ForHeal Forestry Higher Education Advancement in Laos

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Forest pests management

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Damping off

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Damping-off is a disease of germinating seeds and seedlings caused primarily by fungi. The entire seed may decay before germination or the seedling may rot just below the soil line. Healthy appearing plants selected from flats with damping-off may develop root rot or stem canker several weeks later. With some damping-off fungi, foliar blight may also occur. *Pythium, Fusarium, Phytophthora, Rhizoctonia* and *Alternaria* are fungi that commonly cause damping-off. There are many other species of fungi that occasionally cause this disease.

Botrytis cinerea - grey mold

Forestry harmful especially in nursery plants
important for the spread is stable high air humidity
attacks all species of trees, likes its ground after frost damage
is capable of spreading even at temperatures around 0 ° C.

Phytophthora cactorum

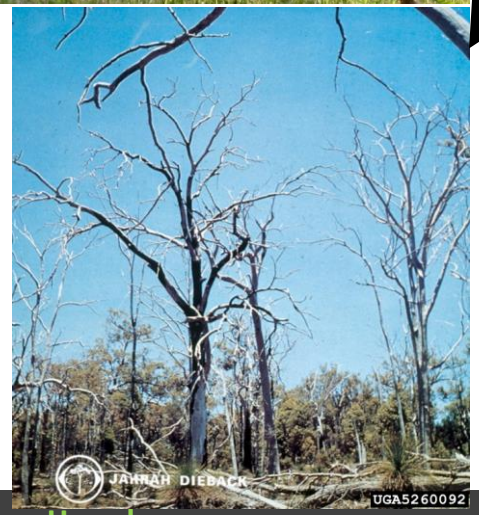
Crown rot *Phytophthora cactorum*

Phytophthora cactorum is a fungal disease that can infect both the roots and the above ground parts of the deciduous
trees seedlings, especially of beech.

PHYTOPHTHORA ROOT ROT (DIEBACK)
Phytophthora cinnamomi

- one of the world's most invasive species
- currently in tropical and warm temperate areas worldwide
- present in over 70 countries around the world
- originally isolated from cinnamon trees in Sumatra
- attacks more than 900 species of plants
- primarily pathogen of trees and shrubs

Phytophthora cinnamomi HOST RANGE



- AVOCADO
- CHESTNUT
- EUCALYPTUS (Jarrah dieback)
- FIR
- PINE
- ERICACEOUS ORNAMENTALS
- PINEAPPLE
- AND OTHERS…

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Phytophthora cinnamomi

- root pathogen
- SYMPTOMS: wilting, decreased fruit size, decrease in yield, collar rot, gum exudation, necrosis, leaf chlorosis, leaf curl, and stem cankers
- requires warm, wet soil for activity

Phytophthora cinnamomi
LIFE CYCLE

ASEXUAL SPORE

SEXUAL SPORE

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Phytophthora cinnamomi PLANTATIONS

Pineapple root rot

***Rhododendron* sp.**

Pine seedlings

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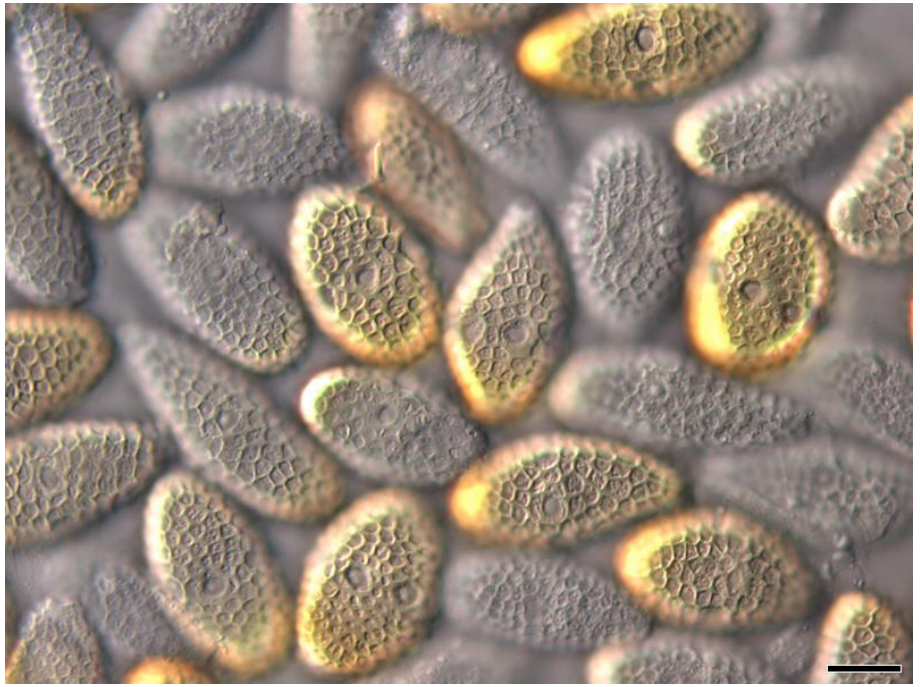
Phyllode rust - *Endoraecium digitatum*

