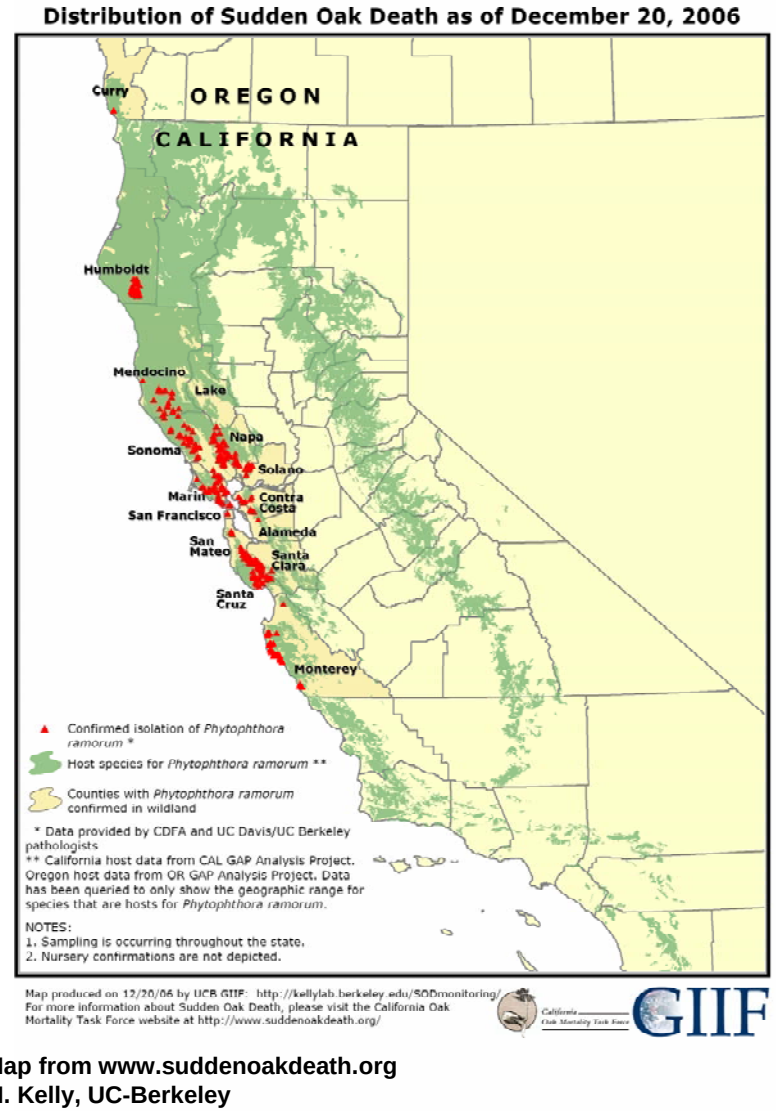
Conclusions (cont.)

-First report of a *Phytophthora* spp. causing an aerial disease in exotic *Pinus* plantations

-The morphology and habitat of *P. pinifolia* is different from all other *Phytophthora* spp. in Clade 6.

-There is an urgent need for studies on the origin, biology, epidemiology and management

Other *Phytophthora* spp. in forests



Map from www.suddenoakdeath.org
M. Kelly, UC-Berkeley

P. ramorum

- Symptoms in USA registered since the mid 1990s

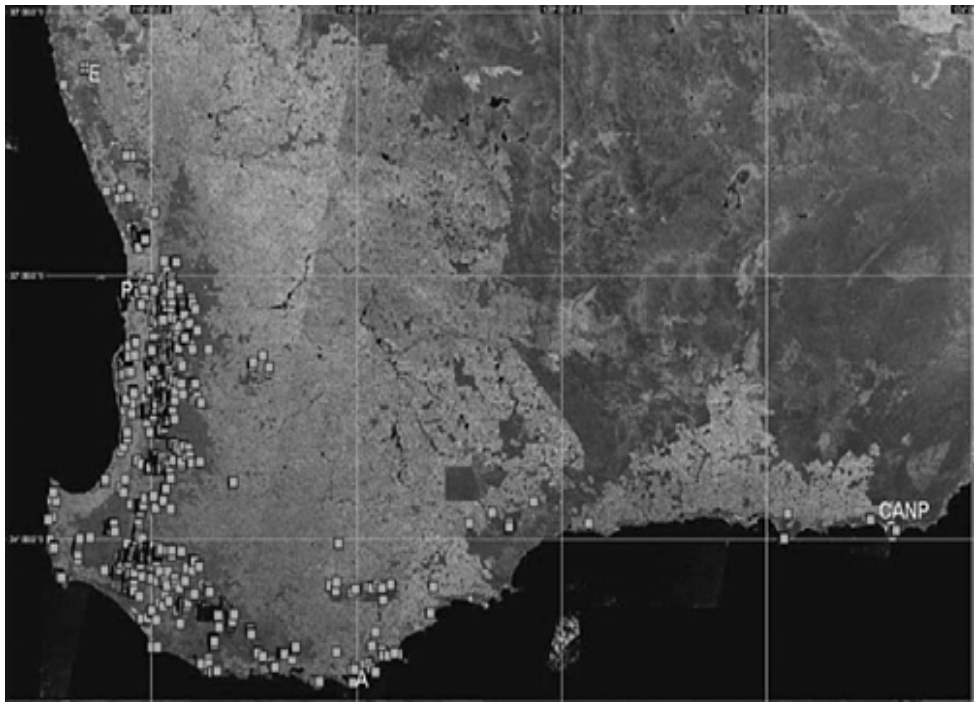
- Description in 2001 (Werres *et al*.)

