Ascomycete Pathogens 2.
Species with perithecioid ascocarps
“pyrenomycetes” and “plectomycetes”

Sordariomycetes
- ascocarps are perithecia
- may be single or aggregated in stroma

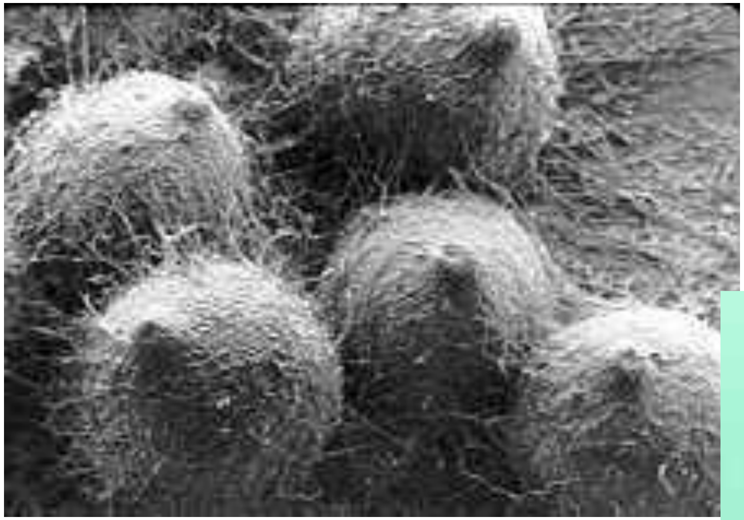
Dothideomycetes
- ascocarps are pseudothecia
- functionally indistinguishable from perithecia
- asci usually are ‘bitunicate’
- formerly called ‘loculoascomycetes’

Eurotiomycetes
- ascocarps are true cleistothecia, no pore (ostiole)

Important Sordariomycete pathogens

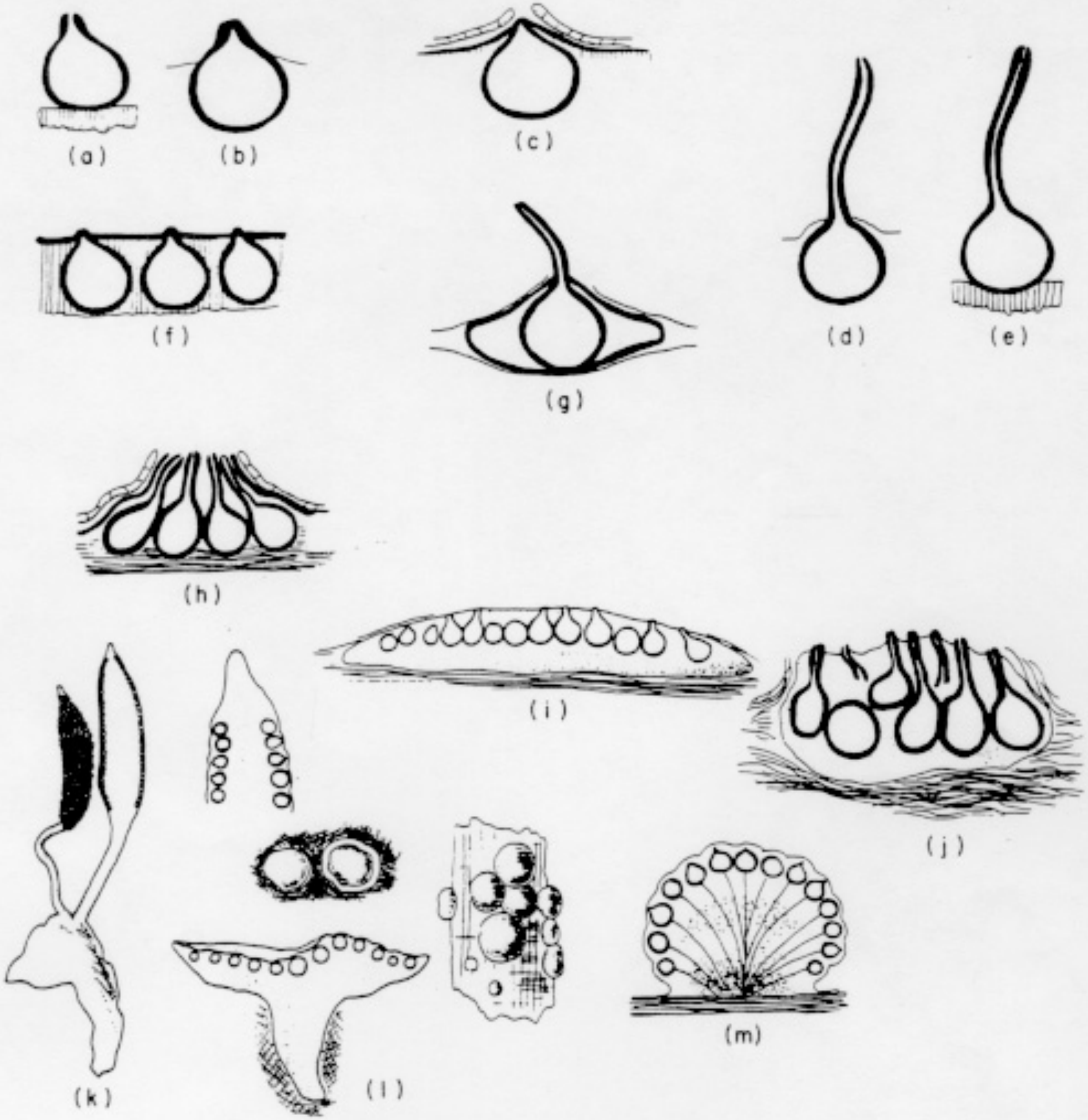
Pathogen	Disease/host
Cankers of woody hosts	
Cryphonectria	Chestnut blight
Anisogramma	Eastern filbert blight
Vascular wilts of woody hosts	
Ophiostoma and Ceratocystis	Dutch elm disease, oak wilt
Diseases of cereals	
Magnaporthe	Rice blast
Gauemannomyces	Take-all of wheat
Claviceps	Ergot
Fusarium	head blight, maize end rot, others
Foliage and stem diseases	
Diaporthe	soybean blight, black rot of cucumber
Fusarium	Numerous diseases of various hosts
Colletotrichum/Glomerella	Anthracnose, many hosts
Monosporascus	root and stem rot of cucurbits