- Host trees: a wide range of (sub) tropical acacias, for example *Acacia aulacocarpa*, *A. auriculiformis*, *A. crassicarpa*, *A. koa*, *A. leptocarpa*, *A. mearnsii*, *A. mangium* and *A. polystachya* (Fabaceae).

- Distribution: Australia, Papua New Guinea, China, Hawaii, Indonesia, New Zealand.

Phyllode rust - *Endoraecium digitatum*

- **Symptoms:** Infected phyllodes, shoot tips, petioles and even fruits of infected trees may suffer gross malformation, or more orderly cell proliferation in the form of galls or blister-like swellings.



- When the growing points of young trees are infected, the rust causes extreme swelling (hypertrophy) of the apical meristem and death of leading shoots with consequent loss of stem form.

Management

- Control of the pathogen in nurseries will be readily achieved using appropriate application of systemic fungicides.

- Systemic fungicides such as Baycor® (bitertanol) and Plantvax® (oxycarboxin), effective against other rust fungi, are likely to be useful.

teliospore with finger-like apical protrusions, giving the fungus its name.

Oidium spp. – Powdery mildew

Anamorphic Erysiphe spp.; Ascomycota, Erysiphaceae

- obligate parasites of many hosts
- On acacias, powdery mildew is found on the phyllodes, mainly of plants in the nursery and also in the lower crown of youngtrees in the field.

Distribution:

- Australia, parts of Africa, China, Hawaii, India, Indonesia, the Philippines, Malaysia and Thailand.
- Spores (conidia) are dispersed by wind to susceptible hosts.
- Fungus germinates on the surfaces of the phyllodes, penetrates to epidermal cells, forms absorbing structures known over the phyllode surfaces.
- Spores are produced successively on specialised hyphae of the superficial mycelium.

Oidium spp. – Powdery mildew

Symptoms:

- Early symptoms - discrete, cobweb-like to powdery white patches of hyphae and spores on the primary, juvenile, pinnate leaves.
- Patches increase in size, coalesce to form bigger patches, spreading to the secondary leaves, sometimes resulting in defoliation.
- The upper surfaces of foliage is coated with a mat of superficial hyphae and spores, looking as dusted with powder.
- The symptoms can sometimes be mistaken for road dust, especially on trees planted near dirt roads.
- The infection leaves yellow blotches on the surface of the foliage.

Importance:

- In nurseries with good hygiene is this disease not important.
- Heavy infestation may result in premature loss of both the juvenile leaves and phyllodes, thus inhibiting photosynthesis and retarding growth.

Oidium spp. – Powdery mildew

Control and management:

Prevention:

- early recognition and prompt removal of infected plants;
- fallen leaves should be destroyed to reduce inoculum potential.

Chemical treatments:

- Sulphur dusting with a powder duster or application of fungicides such as benomyl, chlorothalonil, triademefon, maneb and zineb
- disease can be controlled by placing diseased seedlings in direct sunlight for an extended period.

Resistance with age - disease is in field seldom observed on trees more than 2 years old

Oidium spp.- Powdery mildew

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Meliola spp. – Black mildew

Ascomycota, Meliolales

- Obligate parasites of many hosts

Hosts:

- On leaves and stems of a wide range of hosts in the tropics.
- On acacias, …

Distribution:

- Australia, Malaysia, Java…
- Dispersion: Water splash and crawling insects may be the main dispersal agents.
- Infestation appears to be more frequent on foliage in the lower crown where conditions are more humid.

