Etiology and Management of Limb Dieback of Figs in California

(new project, 2005)

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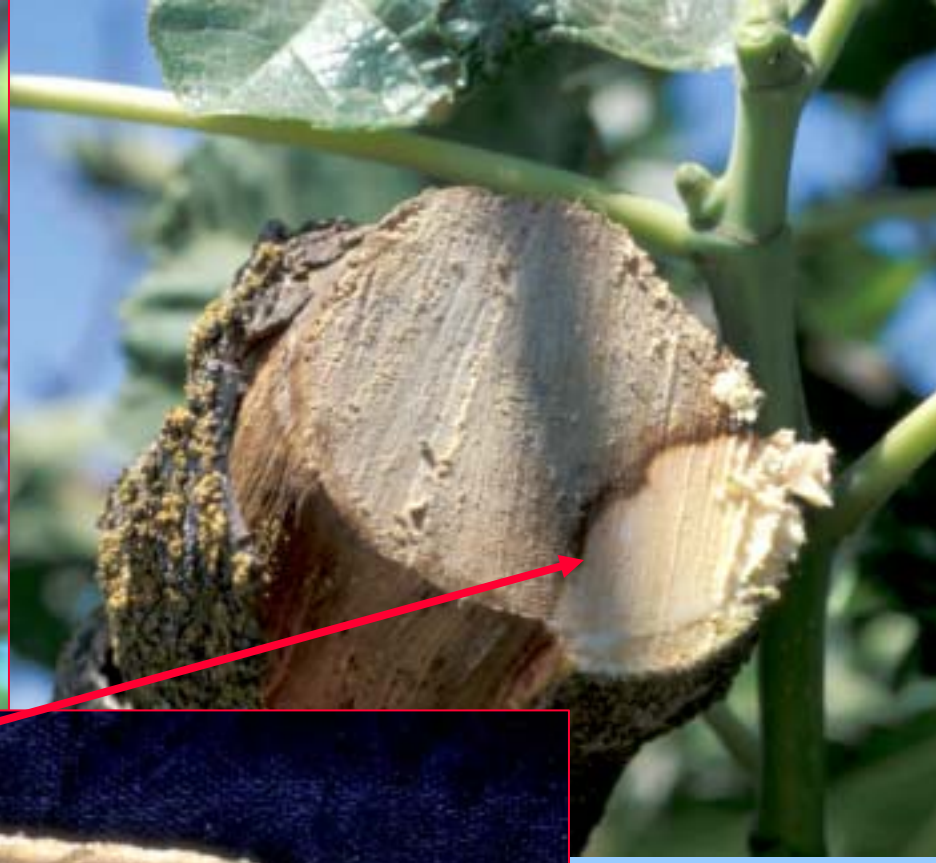


Sharp margins of cankered areas

Objectives of project

1. Determine the causal agent(s) of dieback by performing Koch's postulates.
2. Investigate sources of agent(s) and factors influencing infection of figs.
3. Evaluate susceptibility of fig cultivars to the cause(s) of limb dieback.
4. Develop control methods.

Objective 1: Determine the cause(s) of dieback by performing Koch's postulates:.

- ✓ Isolate suspect agent(s);
- ✓ Inoculate figs with suspect agent(s);
- ✓ Observe and record symptom development;
- ✓ Compare symptoms of inoculations with natural symptoms;
- ✓ Re-isolate agent(s) from symptomatic tissues;
- ✓ Compare the re-isolated agent(s) with those used for the inoculations.

Samples were collected:

Orchard A

- Black Mission
- Calimyrna

Orchard B

- **Black Mission (organic & conventional)**
- **Calimyrna**
- **Conadria**

Incidence of fungi isolated from limb dieback (Orchard A)

Cultivar	Species	Incidence (%)
Mission	*Nattrassia mangiferae*	26.4
	Phomopsis sp.	66.4
	Fusarium sp.	6.4
	Botryosphaeria rhodina	1.0
Calimyrna	*Nattrassia mangiferae*	78.3
	Phomopsis sp.	13.3

