



UNIVERSITÀ DEGLI STUDI DI SASSARI (ITALY)

Dipartimento di Protezione delle Piante

Sezione di Patologia vegetale

Tlemcen-DZ.com

**BIO-ECOLOGY
AND IMPACT
OF PATHOGENIC FUNGI
IN FOREST ECOSYSTEMS
AND CONTROL STRATEGIES**

Antonio FRANCESCHINI

**5th OILB Meeting «Integrated Protection of *Quercus* spp. Forests»
Tlemcen (Algeria), 22-25 October 2007**

A microscopic image showing a dense, intricate network of white, thread-like fungal hyphae against a dark brown background. The hyphae are interconnected, forming a complex web-like structure. The text is overlaid on this image.

FUNGI IN FOREST ECOSYSTEMS

MACROMYCETES

- EPIGEOUS
- HYPOGEOUS

Boletus aereus (Giganteus)



Tuber borchii



Tuber aestivum

Tuber melanosporum



FUNGI IN FOREST ECOSYSTEMS

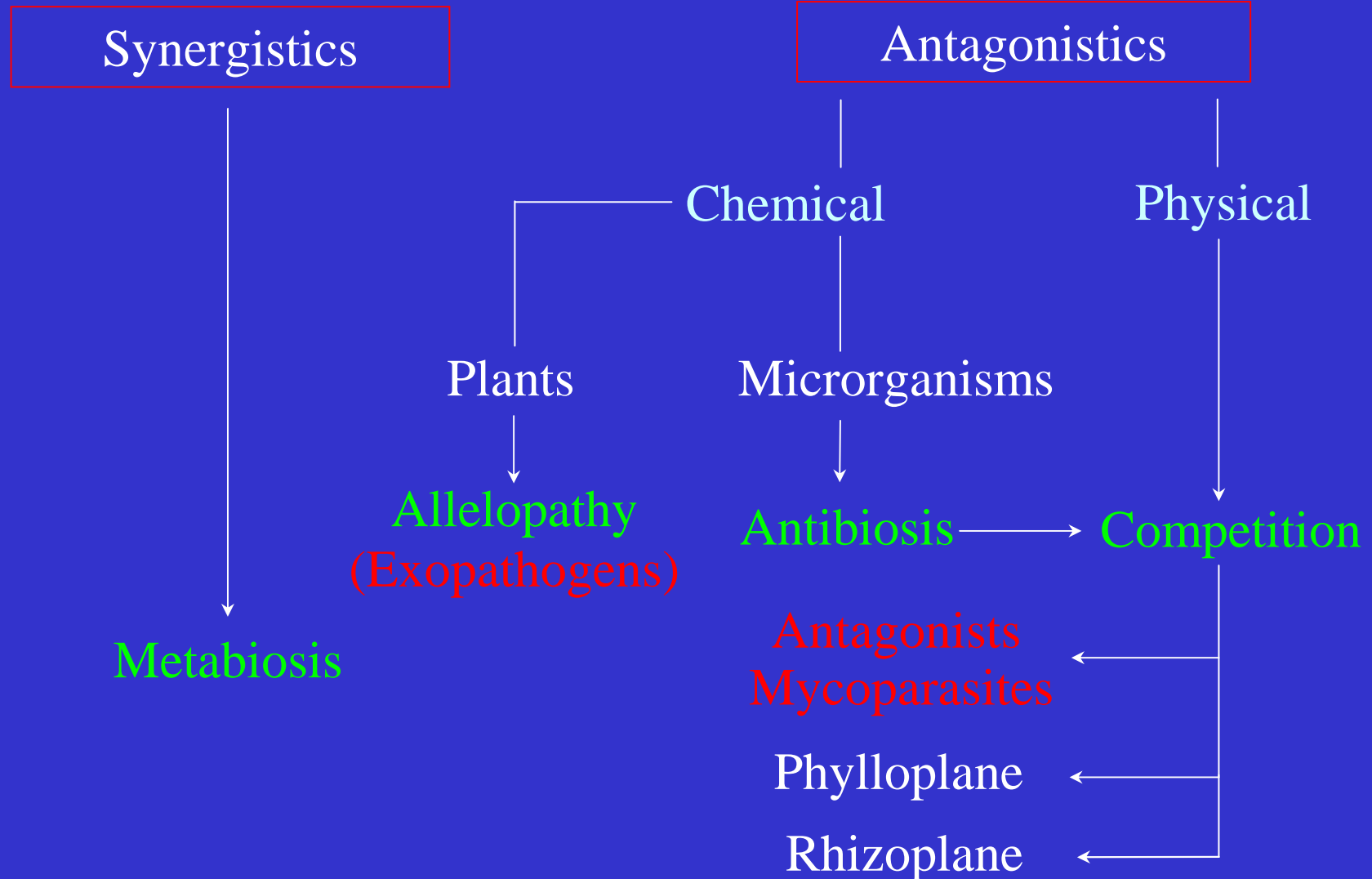
MACROMYCETES

- EPIGEOUS
- HYPOGEOUS

MICROMYCETES

- EPIGEOUS
- HYPOGEOUS

FUNGI AND ECOLOGICAL RELATIONSHIPS





Antibiosis



Mycoparasitism

FUNGI AND PHYSICAL RELATIONSHIPS

Dead substrates



Saprophytes

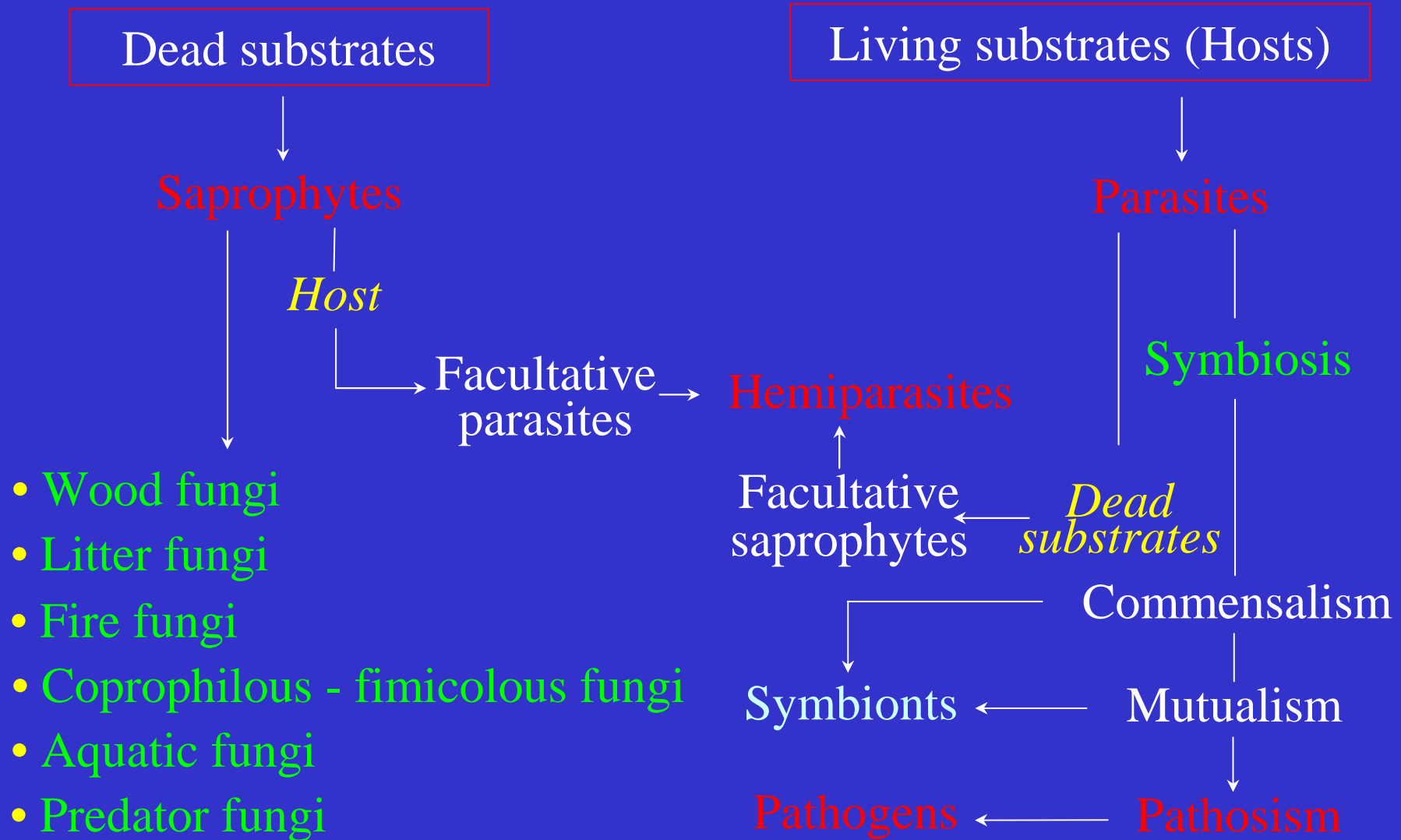


- Wood fungi
- Litter fungi
- Fire fungi
- Coprophilous - fimicolous fungi
- Aquatic fungi
- Predator fungi