Meliola spp. – Black mildew

Symptoms:

- The fungus forms black, radiate, velvety colonies on the surface of the phyllodes.
- In cases of heavy infestation, the entire phyllode surface may be covered.
- The infection is usually more frequent on the upper than on the lower surface.
- Sometimes young stems and twigs can also be infected.
- Minute spherical fruiting bodies develop on the fungal thallus.
- Ascocarps have pigmented walls bearing setae and contain sacshaped asci containing four pigmented ascospores.

Importance:

- Heavily infected phyllodes turned yellow and abscissed prematurely with repeated infection, leading to stunting of seedlings.
- On older trees the black mildew does not cause any serious damage.

Meliola spp. – Black mildew

Control and management:

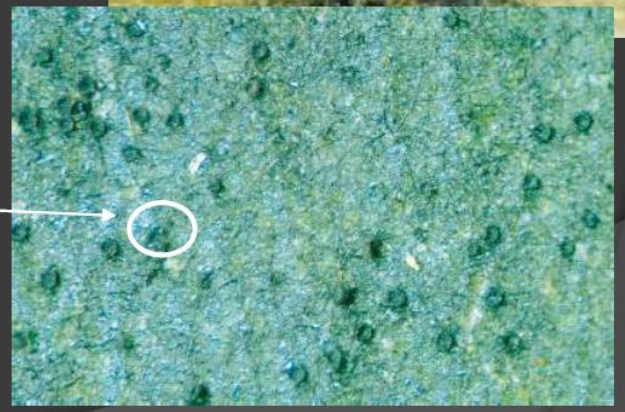
- Control is seldom necessary for little impact on the host.
- If infestation is heavy, black mildew can be controlled by spraying fungicides and insecticides to eliminate scale insects and mealybugs. (the honeydew excreted by these insects provides a rich food source for fungal growth)

Meliola spp.- Black mildew

Black mildew on *Acacia spp.*

Mycelium

Perithecia



Cercospora spp. – *foliar disease*

Anamorphic Mycosphaerella

Distribution:

- Australia, (India, Thailand)...

Hosts:

- Acacia spp., Ceiba pentandra, Parkia biglobosa.

Pathology and impact:

- Cercospora sp. is very similar to Pseudocercospora sp.
- Experience indicates that *Cercospora* sp. is more serious pathogen.
- Disease may be seed-born.
- The impact on seedlings in the nursery and young plantations could be very damaging, many trees could die and the extensive infections may cause multiple branching and severe degradation of form.
- As a result of the epidemic in a seed orchard, seed stand may be abandoned.

Cercospora spp.

lesions on phyllodes

sporulation on a lesion

Symptoms:

- Phyllodes bear spots, blotches and more extensive reddish-brown necrotic areas with scattered, or more densely arrayed, sporulating structures.
- Infected phyllodes often become distorted or crinkled.
- Symptoms for Cercospora sp. are similar as for Pseudocercospora sp.

Phomopsis spp. – *foliar spot*

Anamorphic *Diaporthe* – pathogens of woody and other plants

Distribution:

- On Acacia sp. was observed in Australia, India and Thailand…

Hosts:

- wide range of host plants, including tropical plantation tree species.
- Acacia spp., Gmelina arborea, Quercus suber.
  Phomopsis spp. is commonly associated with **leaf spots** and **stem cankers**.
- Foliar disease are reported as not serious.
- *Phomopsis* species causing canker symptoms are best regarded as secondary, opportunist pathogens.

Control and management

- in forest nurseries using mancozeb and carbendazim fungicides;
- matching species and provenances to suitable site conditions - avoid stress from drought or biotic agents.