- Related to coastal environment

- Has caused substantial mortality in tan oak stands, as well as affecting a number of other oak species

- Despite several management strategies, the disease still spread in USA

Other *Phytophthora* spp. in forests



Shearer BL, Crane CE, Barrett S, Cochrane A (2007) *Australian Journal of Botany* **55**, 225–238.

P. cinammomi

- Introduced into Australia in the early 1800s

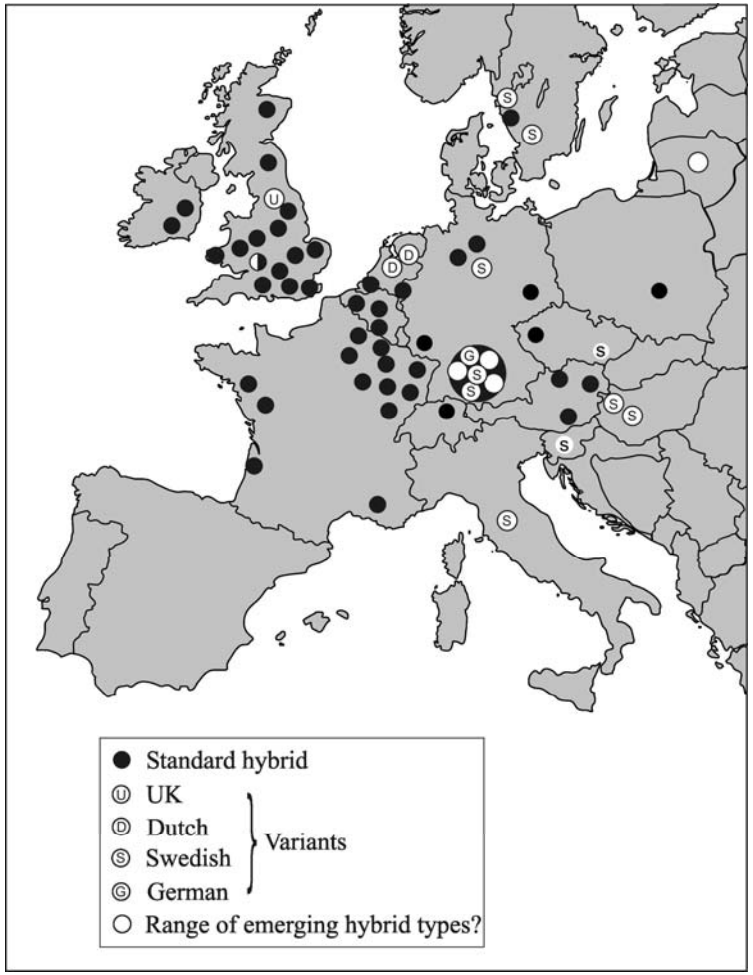
- Was first identified in the Mount Lofty Ranges in 1972 and on Kangaroo Island in 1993

- Related to coastal environment

- Reported for 1467 taxa, which is ~5% of Australia's vascular flora

- The management is based on pesticide and spread regulations

Other *Phytophthora* spp. in forests



Brasier and Jung 2003 updated.

Brasier, C.M.; Jung, T. 2003. Progress in understanding Phytophthora diseases of trees in Europe. In: McComb, J.A.; Hardy, G.E.StJ, eds. Phytophthora in Forests and Natural Ecosystems. Proceedings, 2nd Int. IUFRO Working Party 7.02.09 Meeting, Albany, Western Australia. September 30 " October 5, 2001. Murdoch University Print, Perth: 4-18.

P. alni

- Symptoms first observed in 1993 on *Alnus* spp. in Britain

- Description in 2004 (Brasier *et al*.)

- Mainly along riverbanks, and in orchard shelterbelts and woodland plantations, as well as coastal environments

- Reported hosts: *Alnus glutinosa*, *A. cordata* and *A. incana*

- The management is based on spread regulations

Conclusions (cont.)

-One of a number of *Phytophthora* spp. that appeared in the last years in forests

-Could this species become such a big problem such as some of these *Phytophthora* spp.?

Acknowledgments

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-Dr. Thomas Jung for very useful comments about *P. alni*, and interaction with various *Phytophthora* experts through this year.

“KEEPING TREES HEALTHY”

THANK YOU

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