



**Basic Plant
Pathology
/Plant Diseases
2010**



Over 30,000 diseases of economical and aesthetic importance in the United States



A healthy plant is when it can carry out its physiological functions to the best of its genetic potential

Growth (good size, form etc)

Differentiation (leaves, roots, flowers)

Development (fruits, appropriate tissues)

Absorption of water/minerals

Photosynthesis

Reproduction

Disease: When normal physiological functions are interrupted by an organism (pathogen) or certain environmental conditions

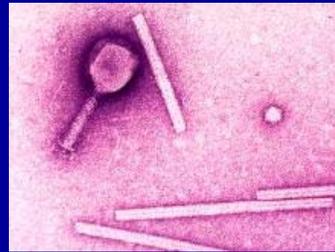
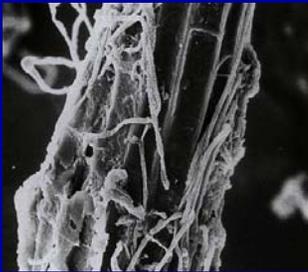
Before We Go Into Plant Diseases.....

Many problems are not diseases

**Many problems derive from poor
cultural practices, poor care,
improper planting etc...**

Factors causing plant damage can be grouped into two categories.

1. Pathogenic Diseases/Living factors: Fungi, bacteria, viruses, nematodes, other pests



2. Non-Pathogenic disease/Nonliving factors: mechanical, environmental, chemical



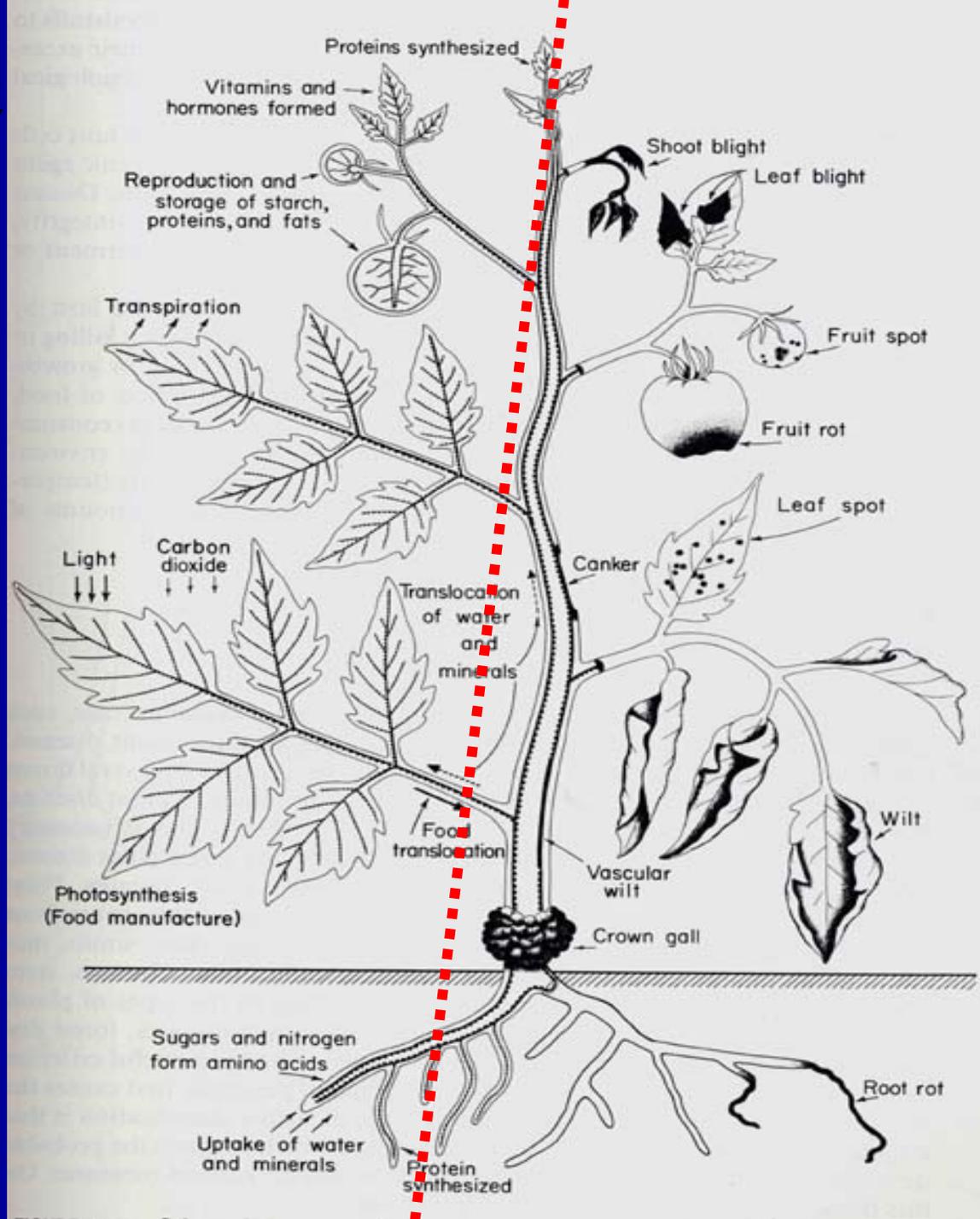
Parasitic Plant Diseases

Fungi

Bacteria

Viruses

Nematodes



THE BASICS

Do I have a Plant Disease Problem?

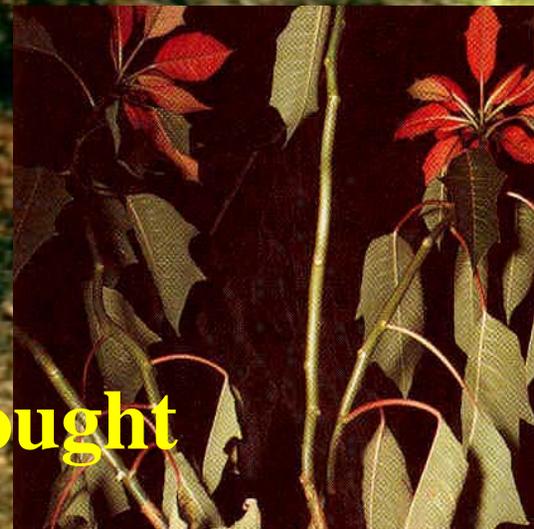
Study the Situation

- 1) Pattern of garden/landscape
- 2) Number of plants affected
- 3) Part of plant affected
- 4) Chemicals used on or near the site/rate
- 5) Fertilizer applied (rate, form of application)
- 6) Insects present

Disease?



Drought





**Improper planting/
soil compaction**



Nitrogen deficiency



Fertilizer spill

Soil drainage problems, improper soil grading



Excess fertilizer, salts, drought



**Nitrogen, iron
Deficiencies**



Cold damage

Chemical Injury



DISEASE PROBLEM ?