Samples collected on 10 May 2005

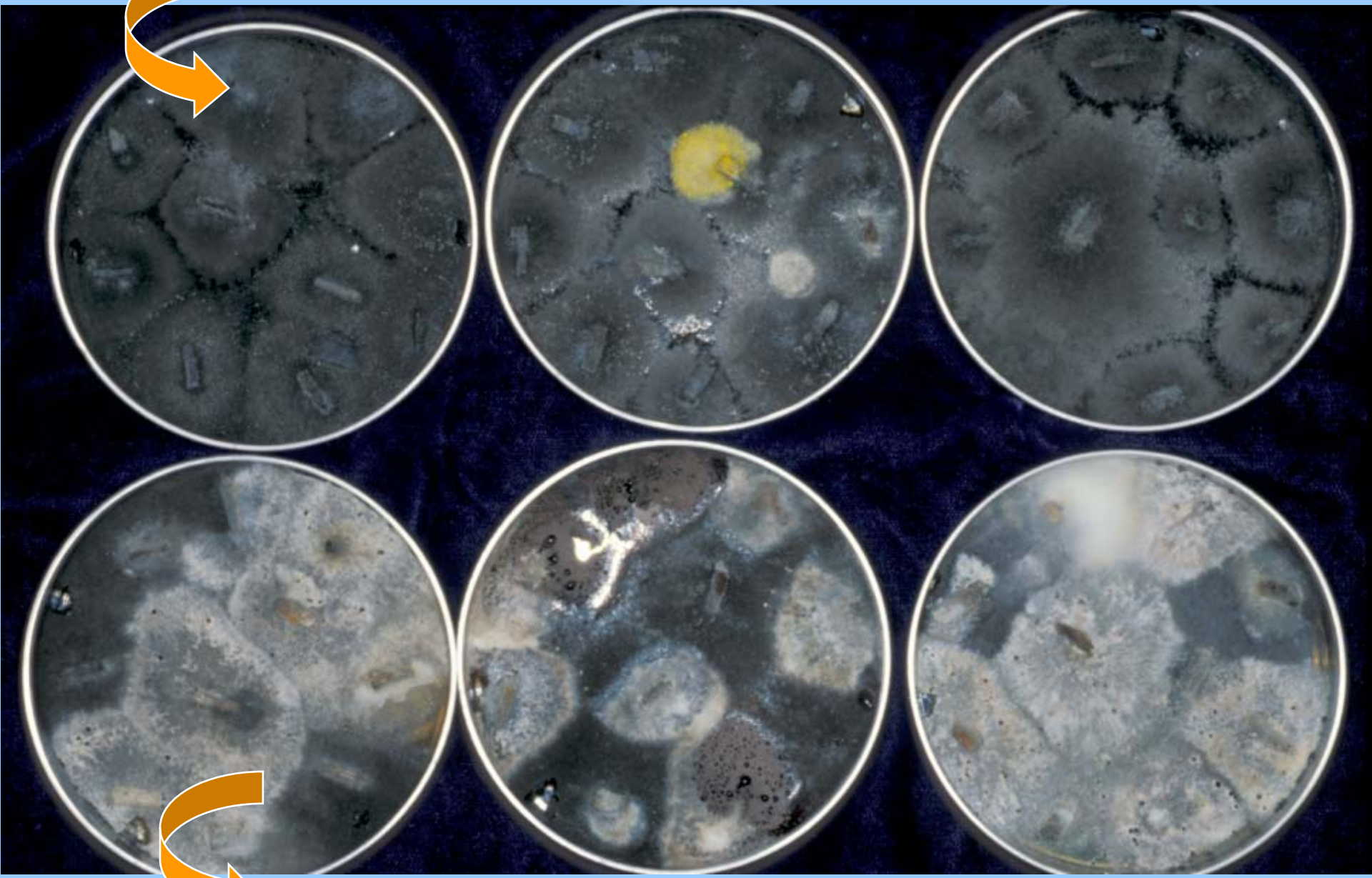
Incidence of fungi isolated from limb dieback

(Orchard B)

Cultivar	Location	Fungus	Incidence (%)
Conadria	South end	*N. mangiferae*	82.2
		Phomopsis sp.	7.8
		B. rhodina ☑	7.8
Calimyrna	North end	*N. mangiferae*	65.5
		Phomopsis	32.2
		B. rhodina ☑	3.3
Mission	Organic	*N. mangiferae*	11.3
		Phomopsis	55.5
		B. rhodina ☑	1.7
Mission	Conventional	*N. mangiferae*	6.7
		Phomopsis sp.	93.3