Phomopsis spp. – *foliar spot*

Symptoms:

- Foliar spot disease usualy affects younger phyllodes.
- The disease initially forms dark-reddish brown necrotic lesions.
- The lesions gradually spread down the laminae and occasionally cover up to half the phyllode. In some casesextend the full length of the phyllode.
- Necrotic lesions are often characterised by light-coloured, necrotic areas with irregular, raised and well demarcated dark-brown margins.
- Pycnidia develop as minute greyish-black dots within these necrotic areas and produce two types of conidia: α-conidia and β-conidia

Phomopsis spp. – *foliar spot*

Lesions caused by *Phomopsis* sp. on *Acacia sp.*

Colletotrichum spp. – *foliar spot*

Most important: ***Colletotrichum gloeosporoides***
Anamorphic Glomerella; Syn. *Glomerella cingulata* – teleomorph
Die-back, leafspots, antracnose, seedling blight, and leaf blight of several hosts

Distribution:

- Worldwide, especially in the warm-humid tropics.
- India, Thailand, Vietnam, Papua New Guinea, Malaysia, USA – Florida, ...

Hosts:

- Acacia spp., Albizia lebbeck, Azadirachta indica, Ceiba pentandra....
  Tip necrosis and anthracnose of acacias are not generally regarded as serious, in severe cases they may cause defoliation and adversely affect growth.
  Severe anthracnose can occur in the nursery, sometimes associated with premature defoliation.
  In the field it is more likely to occur on plants suffering from environmental stress, e.g. suppressed trees

Colletotrichum spp. – foliar spot

Symptoms:

- various including tip necrosis and foliar spots
- characteristic for some hosts
- Spots could be circular to oval, of variable size, reddish-brown, black or chocolate-brown with necrotic center and different-coloured margin.
- severe anthracnose can be commonly found on lower portions of the canopy in plantations.

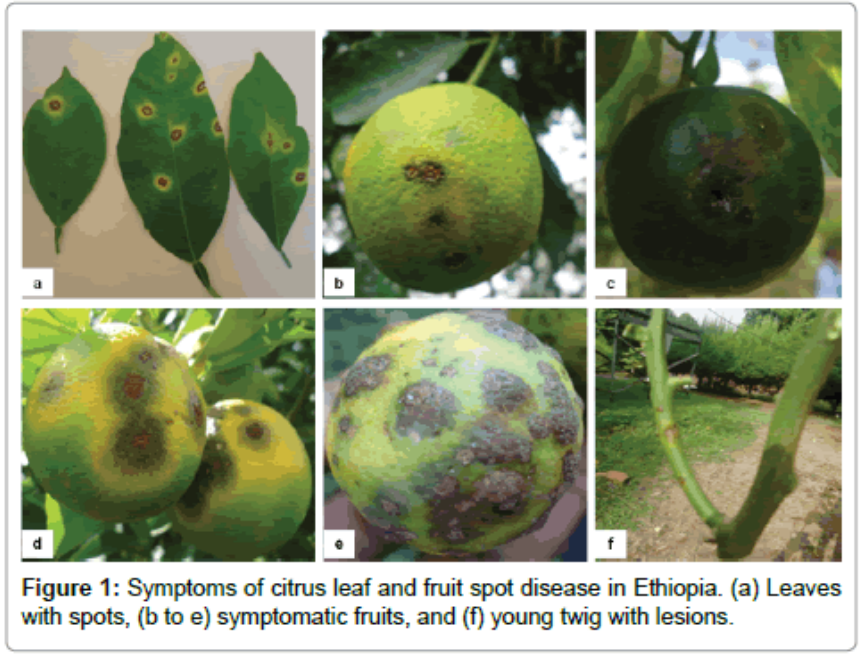


Figure 1: Symptoms of citrus leaf and fruit spot disease in Ethiopia. (a) Leaves with spots, (b to e) symptomatic fruits, and (f) young twig with lesions.

Phanerochaete salmonicolor – PINK DISEASE

Distribution:

- Widely distributed in the tropics, sub-tropics and warmer parts of the temperate region.

Hosts:

- Obligate parasite of numerous woody plants from forest to fruit trees.
- Recorded on many tropical crops such as cacao, coffee, tea, ramie, rubber and many forest plantation trees.

Pathogenicity:

- Obligate parasite of numerous woody plants
- Primarily a disease of the stem and branches.
- Infects and kills living bark tissue.
- Attacks trees of almost any age

Phaanerochaete salmonicolor – PINK DISEASE

Symptoms:

1. The cobweb stage

silky, white mycelia grow over the surface
of the bark. This stage occurs soon after the onset of rain.