Identify the Problem

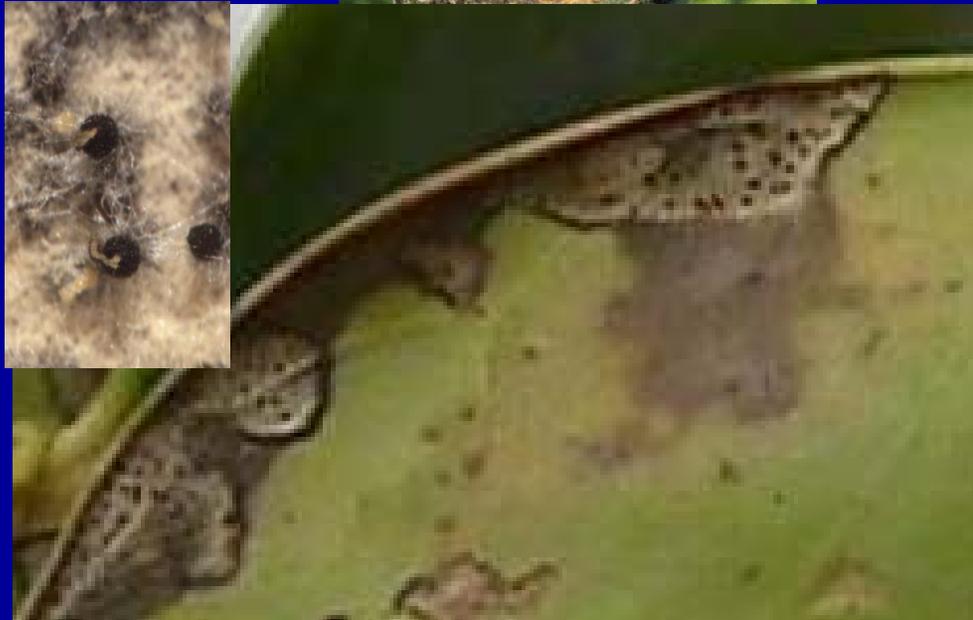
Symptoms of disease (spots, wilt, dieback etc)

Signs of pathogen (pimples, mycelium, powdery etc)

Bark darkening

Rotten roots, oozing, yellowing

Spreading Pattern



Look For Patterns

Living Factors:

No wide spread pattern

Not uniform

Usually plant specific

Rarely afflict 100% of host

Spreads with time



Look For Patterns

Nonliving Factors

Widespread on certain leaf age
or exposure side

Uniform

Cover more than one host



Patterns on Plant Canopy

A. Entire or major portion or top dying: Suspect root problem

Gradual decline: Root and vascular problems

Sudden decline: Chemical or drastic climate changes



B. Single branch dying: Foliage or aerial environment

Gradual death of branch: Canker pathogen
or shoot blight

Sudden death of branch: chemical drift, weather



Delineate Development

Have symptoms spread?





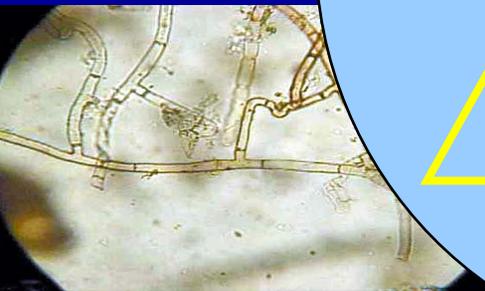
Host

Plant out of place
Stressed plant
Too Wet/Drought
Susceptible host

Microenvironments
Fertility
Over-watering
Leaf wetness
Compact soils
Cold/Warm
Temp/Irrigation

Disease

Fungi
Bacteria
Viruses
Nematodes

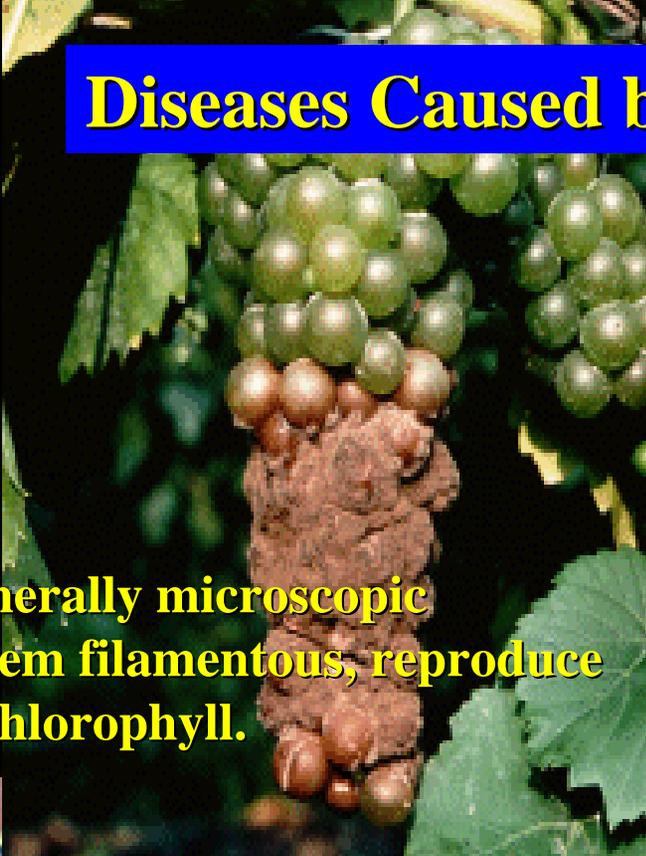


Pathogen



Environment

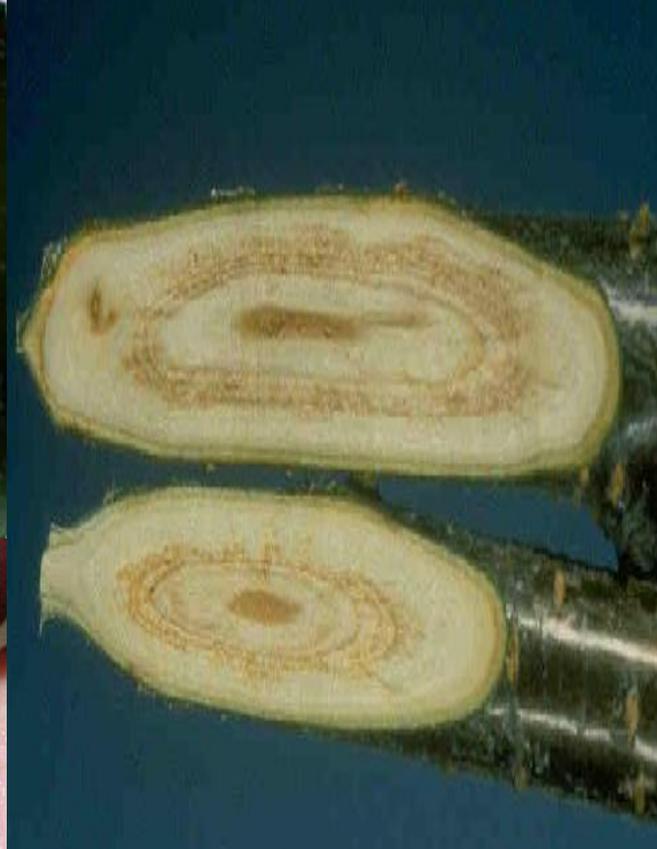
Diseases Caused by Fungi



Fungi= Are small, generally microscopic organisms, most of them filamentous, reproduce by spores; they lack chlorophyll.