LIGNIVOROUS FUNGI



FUNGI AND PHYSICAL RELATIONSHIPS



GLOBAL CLIMATIC CHANGES

Rise in temperature

Reduction and irregular distribution
of the precipitation

Bio-ecology of pathogens
(Primary - Opportunistic)

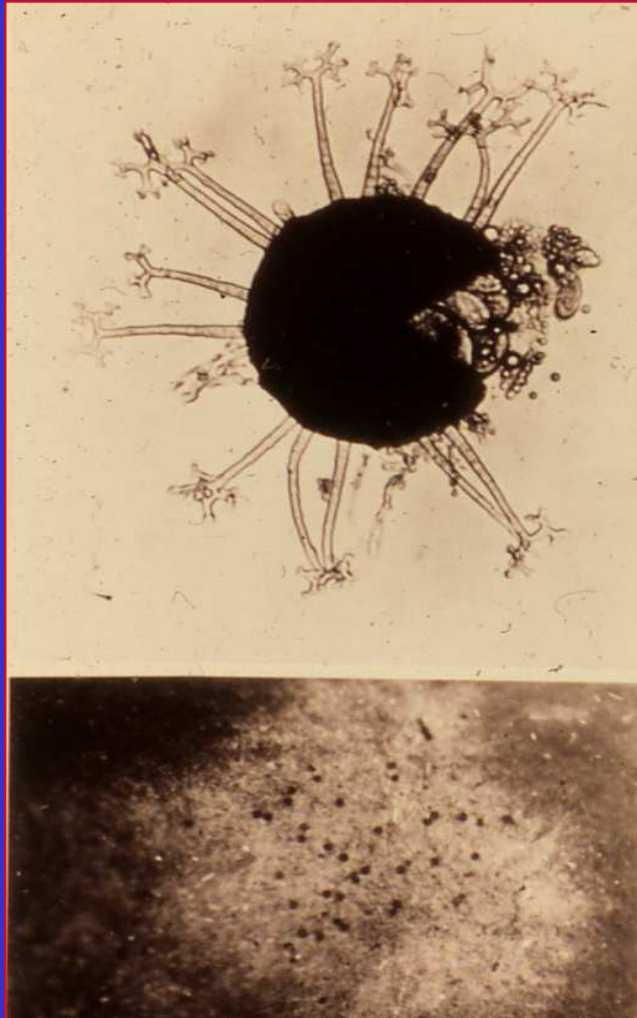
EPIDEMIC OUTBREAKS

Primary Pathogens

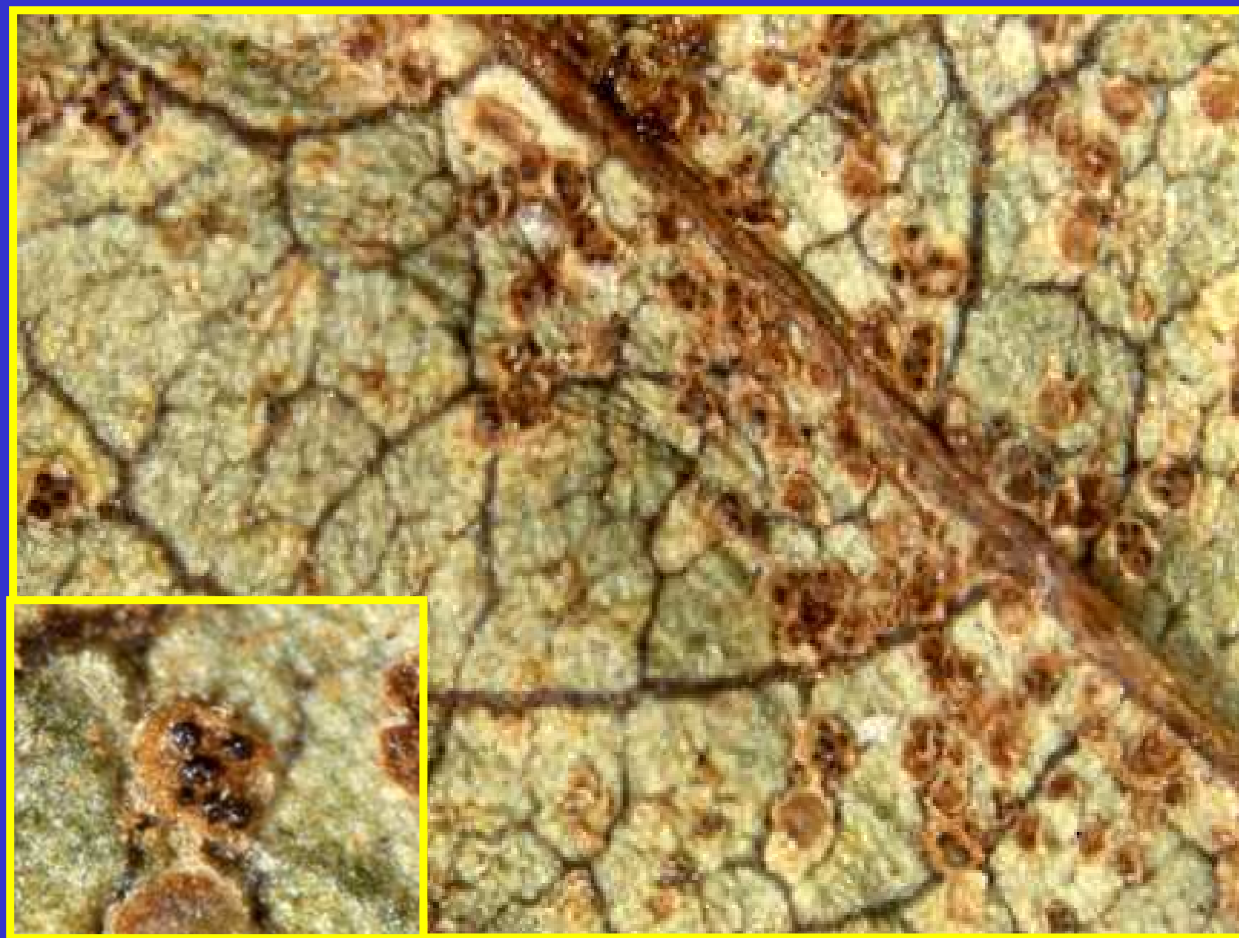
ON LEAVES

- *Microsphaera alphitoides* Powdery mildew
- *Uredo quercus* Rust

*Microsphaera
alphitoides*



Uredo quercus