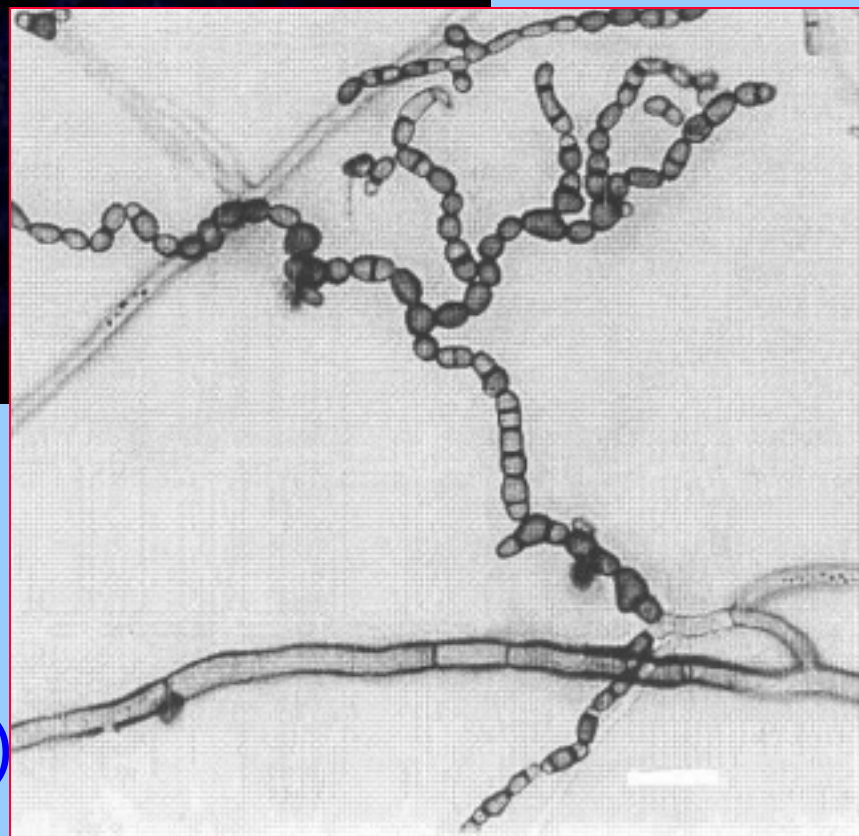
Samples collected on 29 June 2005

Nattrassia mangiferae



Phomopsis sinerascens

Mycelia fragment into spores (arthrospores)



Nattrassia mangiferae

cause of branch wilt

(syn. *Hendersonula toruloidea*)

Nattrassia mangiferae pycnidia

arthrospores

pycnidiospores

Arthrospores of *N.mangiferae* from culture.

Arthrospores of *N. mangiferae* directly from inner bark of infected branch.


Phomopsis cinerascens
α and β spores


Botryosphaeria rhodina

Conclusion

In Conadria and Calimyrna:

The predominant isolated fungus was *Nattrassia mangiferae* (Synonym: *Hendersonula toruloidea*).

In Black Mission:

The predominant isolated fungus was *Phomopsis cinerascens*.

Pathogenicity studies:

- ***Nattrassia mangiferae***
- ***Phomopsis cinerascens***

Inoculation of Calimyrna


Inoculation of Calimyrna

Canker development by *Nattrassia mangiferae*

Inoculations: (3.5 months later)

Nattrassia:

Sunburned: 14.6 mm (46 mm internal streaking)

No sunburned: 11.3 mm (35 mm)