More than 10,000 species of fungi can cause plant diseases problems



Diseases Caused by Fungi



Mycelium=The vegetative structure of the fungus, consists of a mass of branching, threadlike hyphae (tube containing Cytoplasm)

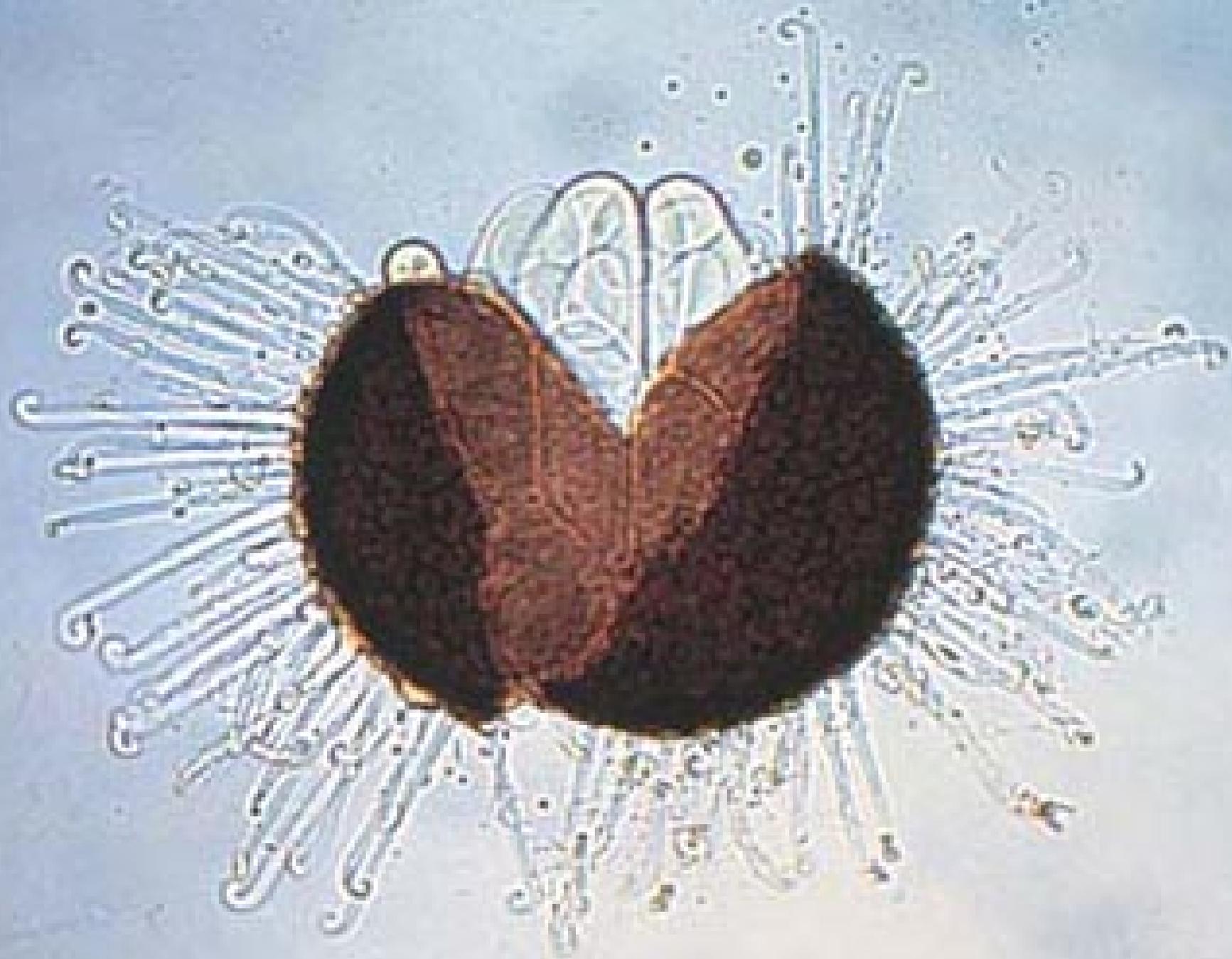




SPORE

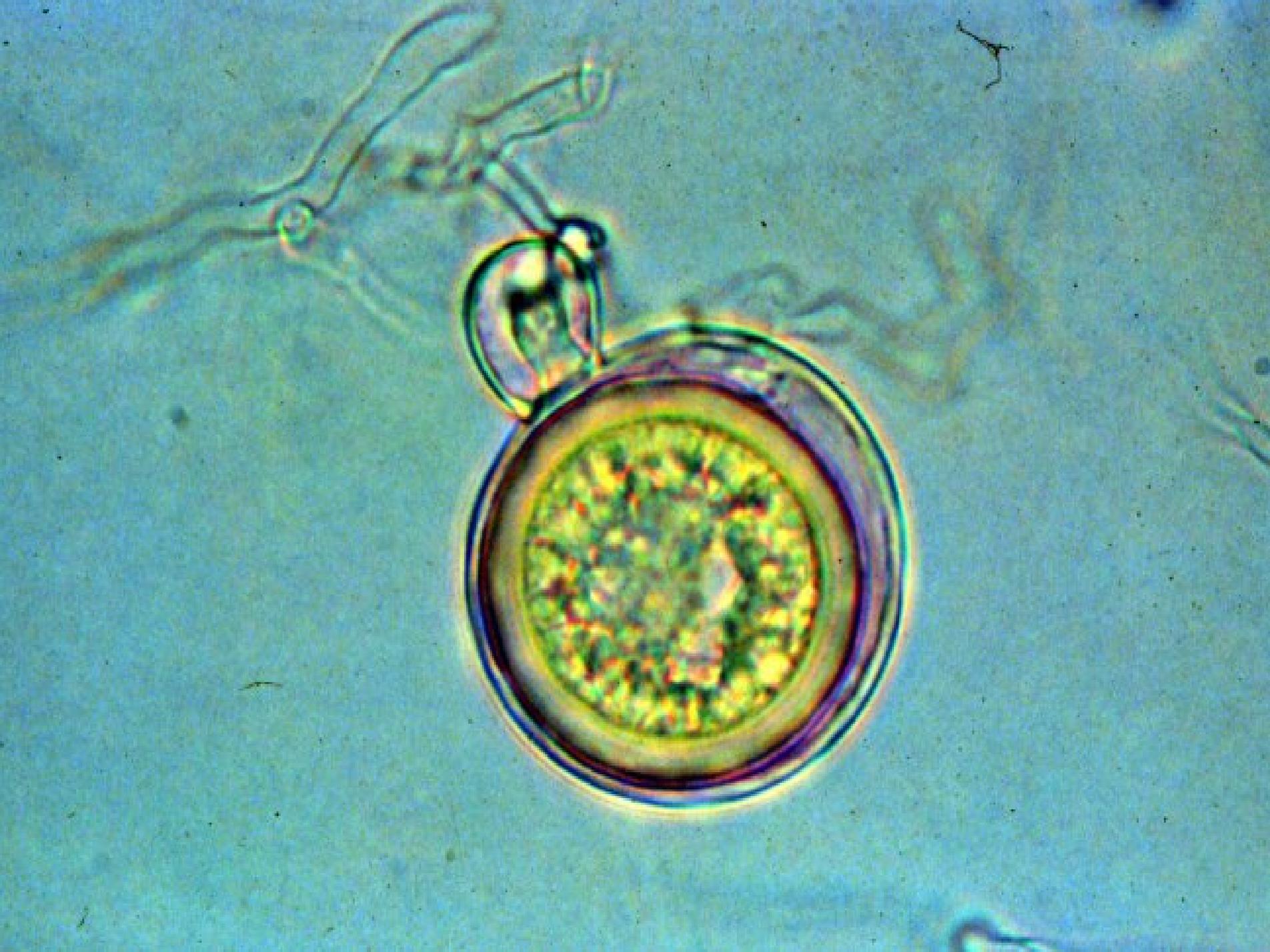