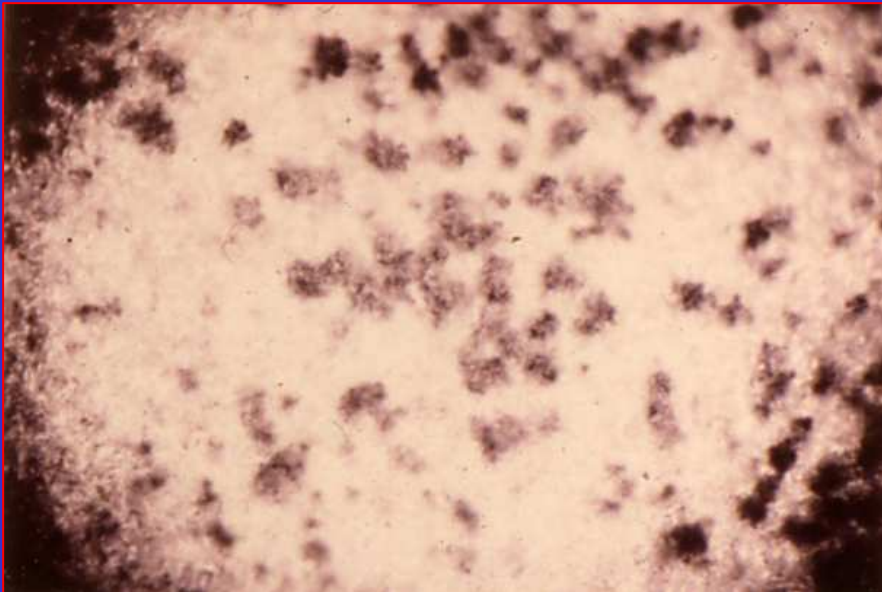
Primary Pathogens

ON LEAVES

- | | |
|-----------------------------------|----------------|
| ▪ <i>Microsphaera alphitoides</i> | Powdery mildew |
| ▪ <i>Uredo quercus</i> | Rust |
| ▪ <i>Cystodendron dryophilum</i> | Necrotic spots |
| ▪ <i>Dendrophoma myriadea</i> | “ “ |
| ▪ <i>Discula quercina</i> | “ “ |
| ▪ <i>Elsinöe quercus-ilicis</i> | “ “ |
| ▪ <i>Lembosia quercina</i> | “ “ |
| ▪ <i>Trabutia quercina</i> | “ “ |