2. The pustule stage

pink pustules consisting of sterile mycelia
are produced on the affected area

3. The pink incrustation

develops late in the disease process,
consists of the sexual corticium stage of the fungus.
This smooth salmon-**pink** layer usually develops on
the shaded underside of the dying infected branch.
As this layer ages, it cracks into patches and fades to a dirty white colour.

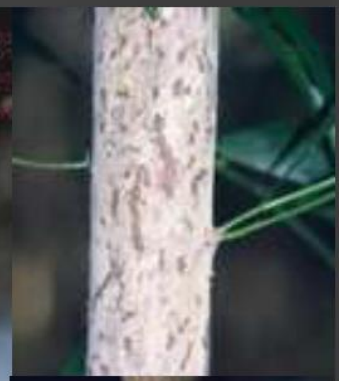
4. The orange-red necator (conidial) stage

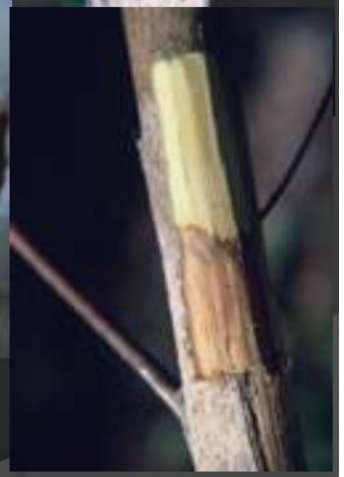
is less frequently seen, being produced late
in the disease process. These pustules develop on
the upper side of infected branches.

Phanerochaete salmonicolor – PINK DISEASE

1. cobweb stage of infection

2. pustule stage





3. early corticium' stage

4. late corticium stage on a dead tree

Phanerochaete salmonicolor – PINK DISEASE

Control and management:

1. Early recognition of the symptoms followed (if economic to do so):
2. Removal and disposal of infected branches or
3. Prompt application of suitable fungicides at regular intervals :

- **Bordeaux mixture** ($CuSO_4:CaO:H_2O = 1:2:10$)
- brush-on formulation of **tridemorph**

Prevention - planting of disease-resistant varieties, removing of source of inoculum – surrounding vegetation

Botryosphaeria spp. - stem canker

- Stem and branch cankers

Causal organisms:

- Botryosphaeria spp.
- anamorphs Lasiodiplodia theobromae, Dothiorella and Fusicoccum

Host range:

- eucalypts, acacias and other forestry species and fruit, shade and amenity trees in plantations and native vegetation

Distribution:

- Worldwide throughout temperate and tropical regions

Botryosphaeria spp. - stem canker

Symptoms:

- Stem cankers:
- Dead areas of bark, which may extend into sapwood.
- Vary from localised lesions confined by callus tissue to sunken lesions which extend more than a metre along the stem axis.
- 'Diffuse' cankers may be darkly discoloured and cracked especially toward the centre.
- Stems may secrete kino (Eucalyptus) from lesions, discolouring the bark with reddish to dark brown pigments.
- Branches and stems may be partially or completely girdled, causing crown dieback and possibly tree death.
- Fruiting bodies on cankers - at the margins between diseased and healthy bark or on newly dead branches.

Botryosphaeria spp. - stem canker

Pathogenicity:

- Can infect healthy shoots and remain as endophytes in healthy tissue until trees are stressed by drought, temperature extremes or defoliation.
- Kill cambial tissue and sapwood but do not cause decay.
- Open lesions exposed by death of bark and cambium, are than infected by decay fungi.

Susceptible to canker:

- Trees planted in unsuitable environments, (infertile soils and climates to which they are poorly adapted - drought-prone areas).
- Trees in dense stands, especially if suppressed.
- Trees with wounded stems due to silvicultural operations.