Ascocarp is a perithecium

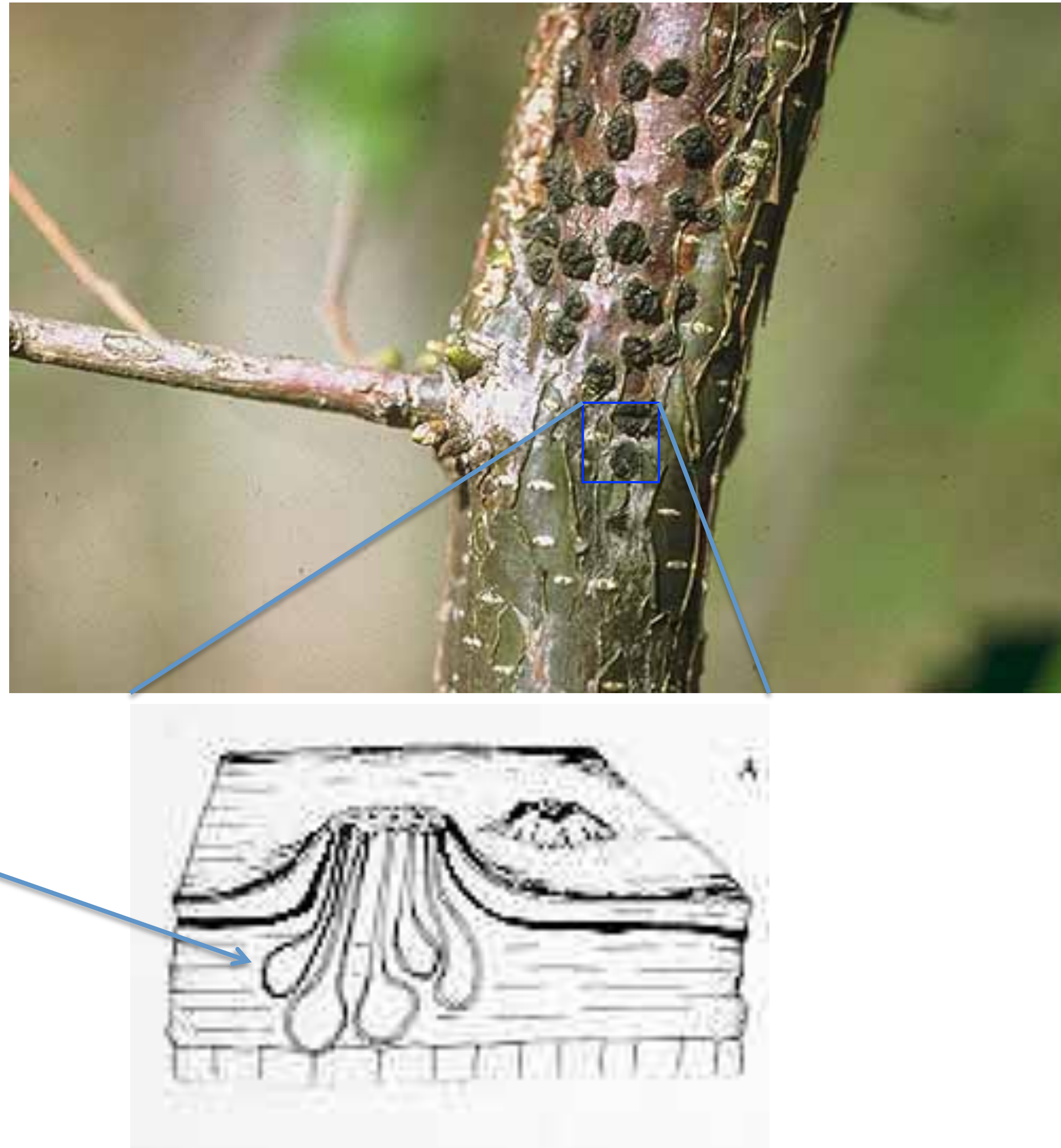


Pyrenomycete stromatal types

Perithecia may be aggretated in a stroma or subiculum

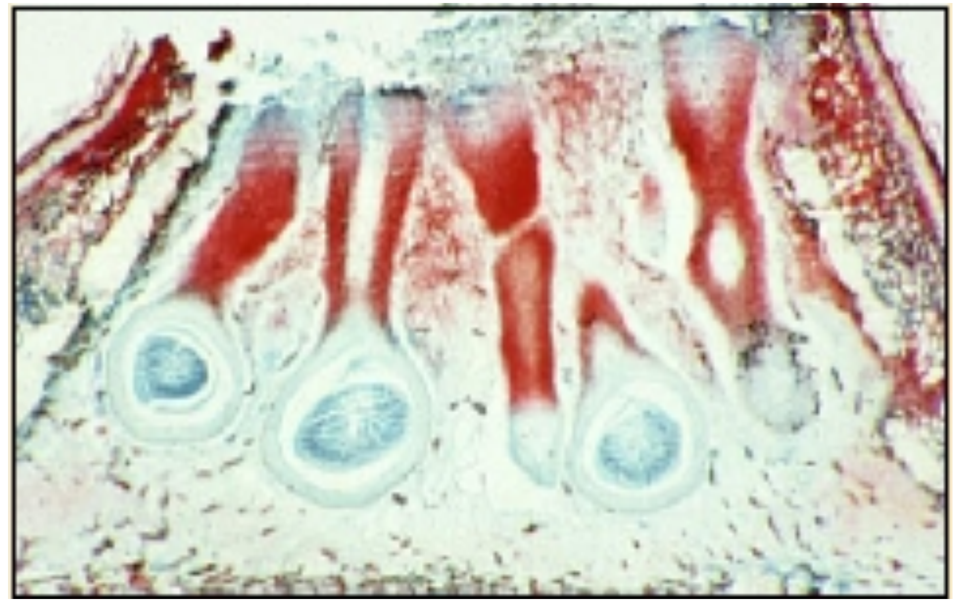


Anisogramma anomala causes Eastern Filbert Blight perithecia grouped in a stroma



Perithecia

Anisogramma anomala, Eastern Filbert Blight



An important disease in Oregon because ~95% of the US hazelnut crop is produced in the Willamette Valley

Natural host of A. anomala is Corylus americana (eastern hazel), which is native to northeastern North America

Cornus cornuta (California hazel) is not a host
C. avellana, cultivated European hazel (native to Europe) is highly susceptible
Wild hazels are not used for cultivation but may be sources of resistance

Eastern Filbert Blight Quarantine 1921

H. P. Barss of OSU, former Botany and Plant Pathology Chair

Argued before the western plant board for a quarantine against movement of American wild hazel (C. americana) or European hazels (filbert) from the territory included within the natural range of the native C. americana

"The disease is evidently natural to and presumably everywhere present on this species of wild hazel, on which however, it is a parasite of only minor consequence, producing only a slight twig blight..."

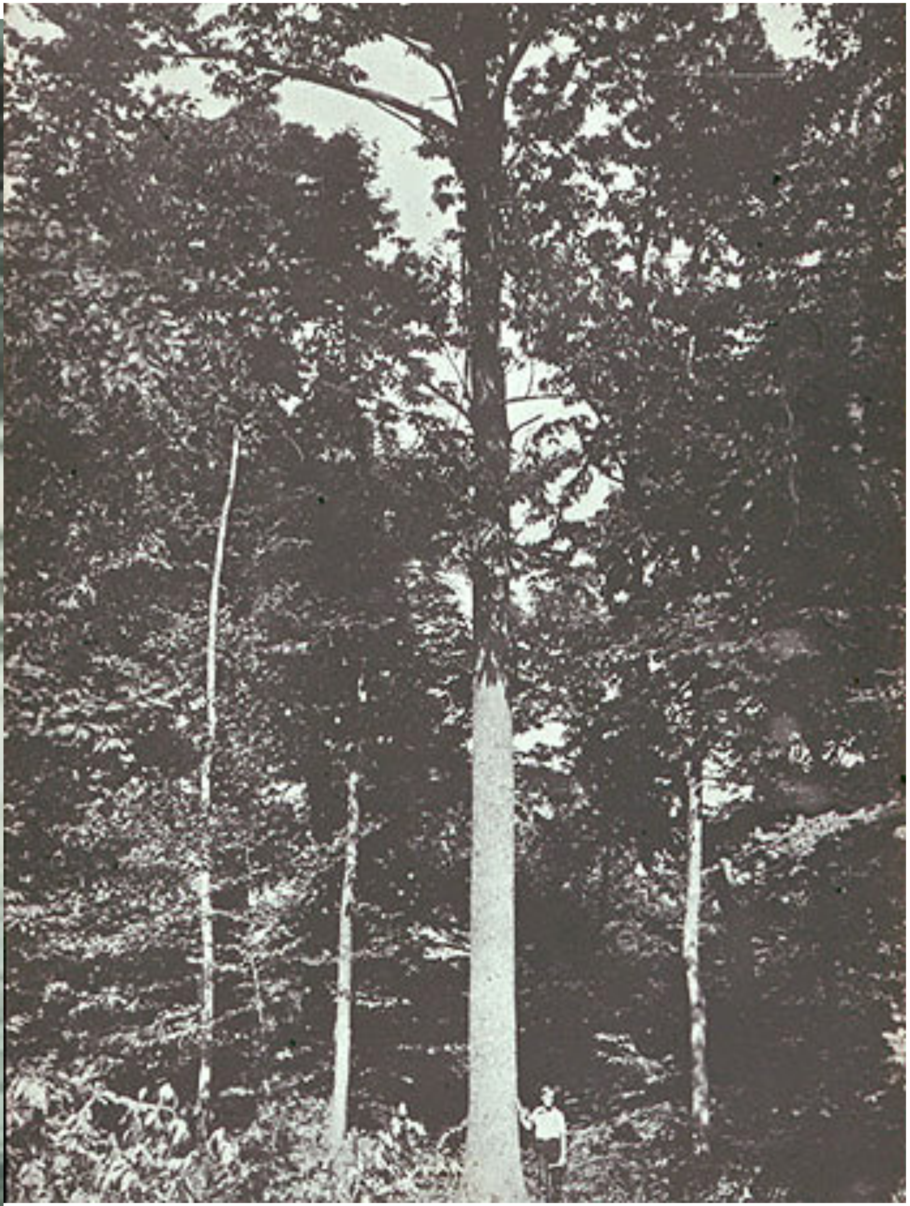
"The protection of the growing filbert industry of the Pacific coast has to depend, therefore, upon the effective enforcement of the exisitng regulations which prohibit the importation of plants, cuttings, or other propagative material of either the American wild hazel or the cultivated filbert from the territory included within the range of Corylus americana."