A small, usually single-celled reproductive body that is highly resistant to desiccation and heat and is capable of growing into a new organism,



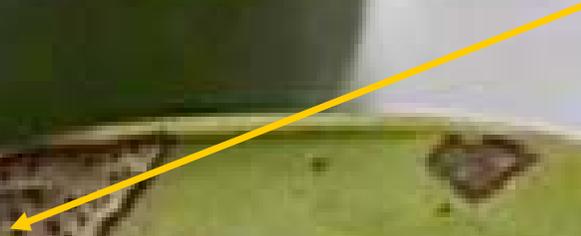








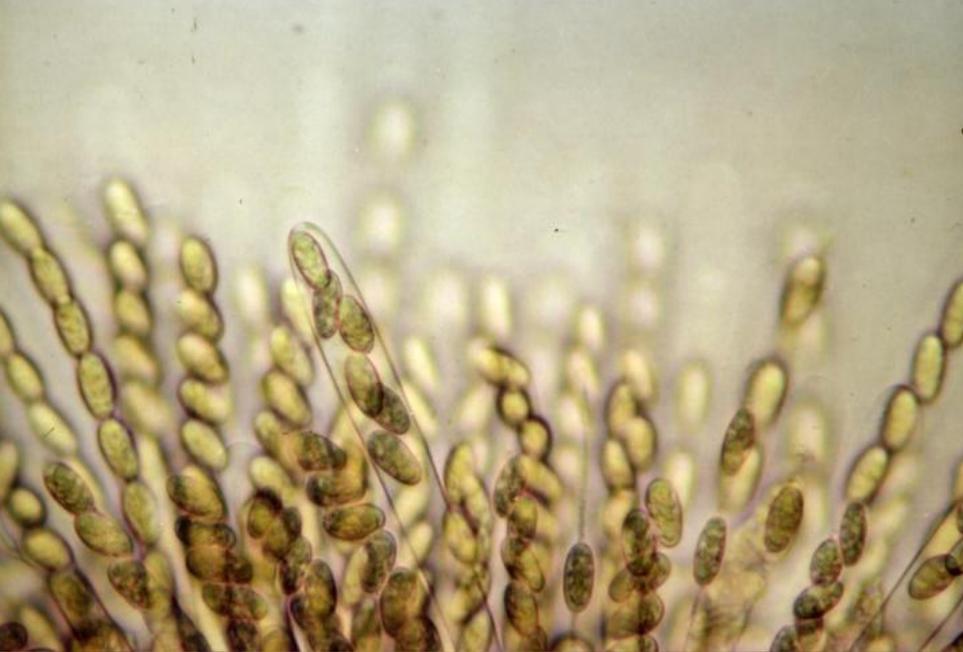
Picnidia
Perithecia



Sclerotia. A hard dense mass of mycelium that contain stored food and are capable of remaining dormant for long periods.