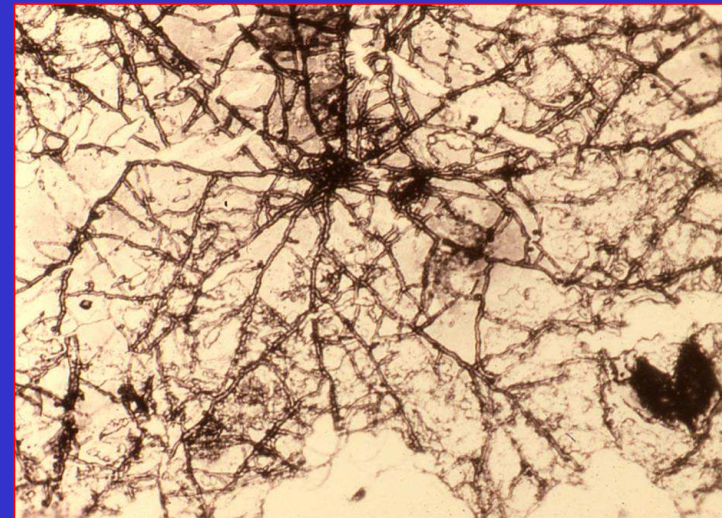


*Cystodendron
dryophilum*





*Lembosia
quercina*



NECROTIC SPOTS

(*Dendrophoma*, *Discula*,
Elsinöe, *Pestalotia*, *Phleospora*,
Seimatosporium, *Trabutia*)





Primary Pathogens

ON LEAVES

- | | |
|-----------------------------------|--------------------------|
| ▪ <i>Microsphaera alphitoides</i> | Powdery mildew |
| ▪ <i>Uredo quercus</i> | Rust |
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| ▪ <i>Discula quercina</i> | “ “ |
| ▪ <i>Elsinöe quercus-ilicis</i> | “ “ |
| ▪ <i>Lembosia quercina</i> | “ “ |
| ▪ <i>Trabutia quercina</i> | “ “ |
| ▪ <i>Taphrina kruchii</i> | Witches' broom - Dieback |

Taphrina kruchii

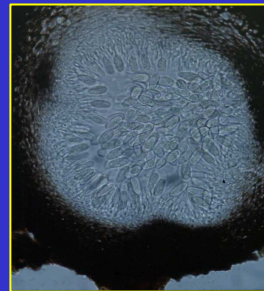
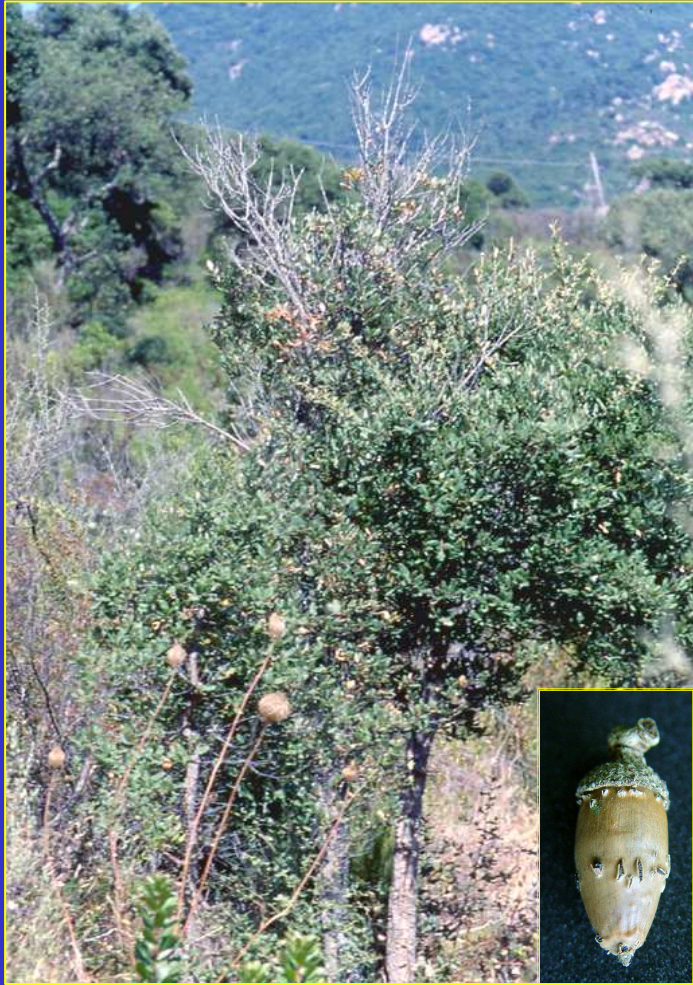