Quarantine worked for 50 or so years to exclude
Corylus americana nursery stock from Pacific Northwest

But ultimately the Eastern Filbert Blight pathogen,
Anisogramma anomala, was introduced into sw Washington
exactly as Barss said it would:
on infected *C. americana* nursery stock, from which it spread to
commercial filbert orchards.

Images: OSU extension

American Chestnut: the shrub that used to be a tree



Chestnut blight

Chestnut and oak were co-dominant in the Appalachians for nearly 4000 years but chestnut did not reach the northeastern states until 2500 – 1500 yrs BP. Chestnut provided important resources for wildlife and humans, and exerted a strong influence on ecosystem structure and function (Paillet 2002).

Blight was first detected at the New york Zoological Garden in 1904. New York city is often cited as the focal point of the introduction, but many nurseries in the eastern USA sold Japanese chestnut trees. Additional disease foci were near Philadelphia and Baltimore (Anagnostakis 1996).

Chestnut blight in effect removed chestnut as a species from the eastern forests. Surviving trees from stump sprouts usually are killed back before any nuts are produced.

Comparison of North American and Asian populations of the pathogen indicate that Japan was the most likely source of the introduction (Milgroom et al 1996).

After chestnut blight and white pine blister rust invasions federal legislation was enacted to prevent future introductions, Plant Quarantine Act 1912 gave USDA authority to regulate international and interstate movement of plants

Cryphonectria parasitica

Cryphonectria parasitica

Asexual and sexual reproduction, both types of spores can infect

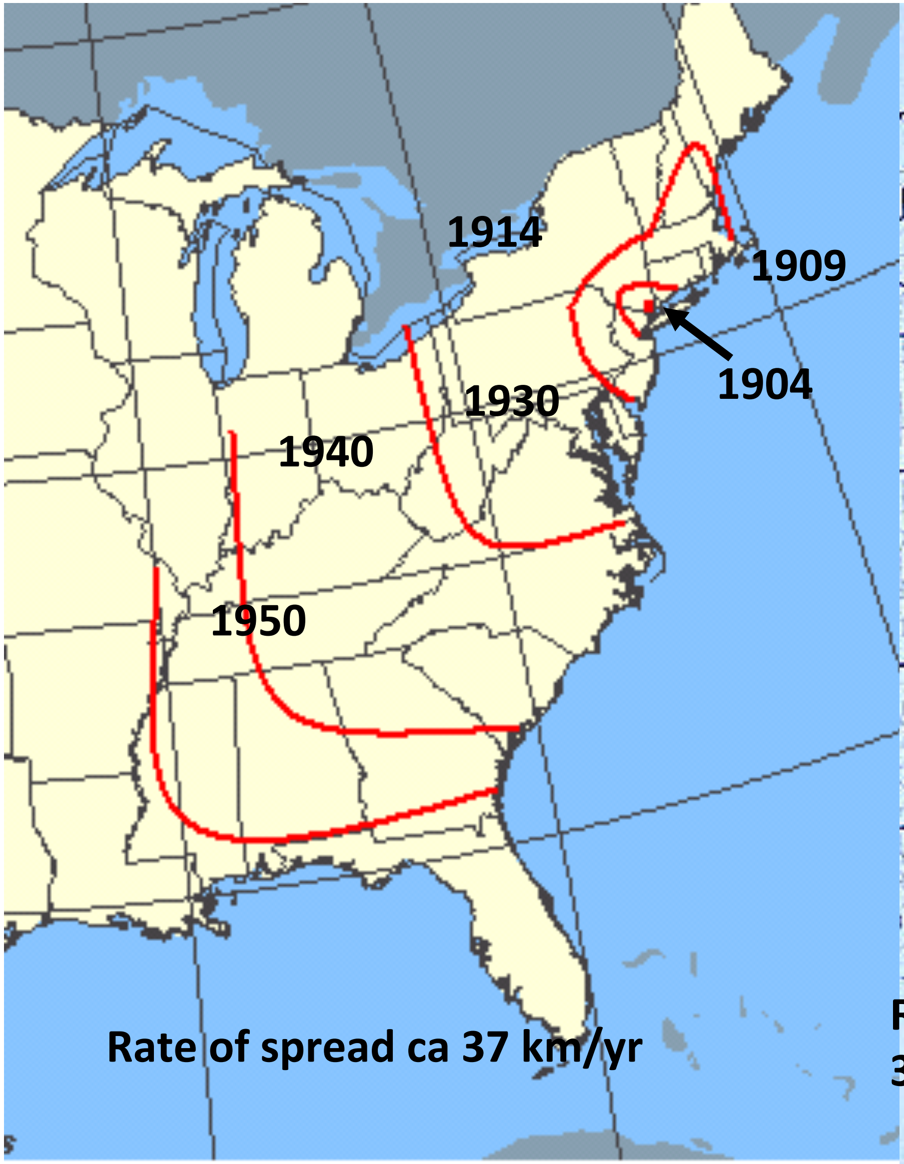
Masses of asexual spores (cirrhi)

Image: Forestry Images

Cross section of stroma

Image: Tom Volk

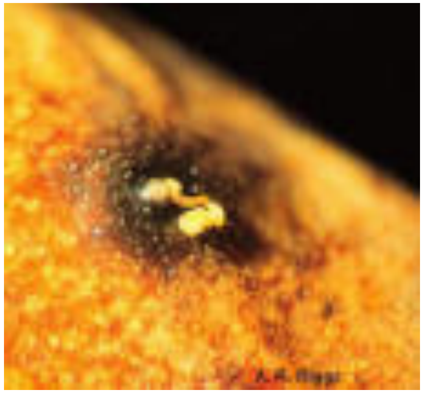
Range of American Chestnut and Spread of Chestnut Blight 1905 - 1950



Dogwood anthracnose

Discula destruciva (anamorph) another introduced Diaporthales. Native North American Cornus spp. are affected but Asian cultivars are resistant

Cytospora and Valsa canker



Cytospora canker typically affects drought stressed trees. Affects poplars and other hardwood trees

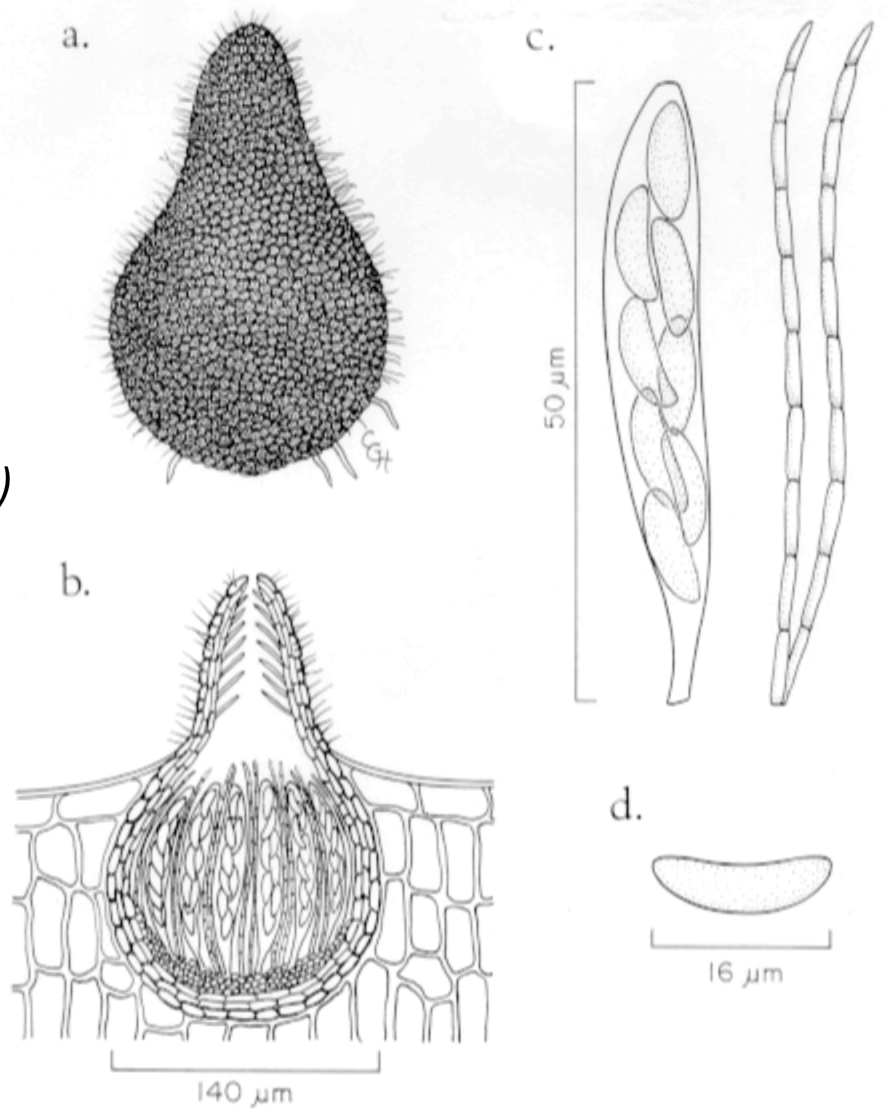
Cirrhi of Cytospora

Diaporthe stem canker of soybean and other hosts

Phyllachorales

Glomerella is the most economically important genus in order. The anamorph, *Colletotrichum,* is associated with many different foliage, stem and root diseases.