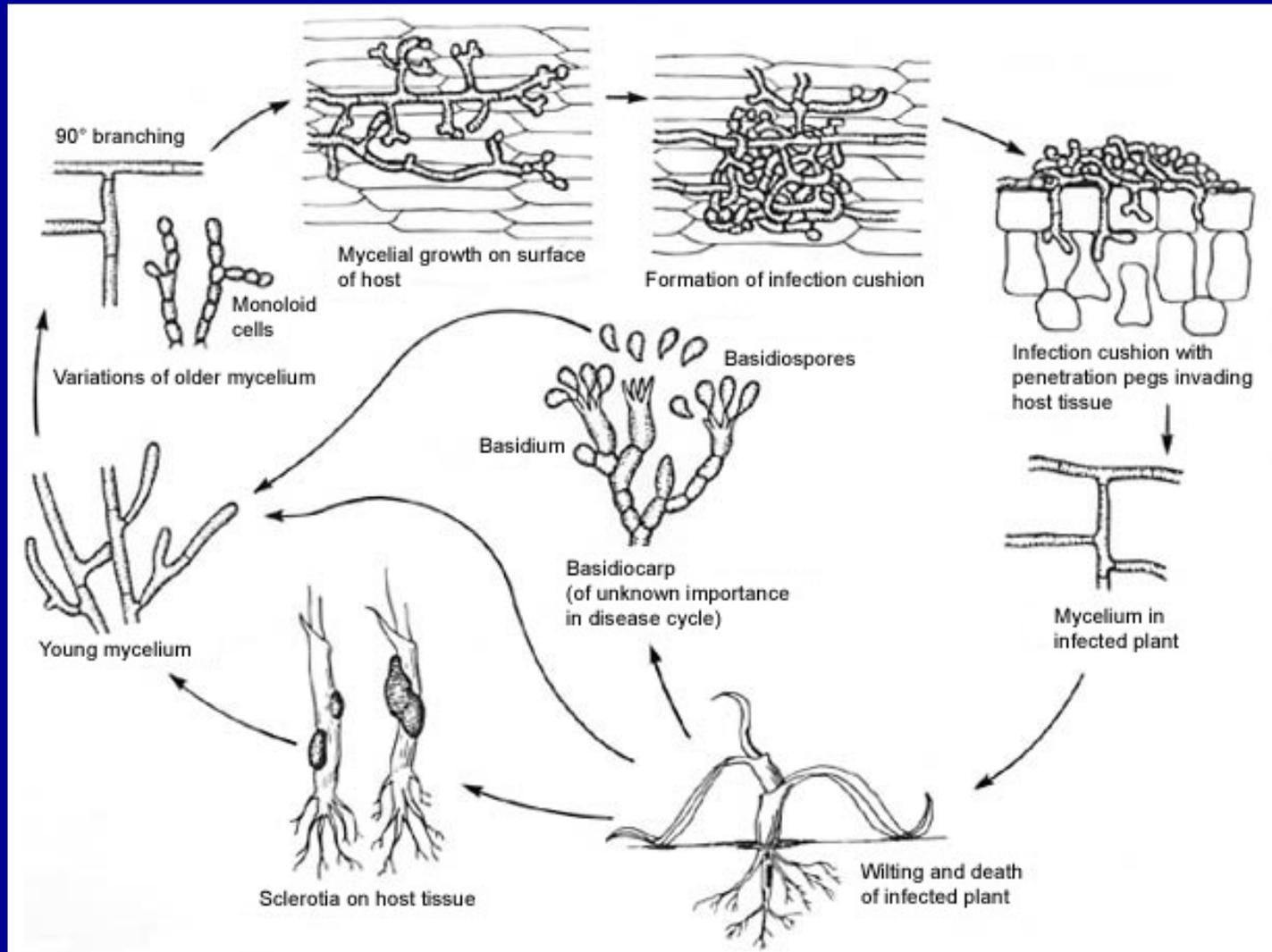
Many fungi cause foliar diseases



**Same pathogens associated with damage in other parts of the plant
Stems, fruits and/or roots**



LIFE CYCLE OF FUNGI



PENETRATION OF PLANT HOST

I. Interactions at the plant surface

D. Degradative enzymes - under developmental control in biotrophs

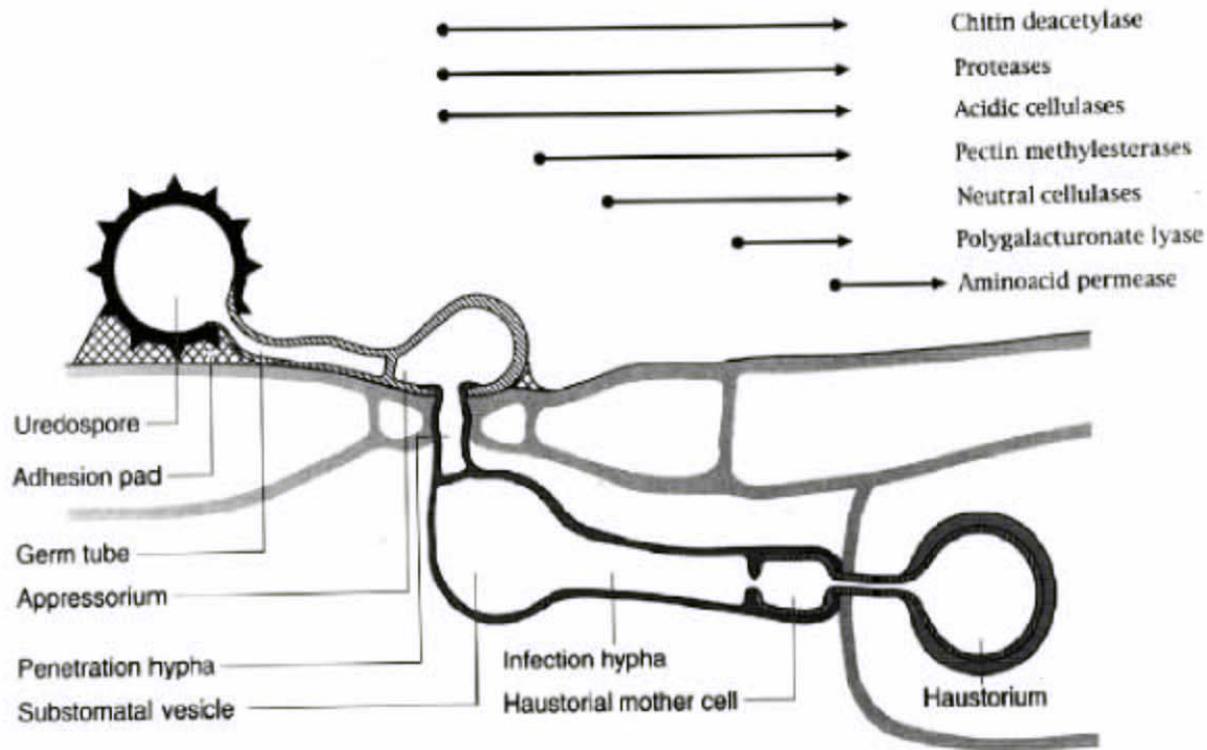


Figure 4 Concerted differentiation of infection structures and production of enzymes by *Uromyces viciae-fabae*. Note that some cell wall-degrading enzymes are already produced during stomatal penetration. A putative amino acid permease was identified that is specifically expressed in haustoria (M Hahn and K Mendgen unpublished).

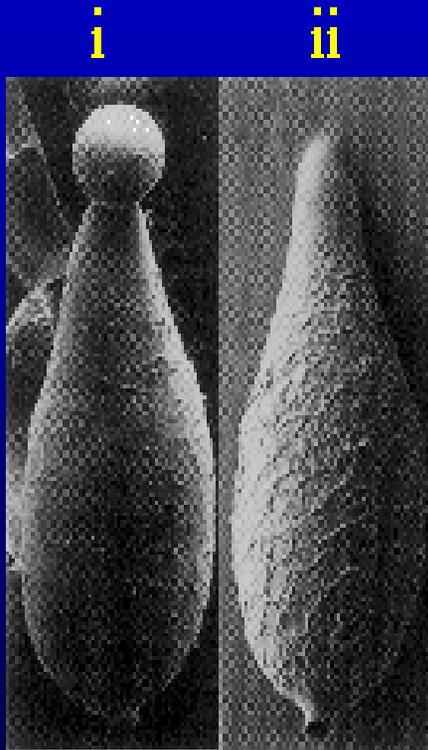
Mendgen, K., Hahn, M. and Deising, H. 1996. *Annu. Rev. Phytopathol.* 34: 367-386

Adhesion

Most fungi attach by hydrophobic interactions

Magnaporthe uses spore tip mucilage (STM)