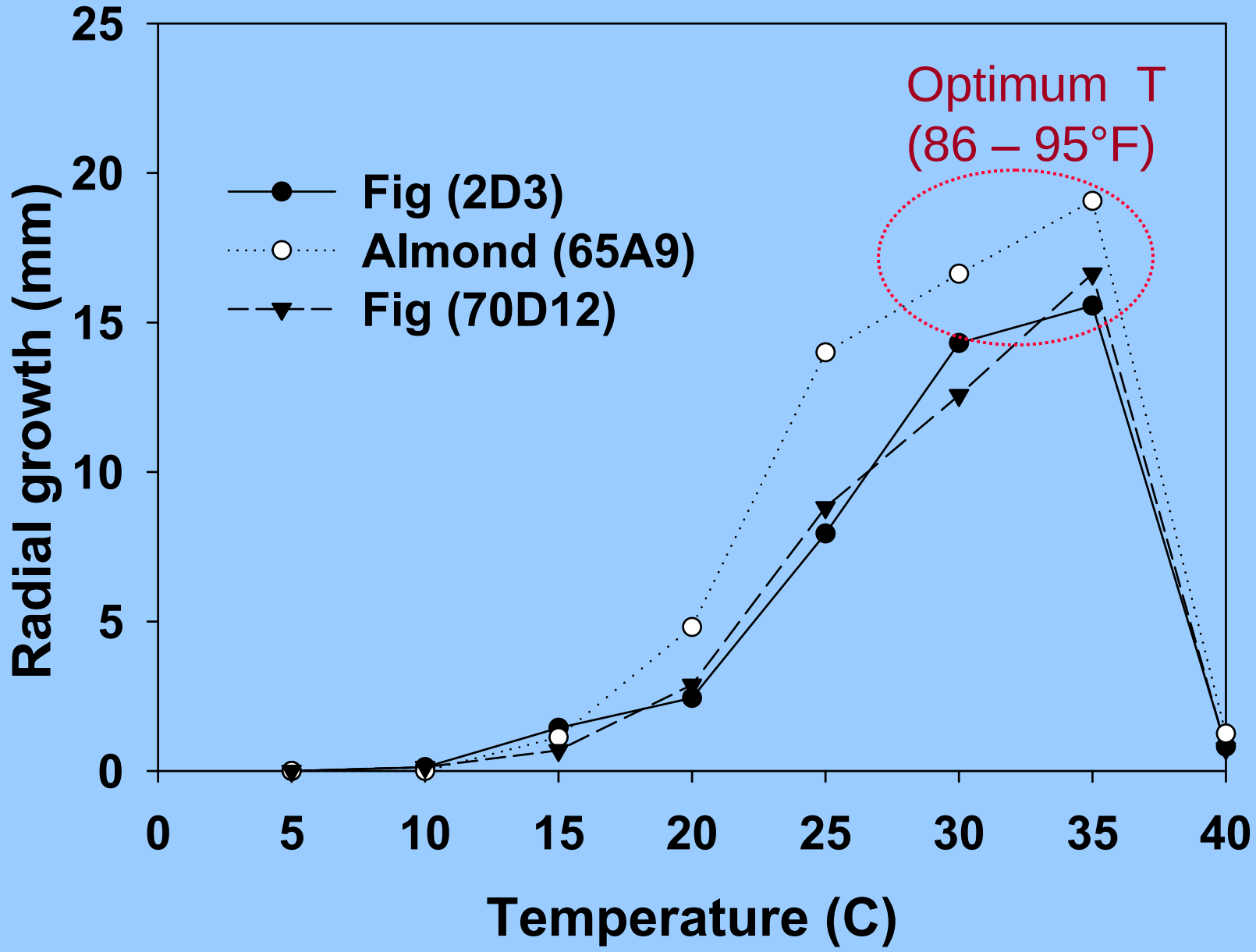
Phomopsis:

8.3 mm (did not grow)