Glomerella cingulata (C. gloeosporioides) causes ‘anthracnose’ type diseases in > 100 species of plants

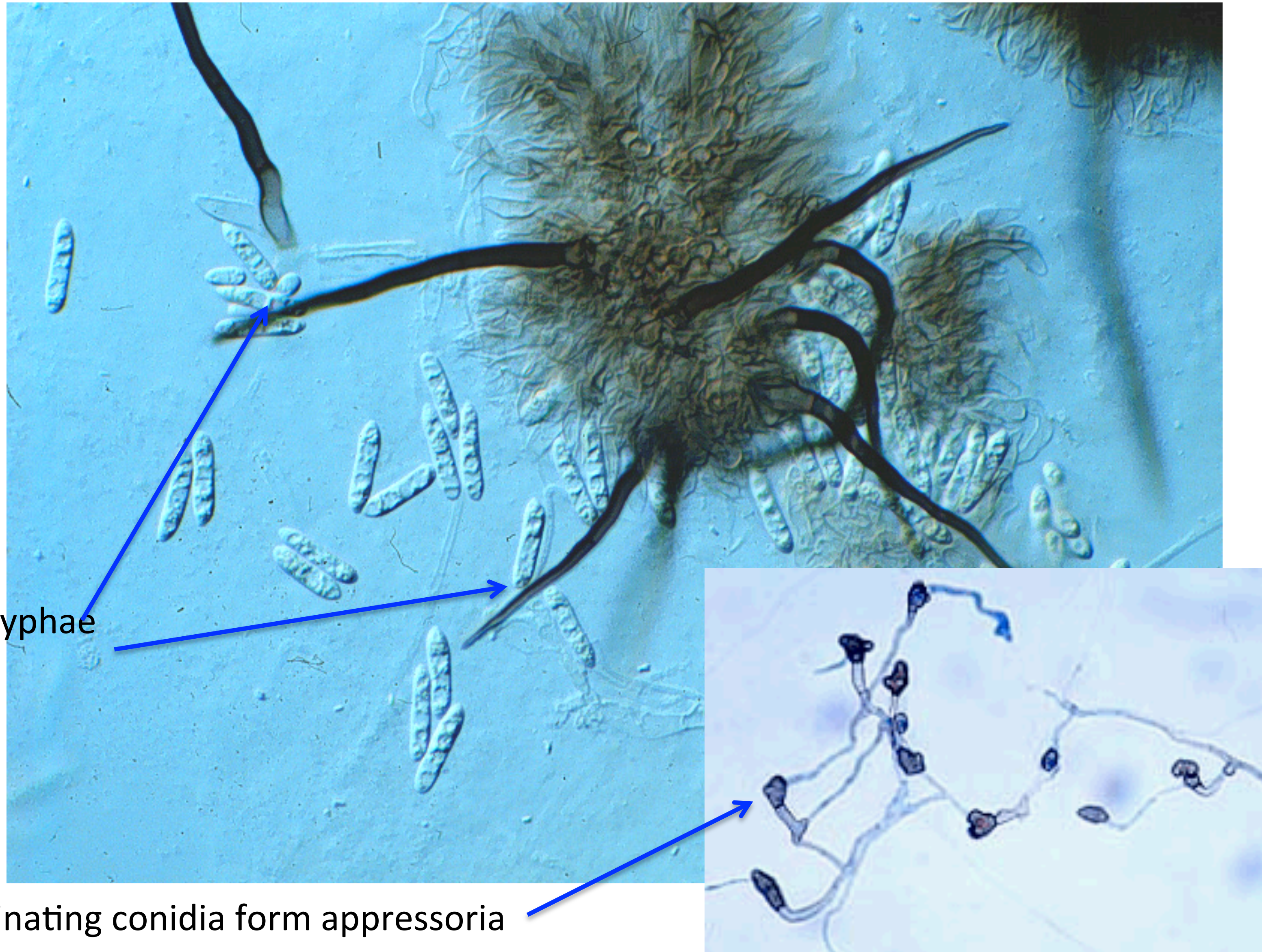


Glomerella cingulata. **a.** Mature perithecium. **b.** Section through perithecium in leaf, with paraphyses, asci and ascospores, and ostiolar neck lined with periphyses. **c.** Paraphyses and asci with ascospores. **d.** Mature ascospore.

Hanlin, 1990

Colletotrichum has acervuli with prominent setae (large, thick walled hyphae), production of appressoria upon conidial germination

Colletotrichum coccoides



setal hyphae

germinating conidia form appressoria

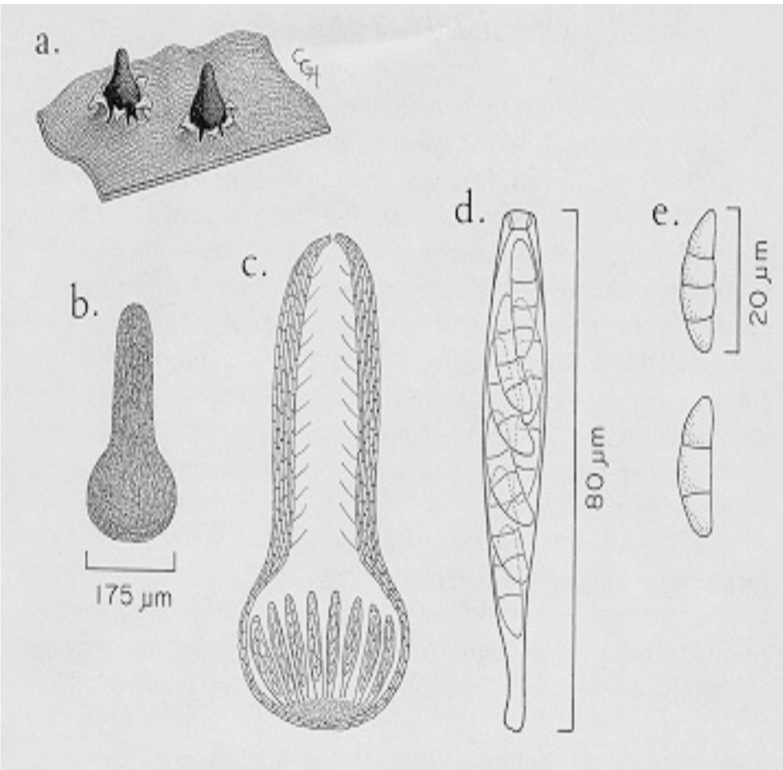
Anthracnose of pepper C. capsici

Black spot of potato
C. coccoides

Colletotrichum anthracnoses

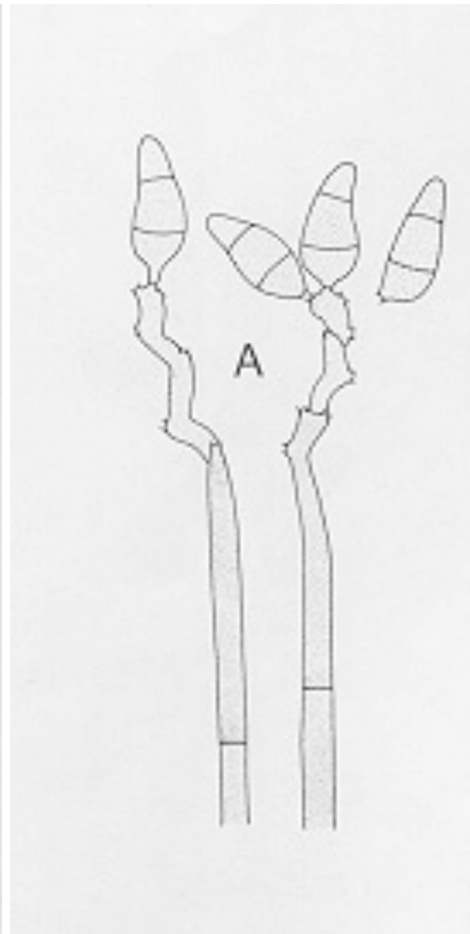
Magnaporthe grisea, cause of rice blast
Gaeumannomyces graminis, take-all of grasses