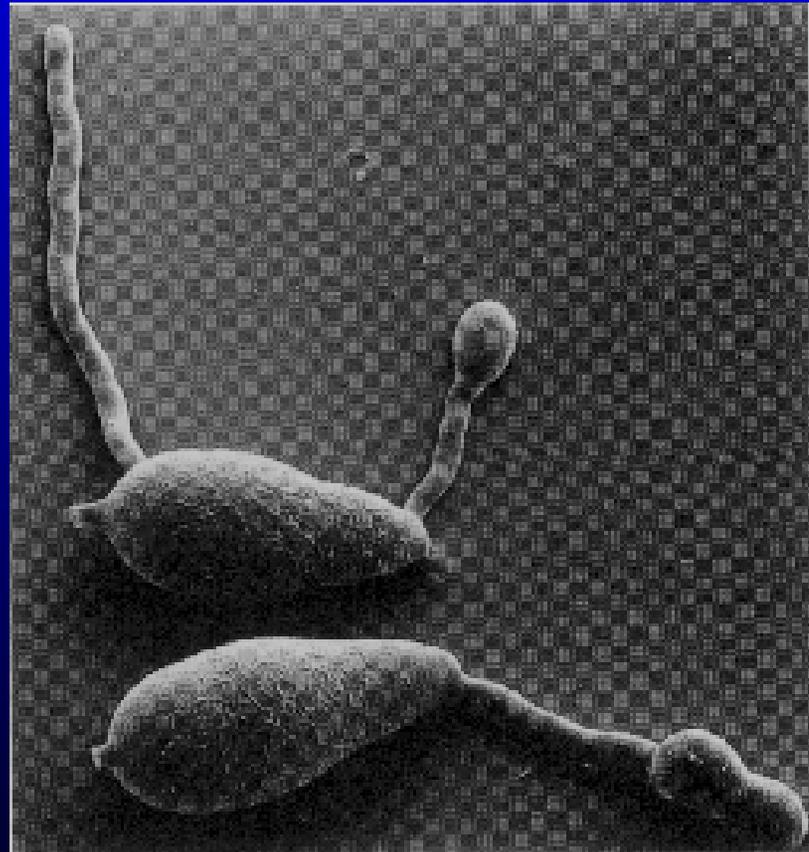
i) conidium with apical droplet of spore tip mucilage



ii) conidium attached to substrate by adhesion of spore tip mucilage

Germination of *Magnaporthe grisea* spores

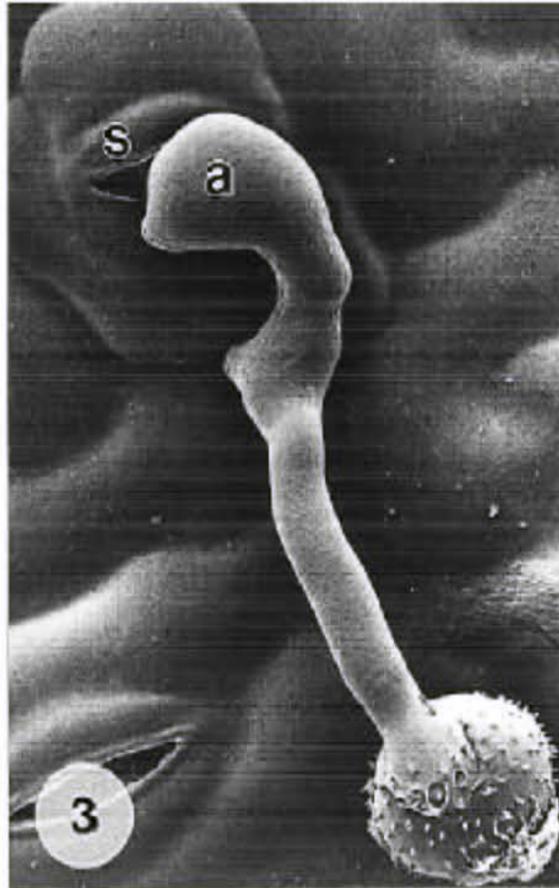
Germination of spores and early appressorium development - swelling of germ tube apex.



Lucas fig 6.3 c

B. Surface sensing (Thigmotropism) - continued

Stomata



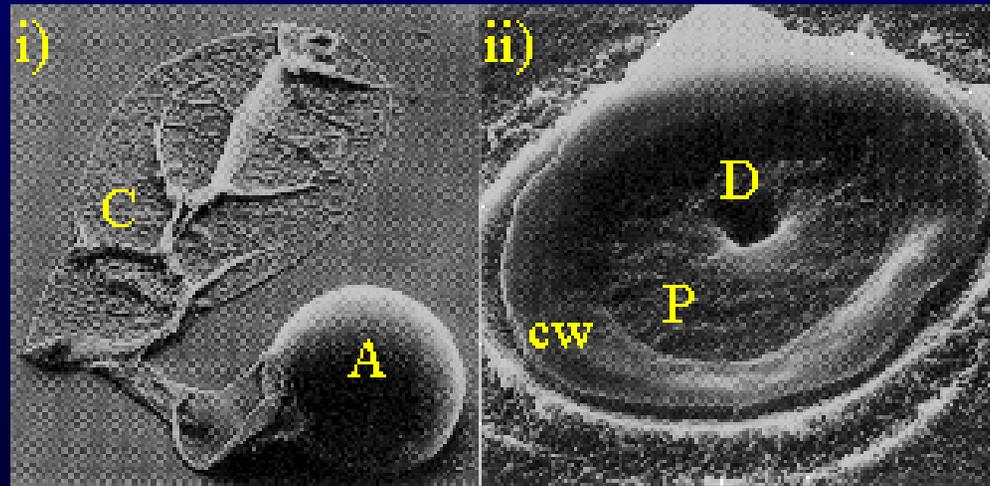
Appressorium

Germling/
germ tube

Bean rust spore
(*Uromyces*)

Figure 3 Penetration of the stomatal pore from an appressorium by the uredospore germling of *U. appendiculatus* (*s* = stoma, *a* = appressorium). Low temperature scanning electron micrograph $\times 1000$.