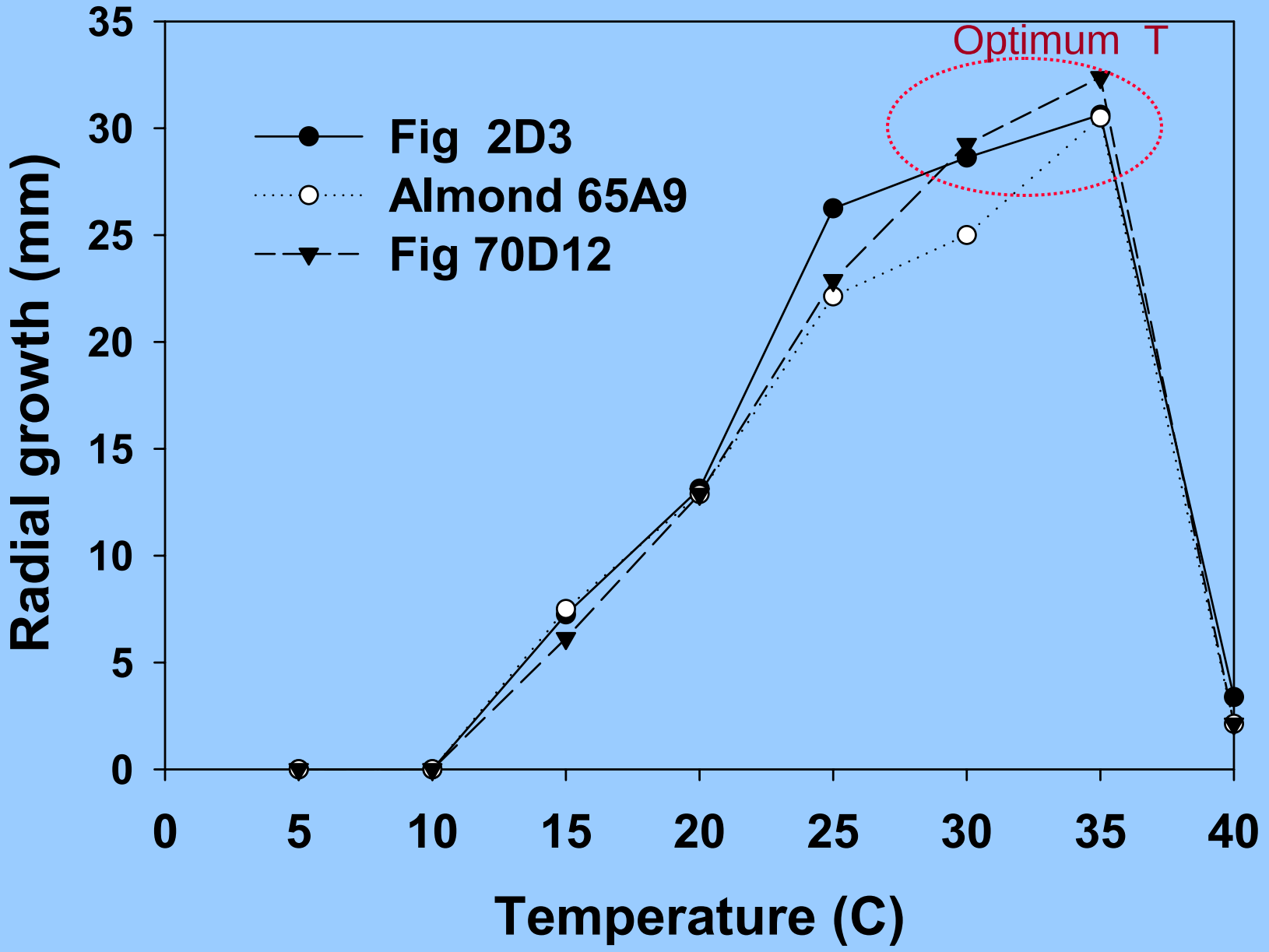
Control

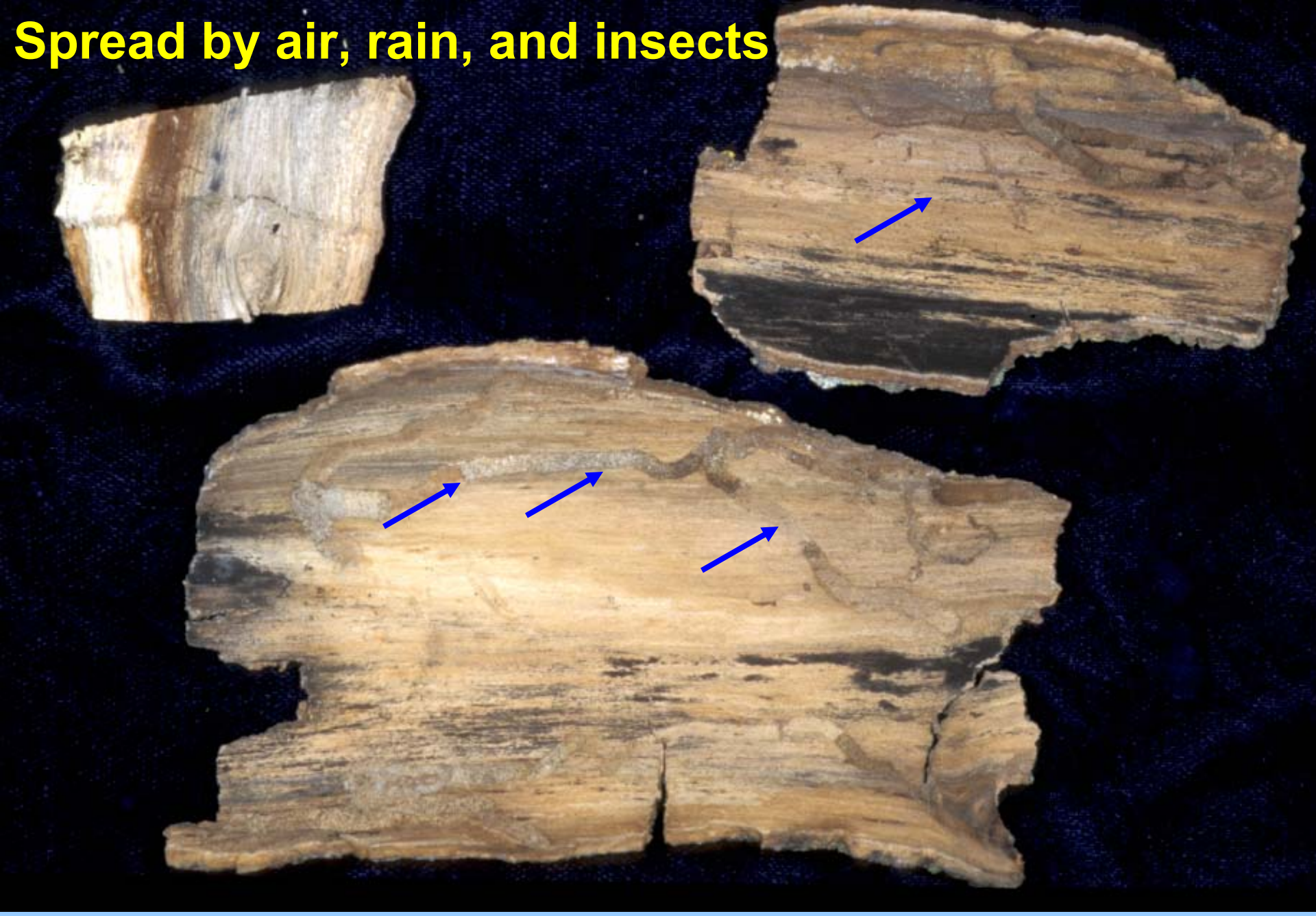
7.5 mm

Growth of *Nattrassia* (1st experiment)



Growth of *Nattrassia* (2nd experiment)





Borers can transfer spores