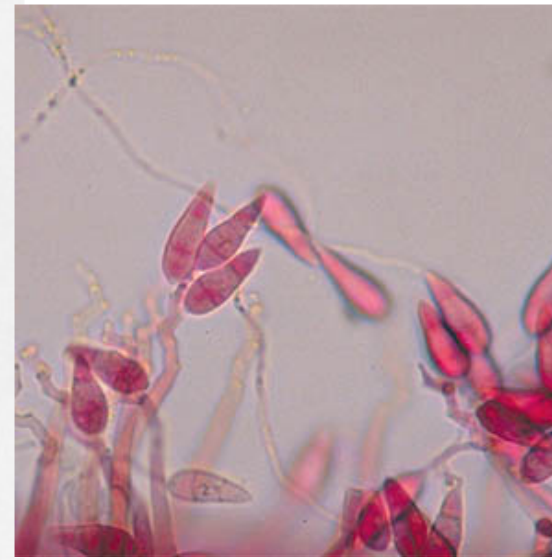
Magnaporthe



Magnaporthe grisea. **a.** Erumpent perithecia on rice leaf. **b.** Exterior of perithecium. **c.** Section through perithecium with asci. **d.** Ascus with ascospores. **e.** Mature ascospores.

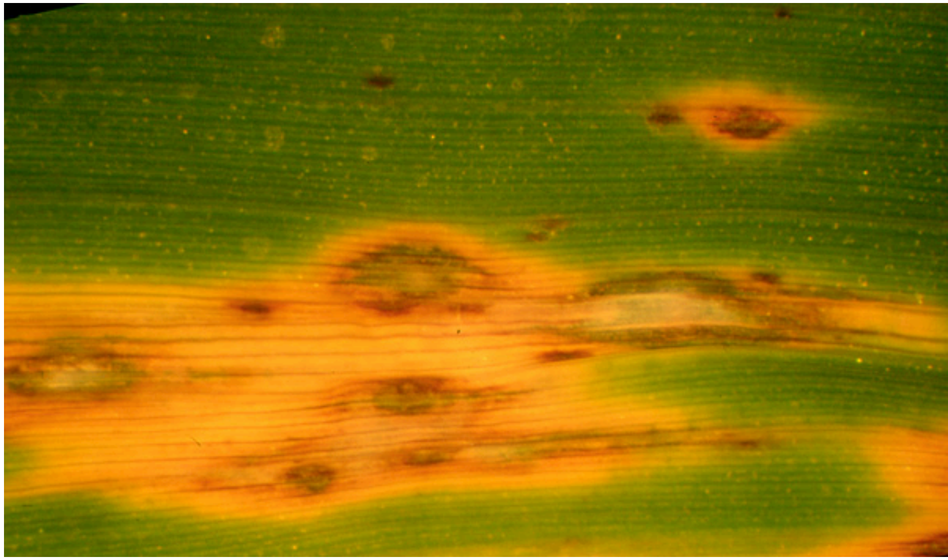
Pyricularia





Sordariomycetes, Magnaporthales

Magnaporthe grisea, cause of rice blast



The most important disease of rice worldwide
first plant pathogen to have its complete genome sequenced

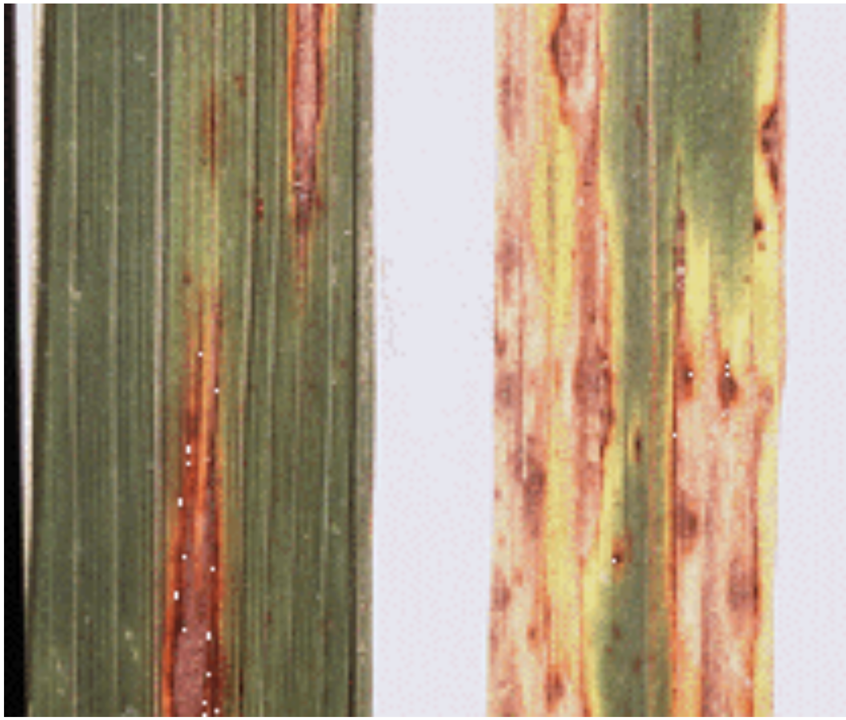
Conidia of Pyricularia, the anamorph of Magnaporthe

Rice Blast Symptoms

infection below the panicle causes “neck blast”

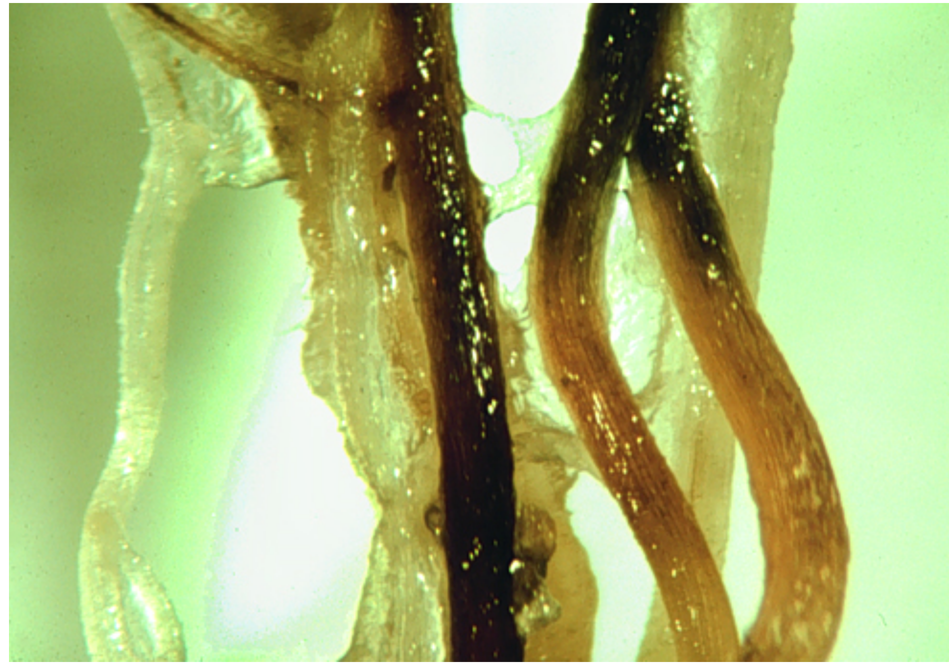
Symptoms of Rice Blast

Gaeumannomyces and Magnaporthe diseases of cereals



Leaf infections, leaf node infections cause "collar rot"