Penetration by *Magnaporthe grisea*.



i) Mature appressorium (A) attached to collapsed conidium (C). Separated by a septum.

ii) Remnants of appressorium attached to a polythene surface. Appressorial pore (P) penetration dent (D) and melanin cell wall (cw)

Lucas figs 6.3 d & e

DISSEMINATION OF FUNGI

Fungi can spread by

Wind

Rain

Mechanical-(people, tools)

Insects

Irrigation water (splashing, film of water)

Soil

Seed

Groups of diseases caused by fungi

LEAF SPOTS

POWDERY MILDEWS

RUSTS

ROOT ROTS

CANKERS

Fungal Leaf Spots

Leaf spots are produced by a number of fungi

e.g. *Septoria*, *Cercospora*, *Entomosporium*



Foliar Pathogens Damage

Reduction of Photosynthetic activity

Reduction Carbohydrate production

Reduction on Energy production

Direct effect on yield

Transpiration reduction

Movement of water upward

water distribution

Gas exchange

CO₂ (in) and O₂ out or in both used in photosynthesis

Physical blockage of vascular tissue





Entomosporium



Colletotrichum



Mycosphaerella

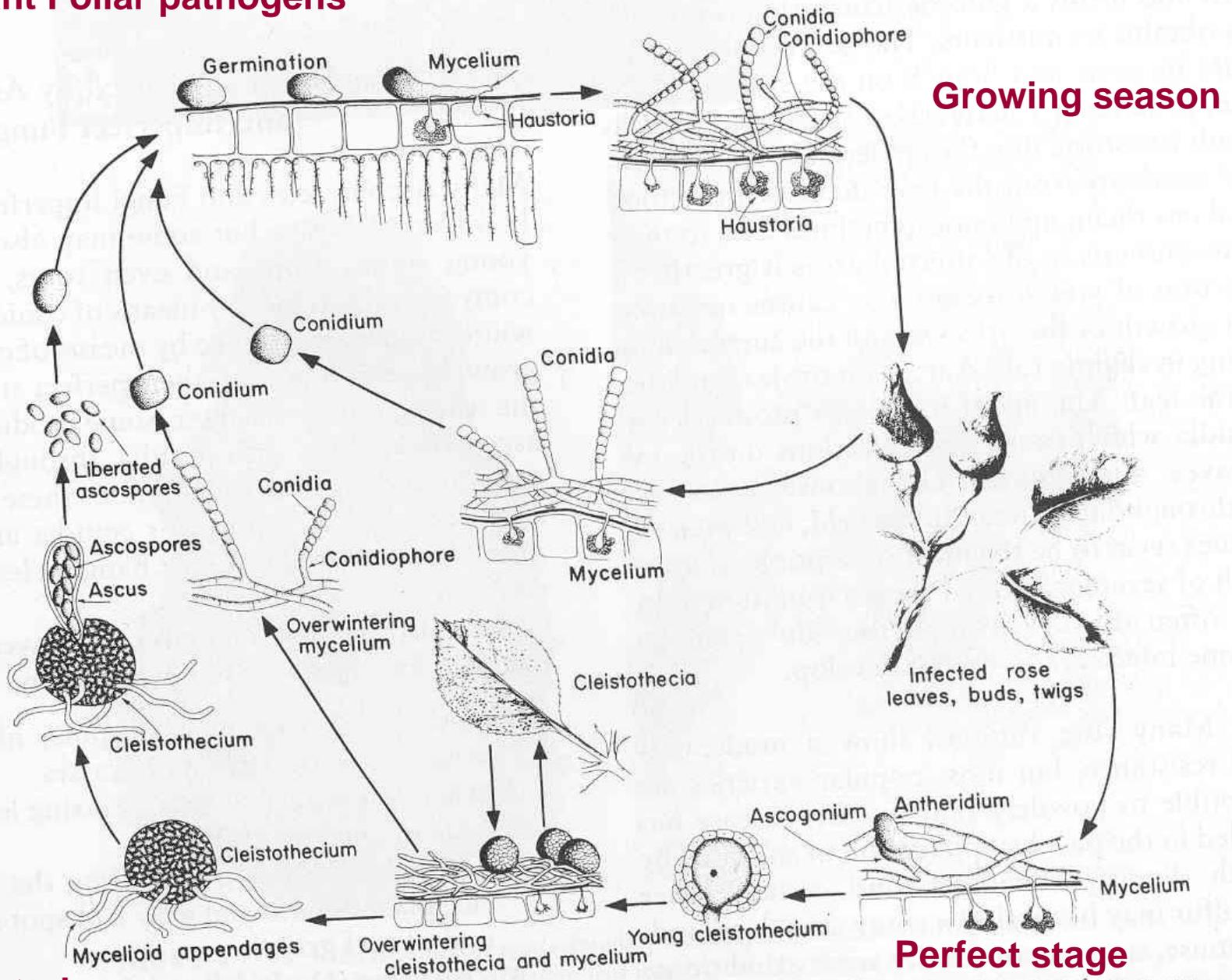
Black Sigatoka



Powdery Mildews



Important Foliar pathogens



Overwintering

FIGURE 11-40 Disease cycle of powdery mildew of roses caused by *Sphaerotheca pannosa* f. sp. rosae.

RUSTS



Red & Black Oaks

Uredinia & telia





Telia on oak

Root rots

Pythium

Phytophthora

Rhizoctonia



Cankers and Stem Diseases

Azalea, Rhododendron



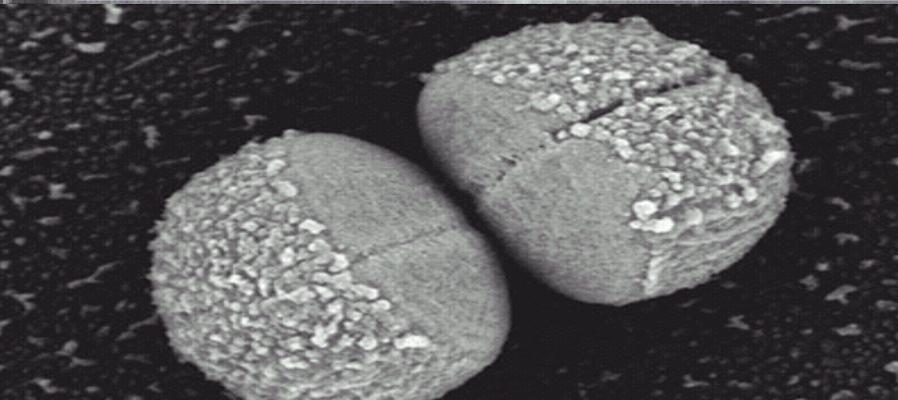


Photo 146. A. L. Jones and T. B. Sutton

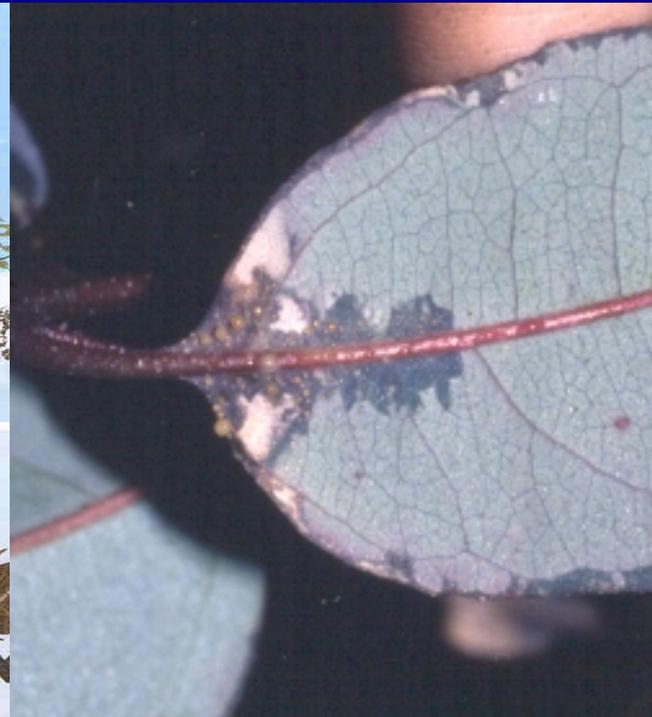
Diseases Caused by Bacteria



Bacteria are microscopic one celled organisms. They are the smallest, simplest and most abundant organisms. They reproduce by dividing in half. Cells divide every 30 min in average



BACTERIAL DISEASES



OOZE!