Botryosphaeria spp. - stem canker

Impact:

- small in vigorous, well-managed stands
- significant in stressed stands (climatic and edaphic factors)

Serious impact of *B. ribis* on Eucalyptus:

- in Japan – through unsuitable climate;
- in Australia – through chronic insect attack;
- in Thailand – on some susceptible clones in plantations
- in Thailand – dangerous combination: defoliation by *Cryptosporiopsis eucalypti* and *Phaeophleospora destructans*, than stem invasion by *L. theobromae*.
- result – many hectares of killed young trees

Botryosphaeria spp. - stem canker

Control and management:

- good matching of species and provenance to climatic and edaphic factors;
- avoidance of stress through good silviculture (spacing, thinning).

Botryosphaeria dothidea

canker

perithecium

Asci with ascospores

Root rots of tropical tree plantations

Causal organisms:

- Most important species of Phellinus (*Phellinus noxius)*
- *Ganoderma* spp., *Rigidoporus lignosus*….

Host range:

- Wide, including forest, fruit and amenity trees.
- Acacia, …

Distribution:

- Wide,
- On plantations in Australia, Indonesia, Malaysia, Thailand and India.

Root rots of tropical tree plantations

Symptoms:

- Root rot disease centres in plantations (slowly enlarging patches of dead and dying trees);
- Foliage paler green, reduced in size and sparse due to reduced water and mineral uptake;
- General decline in the crown condition, growth rate is poor;
- Young shoots may wilt;
- Stressed trees may produce fruits/seeds out of season;
- Trees in advanced states of root rot are very susceptible to wind throw.

Root rots of tropical tree plantations

Symptoms:
The main types of root diseases affecting acacias can be distinguished by the colour of the infected roots:

- red root disease – Ganoderma sp., most likely *G. philippii*.
- brown root disease – Phelinus noxius
- black root disease – *Amauroderma* cf. *parasiticum*
- white root disease – Rigidoporus sp.

Root rots of tropical tree plantations

Symptoms of red root disease:

- roots are covered by a wrinkled reddish brown rhizomorphic skin (is evident when the root is washed clean of adhering soil);
- white mottling pattern is evident on the underside of the infected bark with very characteristic odour;
- in early stages of infection: wood is hard, no colour change is discernible;
- in advanced stages: wood becomes pale buff and spongy or dry (depending on the soil condition).

Root rots of tropical tree plantations

Symptoms of brown root disease:

- roots are encrusted in a mass of earth and sand intermingled with rusty-brown velvety patches
- advanced stages: easily recognised by the brown honeycomb-like, zig-zag pattern of lines formed by plates of hyphae in the wood

Symptoms of black root disease:

- infected root is covered by a thin black crust which can be easily mistaken for necrotic tissue.

Symptoms of white root disease:

- thick white, stringy rhizomorphs adhere to the surface of the root

Root rots of tropical tree plantations

Pathology:

• In natural forests cause basidiomycete fungi only little problem.

• After forest harvesting for new plantations, fungi survive as saprophytes on woody debris in the soil.

• Saprophytic survival of these fungi in harvesting debris may provide inoculum for the second-rotation crop.

Control and Management:

• Site preparation - woody debris should be removed and destroyed to reduce sources of inoculum.

• Isolation trenches to check the spread of the disease x expensive, difficult to construct, not practical in plantations with high tree density.

• Soil drenching with fungicides

• Planting of resistant cultivars or alternative species

• It has been suggested that the susceptible preferred species should be planted only in the second rotation after a first rotation of a resistant species.

Ganoderma spp. – root rot

Ganoderma phillipii

- Is regarded as a cause of root rot of acacias in Sumatra, Indonesia, where large areas are planted with A. mangium.

Ganoderma lucidum

Phellinus noxius – root rot

Phellinus noxius fruiting at the base of a tree

Phellinus noxius – root rot

Network of Phellinus noxius hyphae within colonized wood

Rigidoporus spp.

- Acacia, eucalypts
- Soil drenching with fungicides such as triademefon, propiconazole, hexaconazole, cyproconazole and penconazole has shown promise in the control of white root disease caused by R. lignosus.
- Effective control was obtained by light infection, less effective by moderate infection levels.

Rigidoporus microporus

Fruiting bodies

Armillaria spp.

Hosts:

- Eucalypts,….