Primary Pathogens

ON TRUNK AND BRANCHES

■ <i>Apiognomonia quercina</i>	Canker – die-back
■ <i>Botryosphaeria</i> spp.	“ “
■ <i>Coryneum</i> spp.	“ “
■ <i>Epidochium ilicinum</i>	“ “
■ <i>Fusicoccum</i> spp.	“ “
■ <i>Ophiostoma quercus</i>	“ “
■ <i>Phomopsis quercina</i>	“ “
■ <i>Pleurophoma cava</i>	“ “
■ <i>Sporendocladia bactrospora</i>	“ “

*Botryosphaeria
corticola*



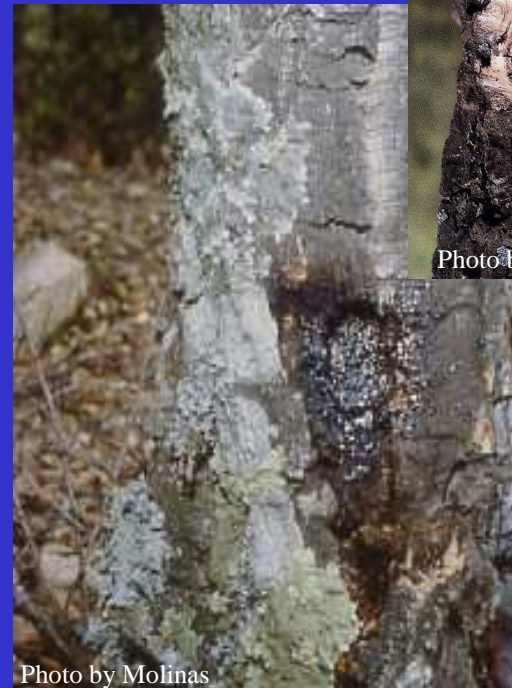
Primary Pathogens

ON ROOTS

- *Phytophthora cinnamomi* Rot – canker – die-back
- *P. cactorum* “ “
- *P. quercina* Fine-root rot