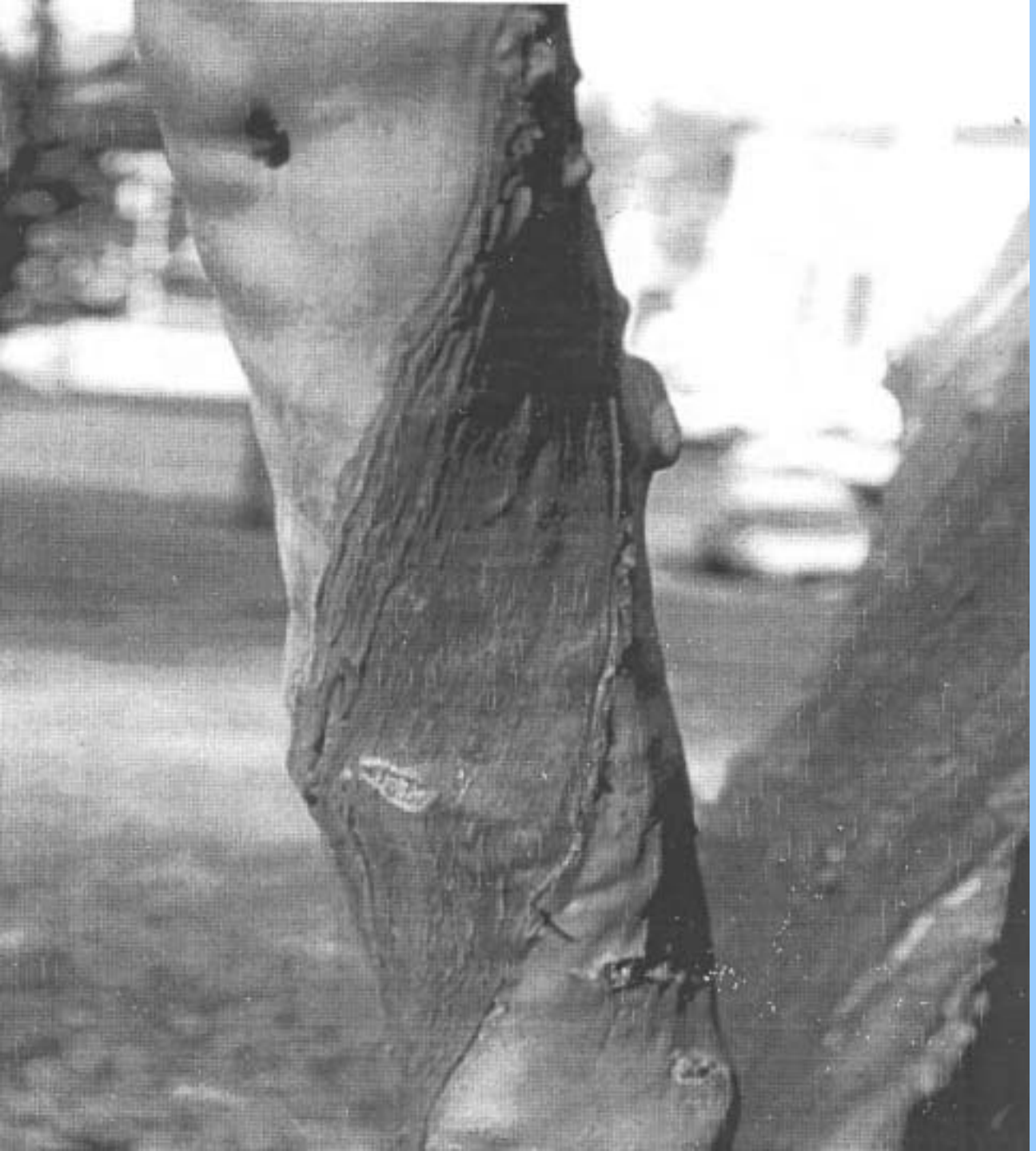

Branch wilt of walnut

Branch wilt of walnut (*Nattrassia mangiferae* = *Hendersonula toruloidea*) and *Botryosphaeria dothidea.*

Similarly, in almonds both fungi present.