Gaeumannomyces graminis, take all disease of cereals

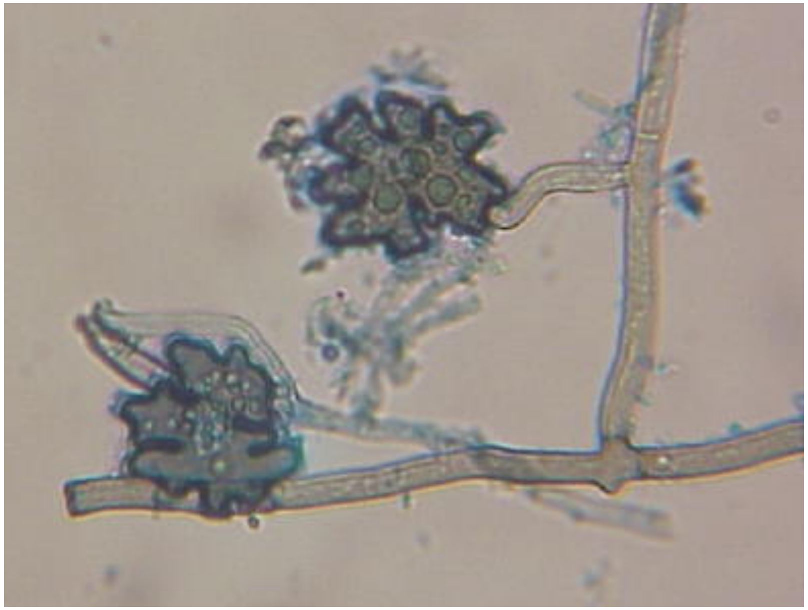


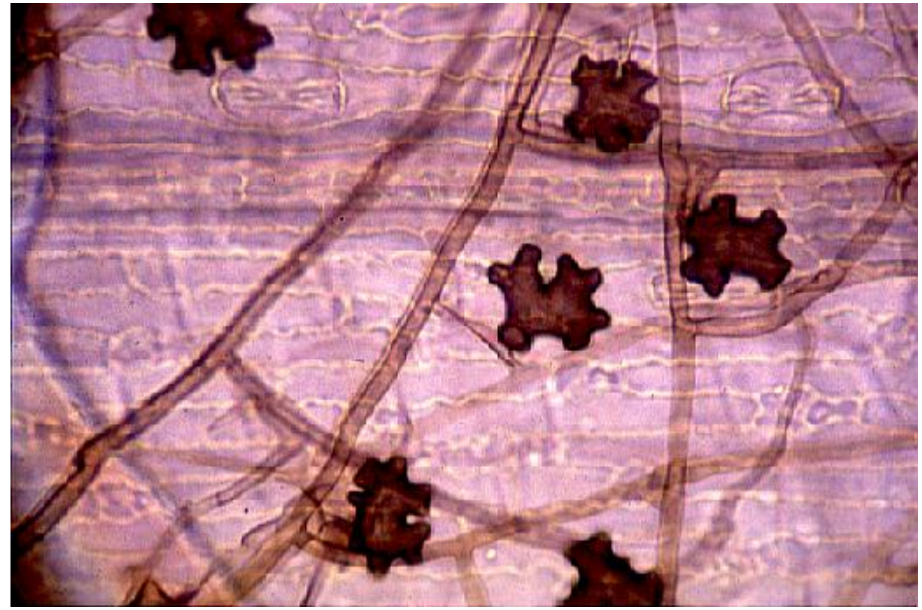
soil borne pathogen, causes root and collar rot

- var. tritici is pathogenic to wheat
- var. avenae is pathogenic to oats and turfgrass
- var. graminis causes sheath rot of rice

Symptoms of Take All

Hyphopodia are dark pigmented hyphal swellings similar to appressoria



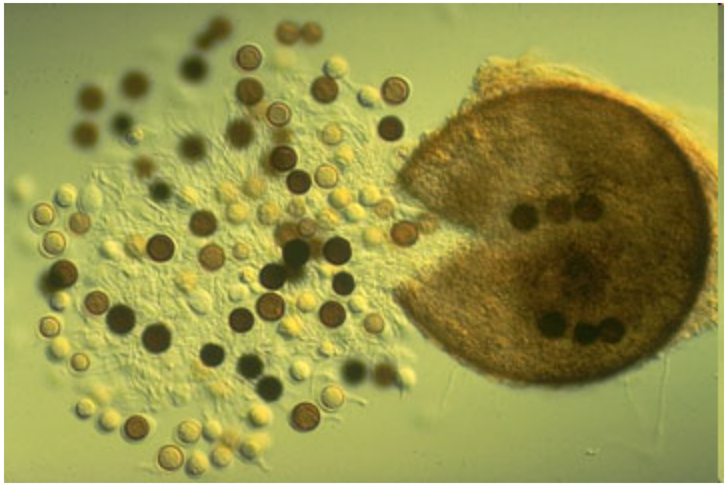


hyphopodia on roots are diagnostic for G. graminis

Gaeumannomyces symptoms on turf

Monosporascus cannonballus causes late season collapse of melons, root rot

Included here just because I like the name!



Only one spherical ascospore in each ascus

Fusarium

Fusarium is a very large genus with numerous important plant pathogens
Teleomorphs are Gibberella, but rarely seen on diseased hosts so most diseases are called 'Fusarium' diseases.

One of the most economically important groups of plant pathogens worldwide

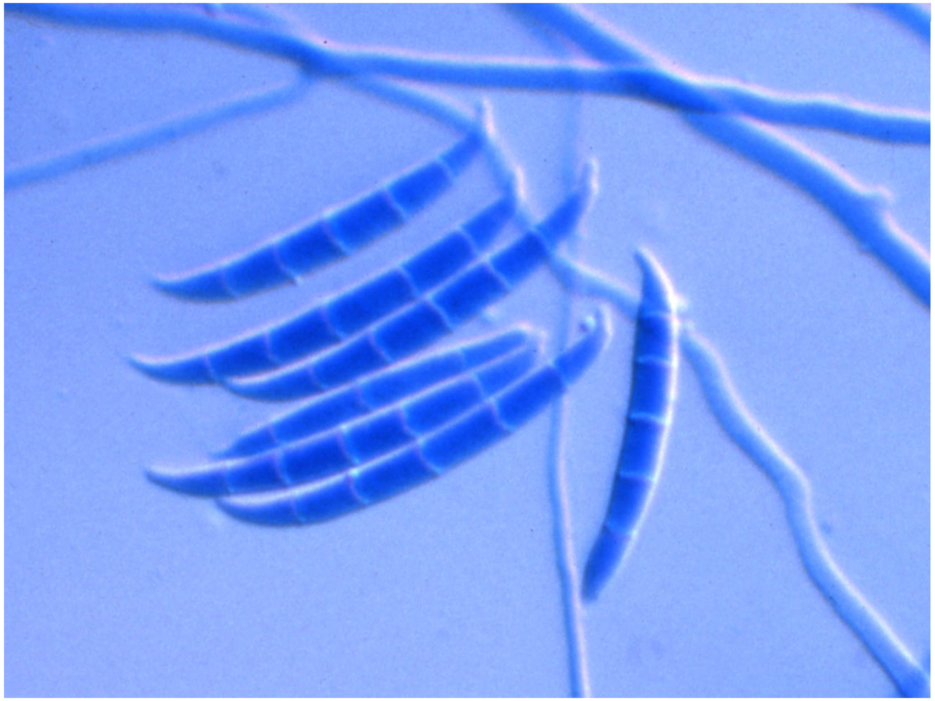
Special Forms "formae specialis" used for groups within Fusarium species that are pathogenic to particular hosts. Example: *F. oxysporum* f. sp. *cubensis*, cause of Panama disease of banana. Increasingly though formae speciales are being recognized as distinct species, based on gene sequence data.