Primary Pathogens

Phytophthora cinnamomi



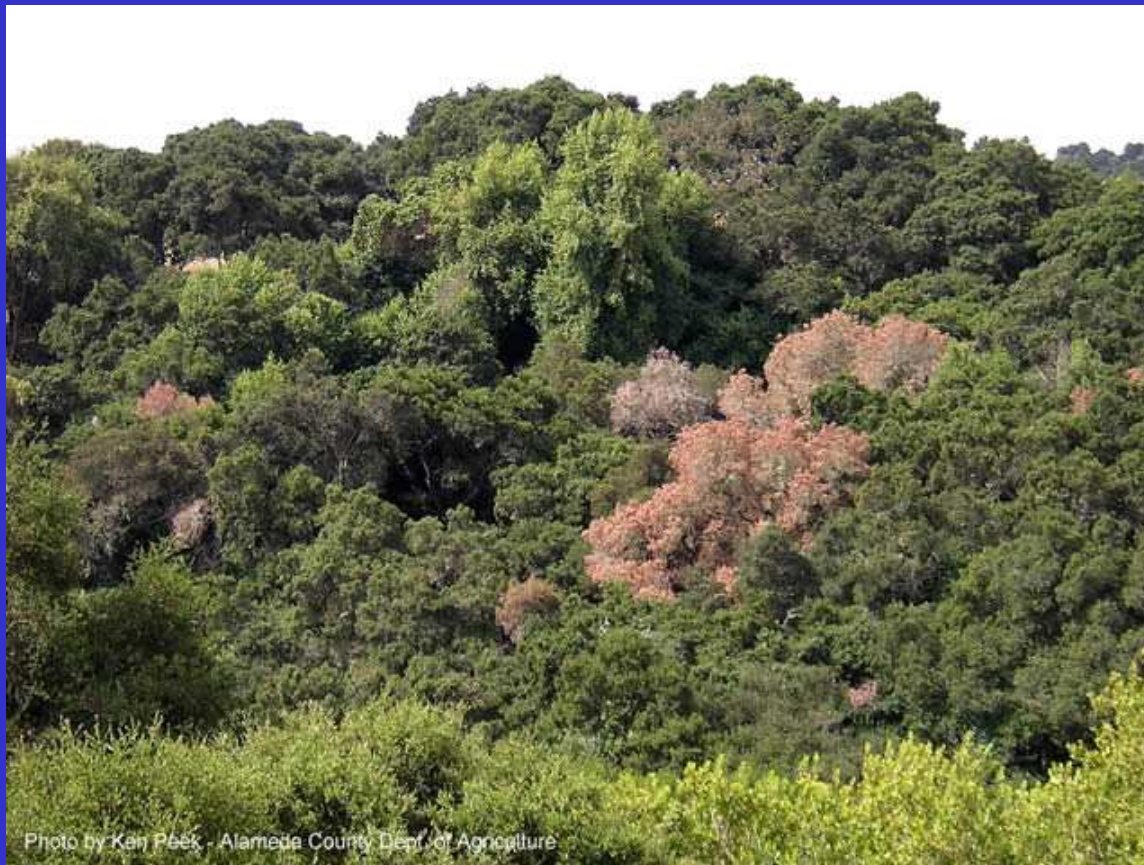
Primary Pathogens

ON ROOTS

- *Phytophthora cinnamomi* Rot – canker – die-back
- *P. cactorum* “ “
- *P. quercina* Fine-root rot
- *P. ramorum* Sudden oak death

AN HARMFUL PATHOGEN

Phytophthora ramorum



Primary Pathogens

ON ROOTS

- *Phytophthora cinnamomi* Rot – canker – die-back
- *P. cactorum* “ “
- *P. quercina* Fine-root rot
- *P. ramorum* Sudden oak death
- *Pythium spiculum* Rot
- *Collybia fusipes* “

GLOBAL CLIMATIC CHANGES

Rise in temperature

Reduction and irregular distribution
of the precipitation

Prolonged drought

Bio-ecology of pathogens
(Primary - Opportunistic)

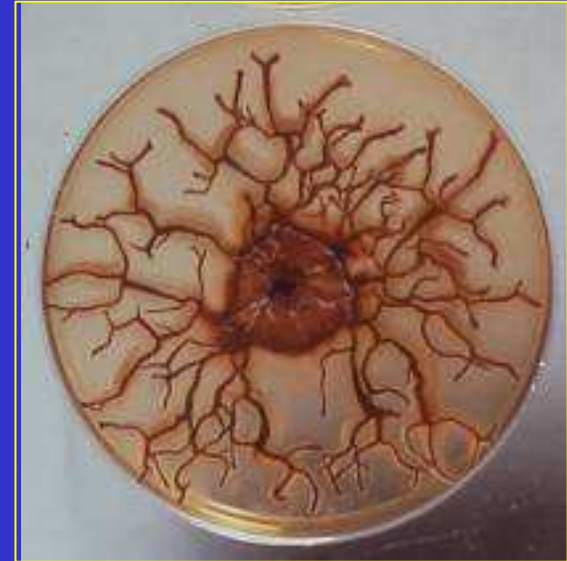
Water stress
of trees

EPIDEMIC OUTBREAKS

Opportunistic Pathogens

ON ROOTS

Armillaria mellea
(Root and collar rot)



Opportunistic Pathogens

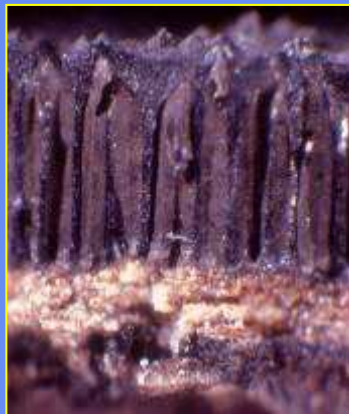
ON TRUNK AND BRANCHES

(cankers - cortical necrosis)