Branch wilt of Magnolia


Limb dieback of birch



Madrone branch canker

Hosts of ***Nattrassia mangiferae*** (branch wilt, cankers, and dieback)

Fig (*Ficus carica*)	Branch wilt (1952)
Ficus religiosa	Dieback and trunk cankers
Ficus bengalensis	Wilt and dieback
Grape	Trunk canker
Hevea brasiliensis	Sudden wilt
Poplar trees	Branch wilt
Eucalyptus	Branch canker
Mango	Blossom blight

Hosts of *Nattrassia mangiferae* causing branch wilt, cankers, and dieback

Walnut	Branch wilt
Citrus	Branch wilt
Figs (*Ficus* spp.)	Branch wilt
Eucalyptus	Branch canker
Mango	Branch canker
Guava	Dieback and trunk cankers
Madrone	Branch canker
Acacia	Branch canker
Cassava	Post-harvest decay
White yam, mango	Post-harvest decay
Other tropical fruit	Post-harvest decay

Objective 1 (2006): Determine the cause(s) of dieback by performing Koch's postulates:

- ✓ Isolate putative pathogens from multiple samples;
- ✓ Inoculate figs with putative pathogens (*N. mangiferae, P. cinerascens, & B. rhodina*);

Objectives 2006

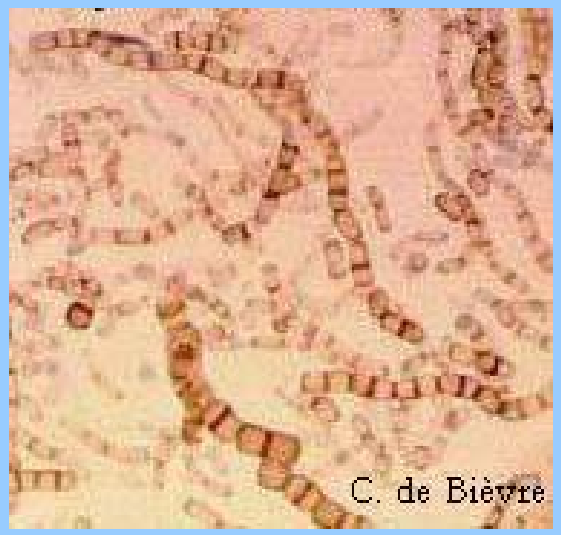
2. Investigate sources of inoculum and factors influencing infection of figs. (sources in and outside the orchard; effects of wound (=sunburn, mallet, insects, …); effects of temperature; phytotoxins?)
3. Evaluate susceptibility of fig cultivars to the causes of limb dieback. (Calimyrna, Conadria, Black Mission, Brown Turkey, Adams, Sierra, and others?)
4. Develop control methods. (sanitation by pruning; chemical control; biological?)