Many different Fusarium diseases of many different hosts. Hosts include pretty much all plants, herbaceous annuals, perennials, broadleaved and conifer trees

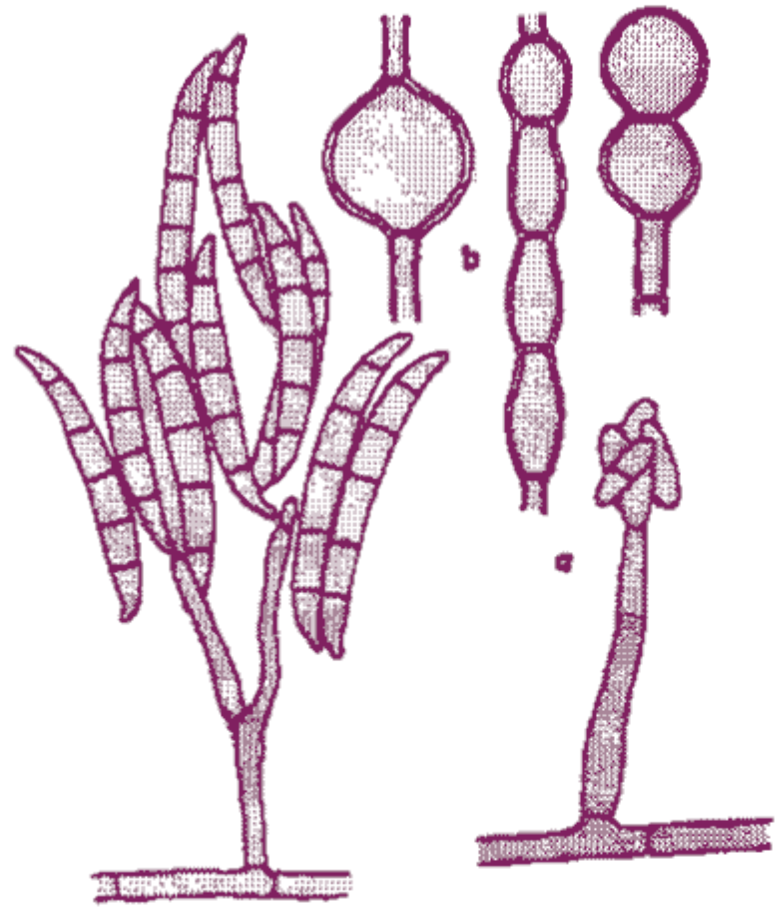
- Root and stem rots
- Damping off
- Wilt diseases
- Cankers of woody hosts
- Cereal rots and blights
- Storage rots

Several Fusarium species produce mycotoxins

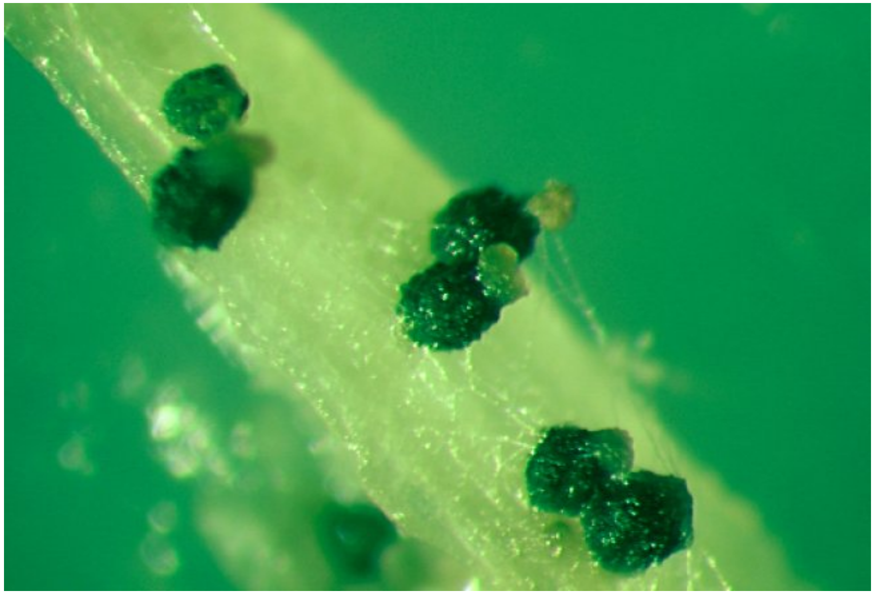
- Trichothecenes, fumonisins, zearalenones



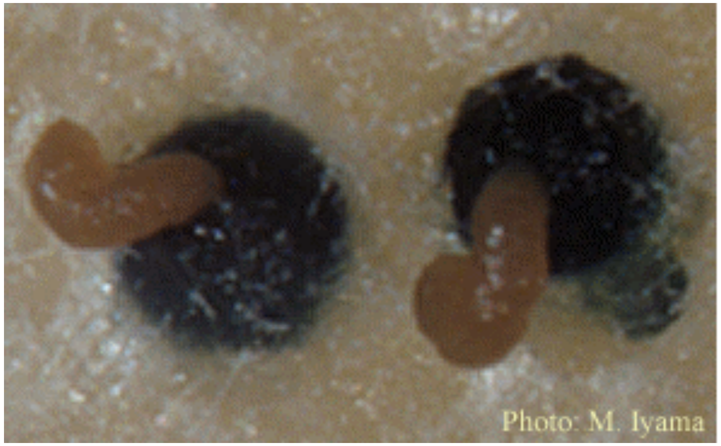
Fusarium species have very recognizable 'canoe-shaped' macroconidia. Often microconidia and chlamydospores are also present



Fusarium



Nectria perithecia



The teleomorphs of Fusarium are Gibberella, Nectria

Gibberellin plant growth regulators were discovered from *Gibberella fujikoroi*, which causes bakanae ('foolish seedling') disease of rice – the shoots elongate abnormally until they fall over

Fusarium wilt of lettuce

Fusarium wilt of tomato

Fusarium wilt of cantaloupe

OSU Extension

Fusarium root disease of nursery seedlings

Pitch canker caused by Fusarium circinatum

Barley scab

Fusarium root and stem rot

Fusarium ear rot

Fusarium head blight

Panama disease of banana caused by Fusarium oxysporum f. sp. cubense

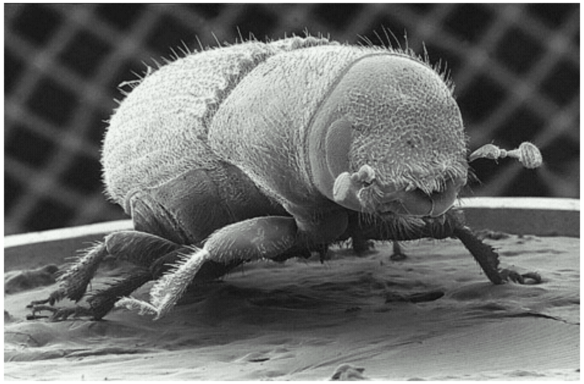
Images: University of Hawaii

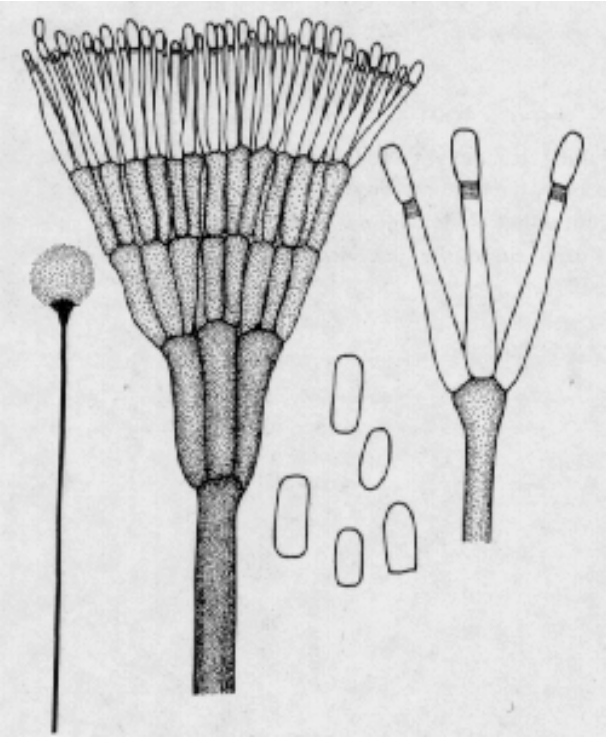
Fusarium fruit rots

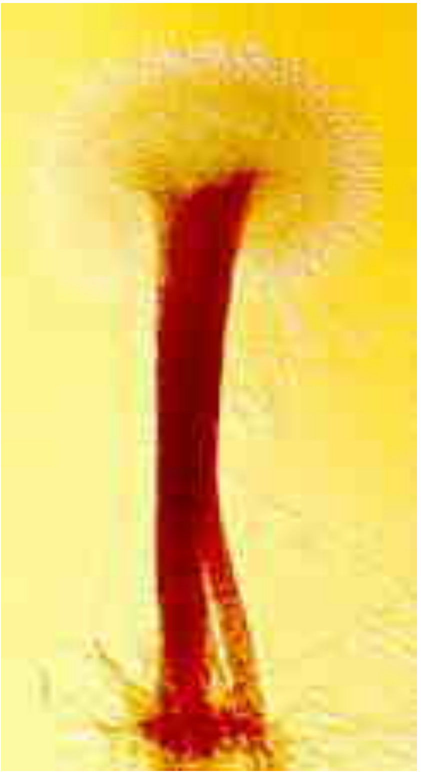
Ophiostoma and Ceratocystis

Wilt pathogens vectored by wood boring beetles

Both anamorph and teleomorph are adapted to elevating the spore mass above the substrate to contact insects