- *Apiognomonia quercina*
- *Biscogniauxia mediterranea*
- *Botryosphaeria* spp.
- *Pleurophoma cava*
- *Phomopsis quercina*



*Biscogniauxia
mediterranea*



GLOBAL CLIMATIC CHANGES

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EPIDEMIC OUTBREAKS

FOREST DECLINE

THE FOREST DECLINE



DECLINE DISEASES

are maladies related to the consequences of stress

- Their **incidence** depends on the occurrence of adverse environmental factors
- Their **severity** depends on the:
 - intensity, duration and frequency of the stress events
 - **successful attack by opportunistic pathogens**

(PM Wargo, 1996)

CONTROL STRATEGIES

1. To avoid death of the trees

- Bringing down the inoculum amount of opportunistic pathogens
- Preventing their endophytic infections

HEALTH MEASURES

- blowing down, removing and burning dead plants
- felling, removing and burning the plants whose trunk and crown are heavily damaged
- cutting, removing and burning symptomatic branches, taking care to disinfect especially large pruning cuts

PREVENTION MEASURES

- to avoid debarking of cut trunks in forests, and to cover the load of the vehicles used during transport
- to strip the cork from the plants without causing wounds
- to treat the debarked trunks before the phellogen dries out with fungicides and with synthetic pyrethroids to kill adult coleopters
- to use bio-pesticides in declining woods on stump suckers following healing treatments, and in nursery to obtain plants free from pathogens

CONTROL STRATEGIES

1. To avoid death of the trees

2. To improve vegetative conditions of trees for regaining the natural resistance to adversities and raising the stress threshold

- Sylvicultural measures
- Phytosanitary measures
 - Pathogens
 - Insects (defoliators and xylophagous)

Sylvicultural measures

- To adapt the density of the plants to be debarked and of those in production, through programmed cutting
- To favour natural regeneration by protecting the young plants from animal bites through adequate protection or by adopting suitable grazing rotations
- To limit the growth of underbrush where it is excessively dense or favoring its growth where it is absent or sparse; underbrush and other *Quercus* species represent alternative hosts of entomophagous insects
- To rationalize grazing pressure and agricultural exploitation
- To protect the areas damaged by fire from grazing, to favor the re-growth of vegetation
- To limit soil tillage in forest, in particular close to the plants, to reduce damage to the root system, and especially avoiding the use of ploughs which, turning the clods, damage the soilborne microflora (mycorrhizal associations) and microfauna (entomophagous insects)
- To avoid a premature first cork-extraction from young plants and “double” extractions from those in production, which induce very severe states of stress
- To postpone, for the same reasons, cork extraction in years of excessive drought or following severe entomatic leaf outbreaks, and in plants showing severe symptoms of vegetative stress

Phytosanitary measures

(i.e., *Phytophthora* - *Armillaria* - *Collybia*)

❖ NEW PLANTATIONS

- to avoid too compact, asphytic and calcareous soils
- to replant in infected areas only after 8-10 years
- to look after drainage and aeration of holes
- to exclude plants from infected nurseries
- to avoid techniques reducing plant vigour

❖ OTHER PLANTATIONS

- to avoid deep soil tillage causing root lesions
- to optimize water regime, avoiding stagnation and mud deposit
- to carry out periodic survey for excluding infection sources
- to treat holes and infected coppices with lime and copper sulphate
- to establish free zones around areas at risk

Conclusions

In the last decades forest health conditions are progressively worsened with heavy losses in productivity and consistence, following the recrudescence of parasitic outbreaks

This situation suggest:

- a setting-up of effective prevention systems and eco-compatible measures, exploiting the chance offered by the biological control
- an efficient phytosanitary service for preventing introduction of new pathogens and for checking health of propagation materials
- a systematic monitoring of forest ecosystems in order to:
 - locate zones at risk of decay
 - outline suitable intervention strategies for:
 - raising plant resistance to adversities
 - improving their capability of vegetative recovery

A large, leafy tree stands in a grassy field. Three children are standing at the base of the tree, holding hands. The child on the left is wearing a red dress and a yellow hat. The child in the middle is wearing a blue shirt and blue shorts. The child on the right is wearing a green shirt and green shorts. The background shows a clear blue sky and some distant trees.

**THANK YOU
FOR YOUR KIND ATTENTION**

**ALSO FROM
YOUNG PEOPLE OF THE
MEDITERRANEAN COUNTRIES**