Effective fungicides against *Nattrassia mangiferae* that infects toenails

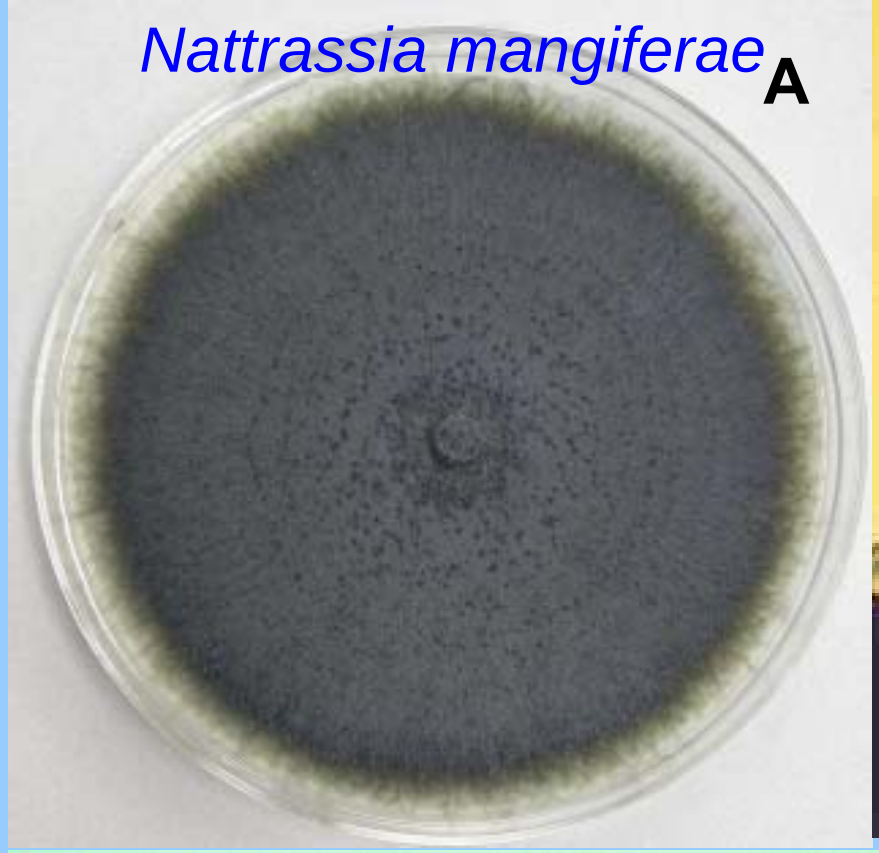
fluzilazol
pyrazophos
Copper-oxychlorite
Ketonocazol
Intraconazol
Fluoconazol

… thus, agric. fungicides such as tebuconazole, propiconazole, …should be tested first.

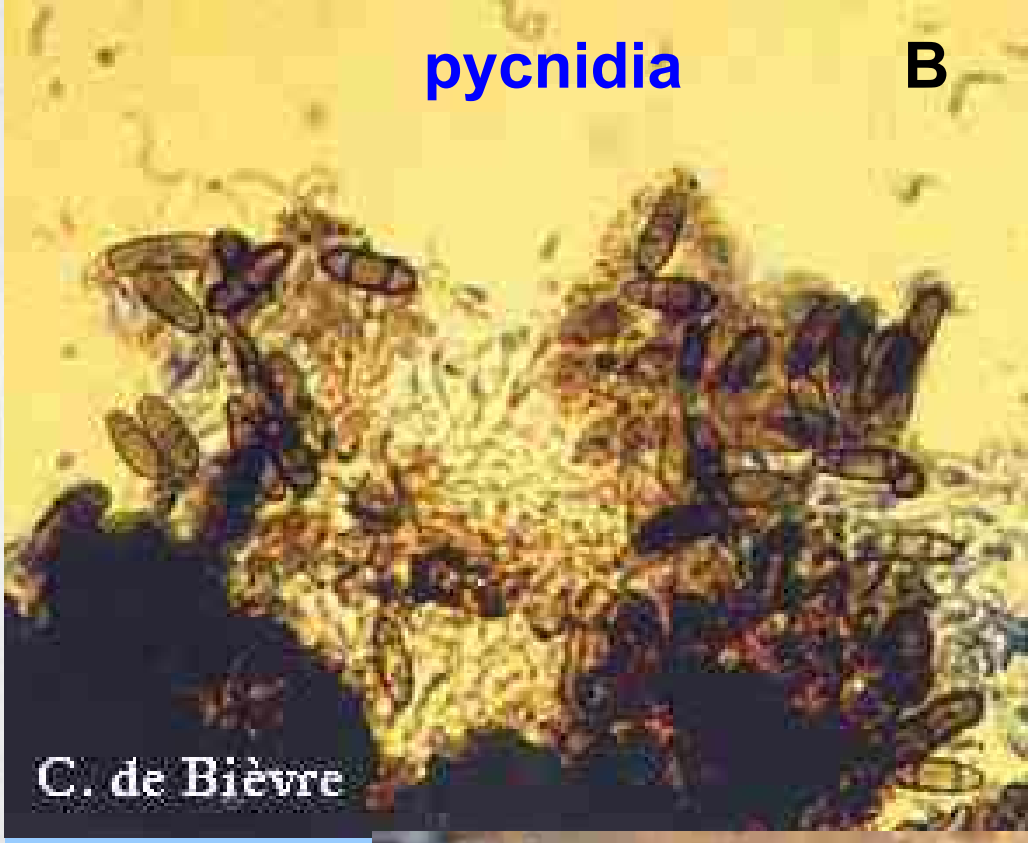
Slides 37-43 are extra not used in the Fig day 2006 talk.



Nattrassia mangiferae **A**



pycnidia **B**



arthrospores **C**

spores **D**