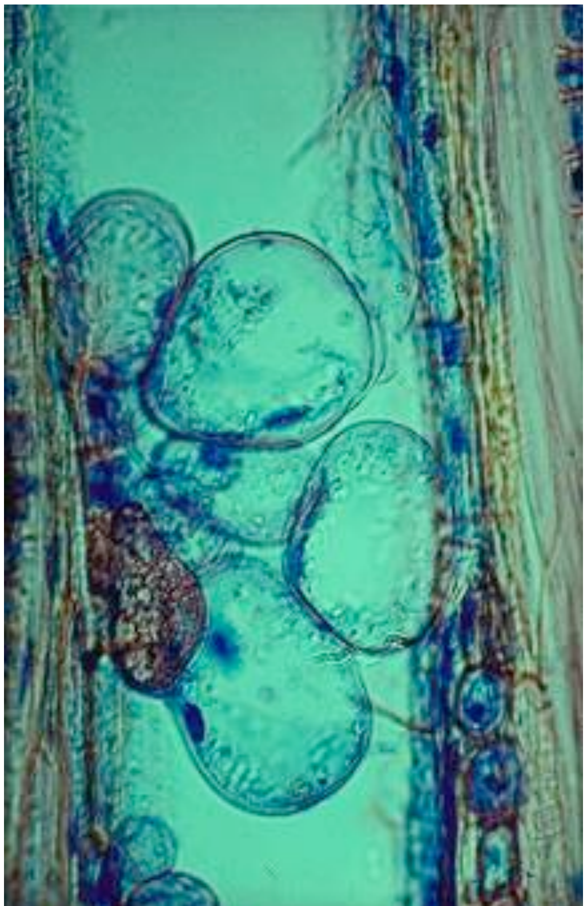




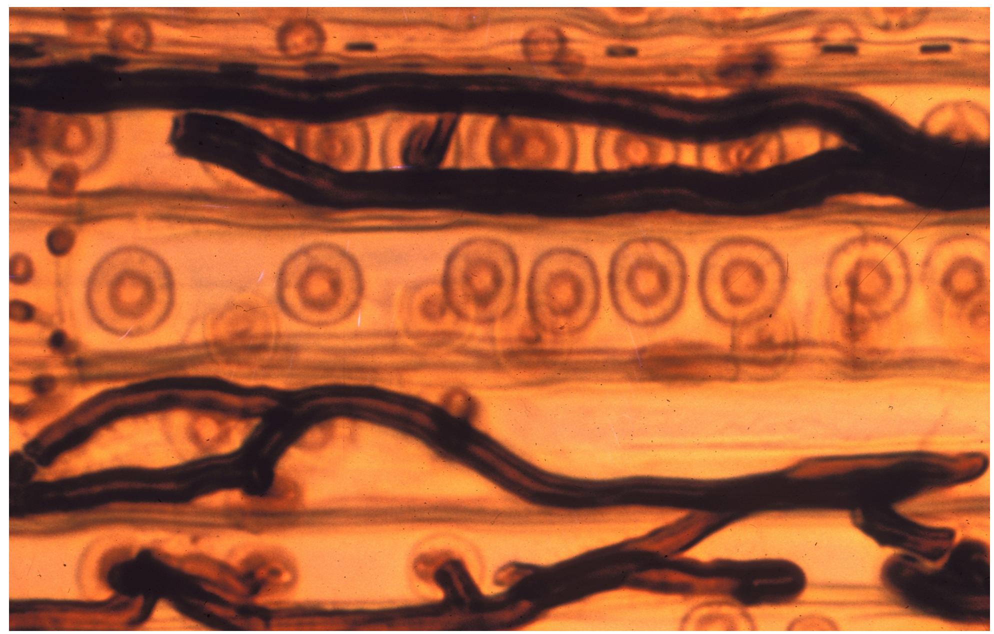


Ophiostoma and Ceratocystis

Ophiostoma and Ceratocystis species cause vascular wilts in woody hosts. Flow of water in xylem elements is restricted due to growth of fungal hyphae, formation of air pockets (embolisms) and host responses to infection that may include formation of gels or tyloses in the xylem vessels.



Tyloses are host response to infection, outgrowths of xylem parenchyma cells into the xylem vessels



Hyphae in tracheids can also restrict water movement

Insect dispersal

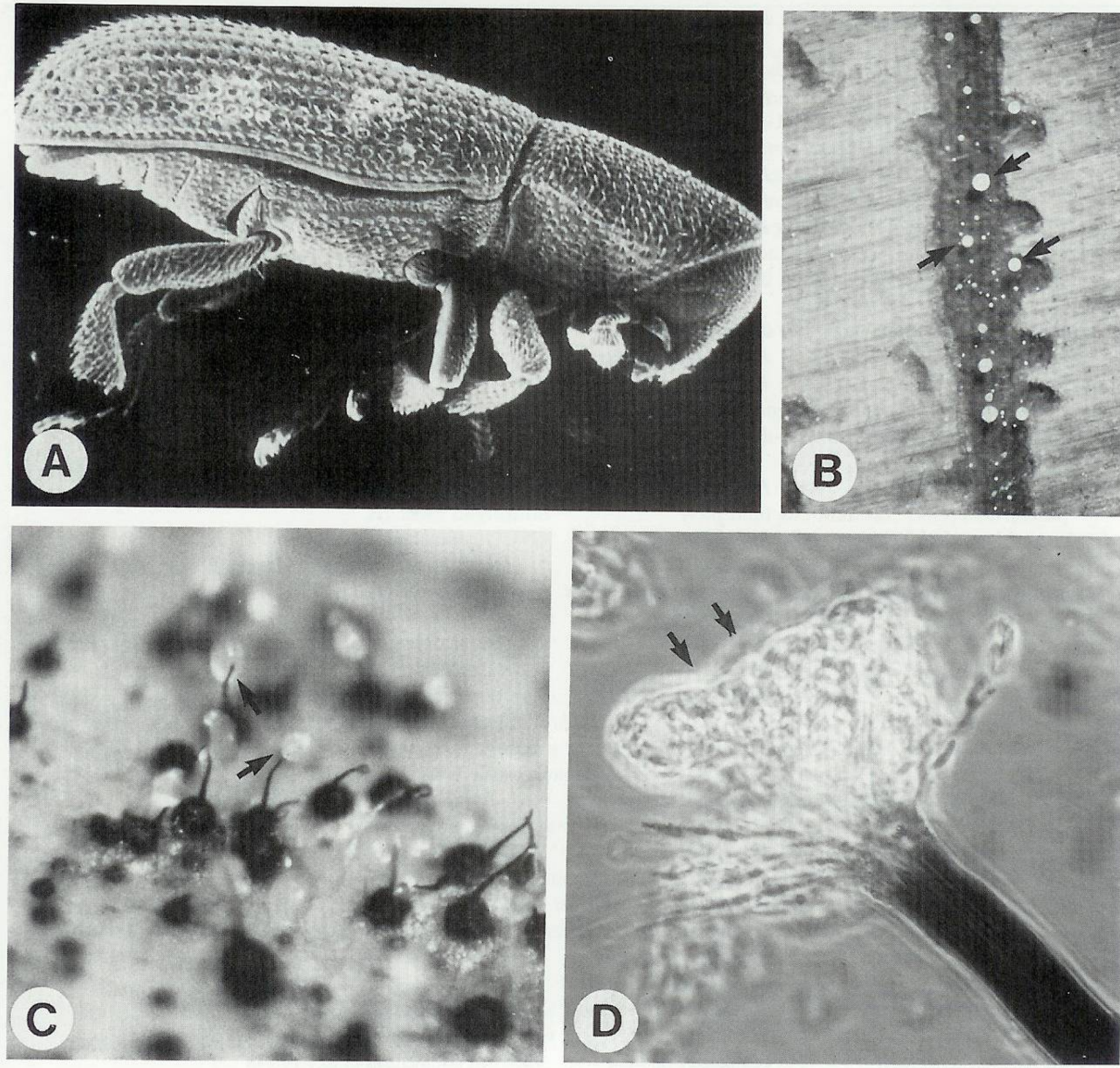


Fig. 11. Most *Leptographium* spp. are vectored by bark beetles such as the root-feeding beetle *Hylastes angustatus* (A). Fungal structures are adapted to insect dispersal with conidiophores (B) and perithecia (C, D) produced in galleries with spores in slimy masses (arrows) at their apices.