Symptoms:

- „Bottle“ shaped stem basis
- Resin outflow on stem
- Fruiting bodies on infected stem
- Syrocium – white mycelial fan under bark
- Rhizomorphs – roots-like mycelial formation
- But rot – light with thin black margine

Armillaria mellea

Distribution:

- Worldwide, throughout temperate and tropical regions

Hosts:

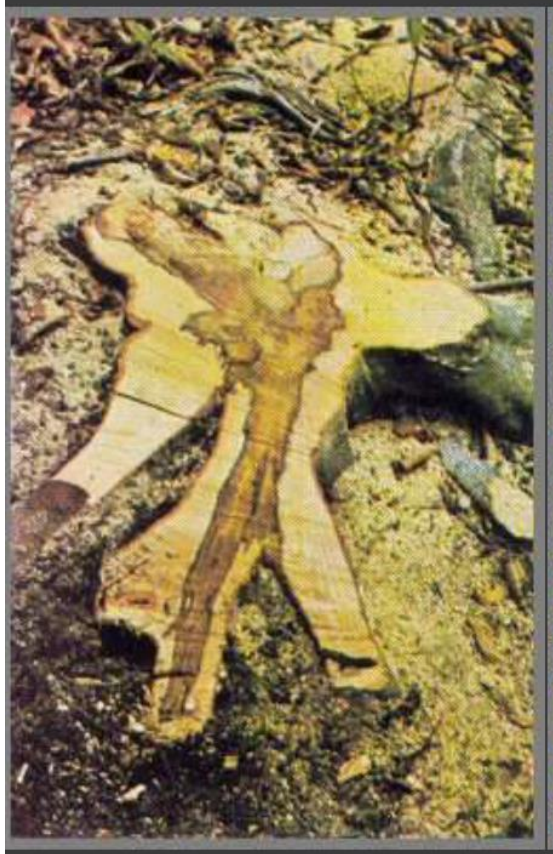
- wide range of angiosperms and gymnosperms
- fruit trees, vines, shrubs, and shade and forest trees.

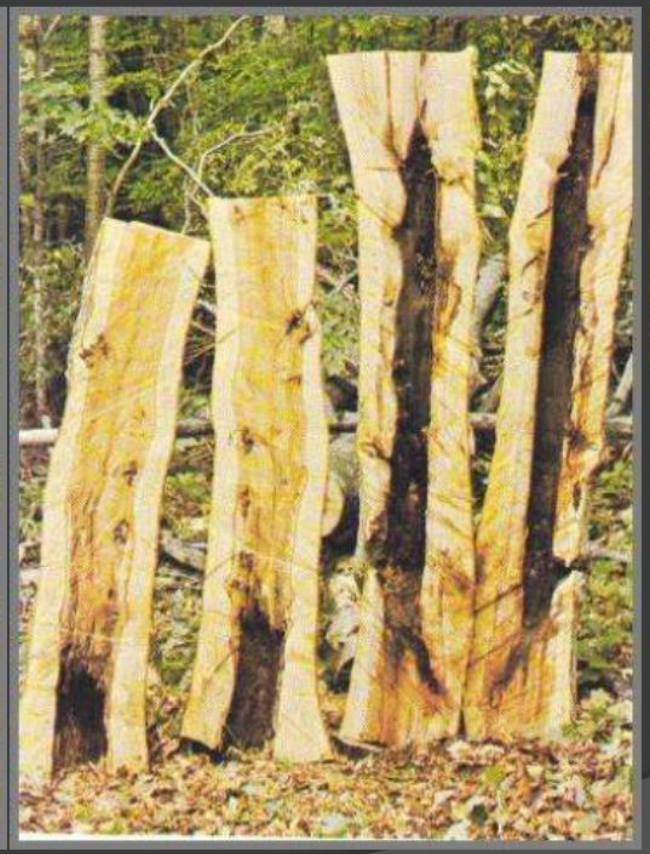
Important pathogen of various hardwood species and to lesser extent conifers in Europe, Asia and North America.

Armillaria mellea

fruiting bodies

Armillaria mellea





butt rot

Armillaria mellea

mycelial fan

syrocium, mycelial fan under bark of black oak

Armillaria mellea

Rhizomorphs

Oil palm diseases (***Elaeis guineensis***)

Coconut palm diseases