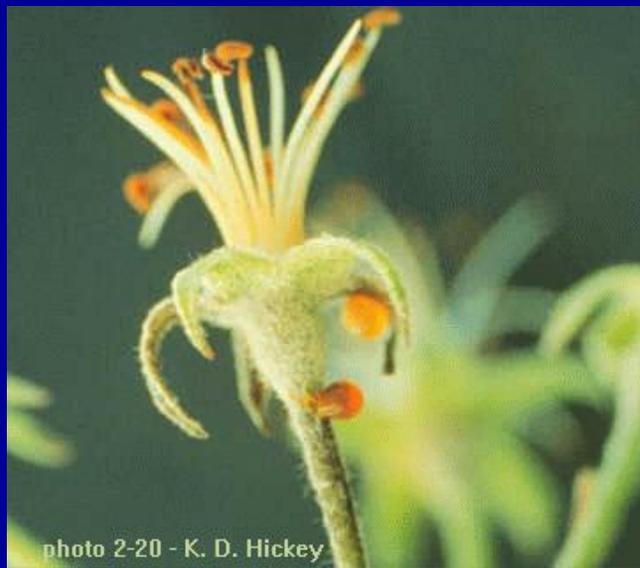
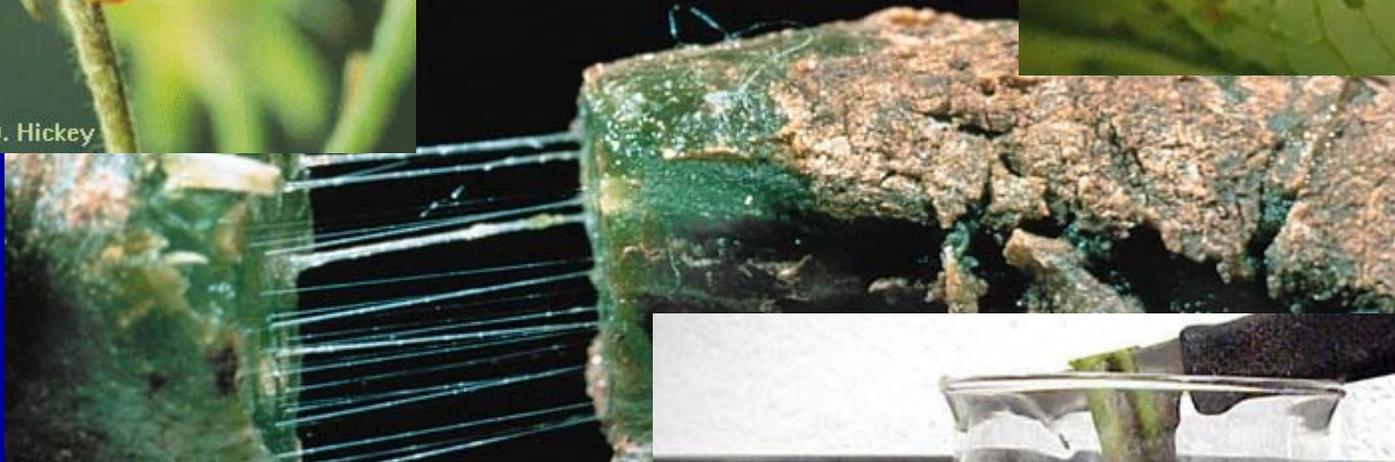
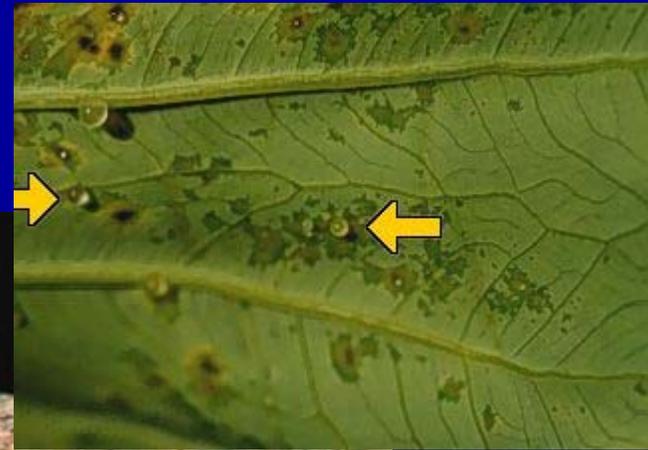


photo 2-20 - K. D. Hickey



Fungal vs. Bacterial Pathogens

Abnormality	Fungal	Bacterial
Water-Soaking	not common	common
Texture	dryish-papery	slimy-sticky
Odor	usually none	fishy, rotten
Pattern	circular with concentric rings	irregular-angular; initially does not cross veins
Disintegration	uncommon	common
Color Changes	common: red, yellow, purple halos	uncommon
Pathogen structures	common-mycelia, spores...	uncommon





Diseases caused by Virus

Virus are small, can not be seen even with a regular microscope

We can only see the effects of their damage

Carried by insects, infected tissues, seed, cuttings, bulbs, etc...





R. Mulrooney, U of DE



Transmission



Seed

Nematodes

Diseases caused by Nematodes

Microscopic round worms

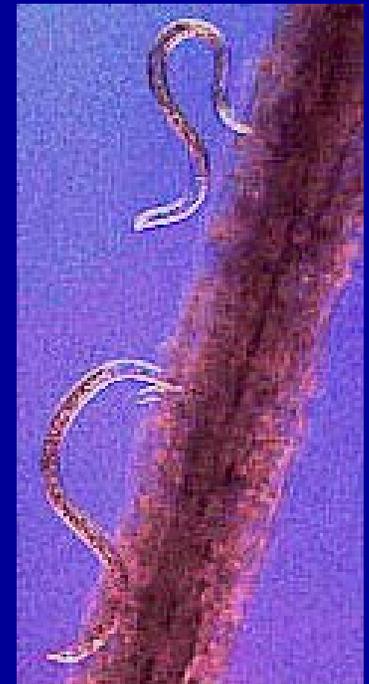
Thrive in living tissue

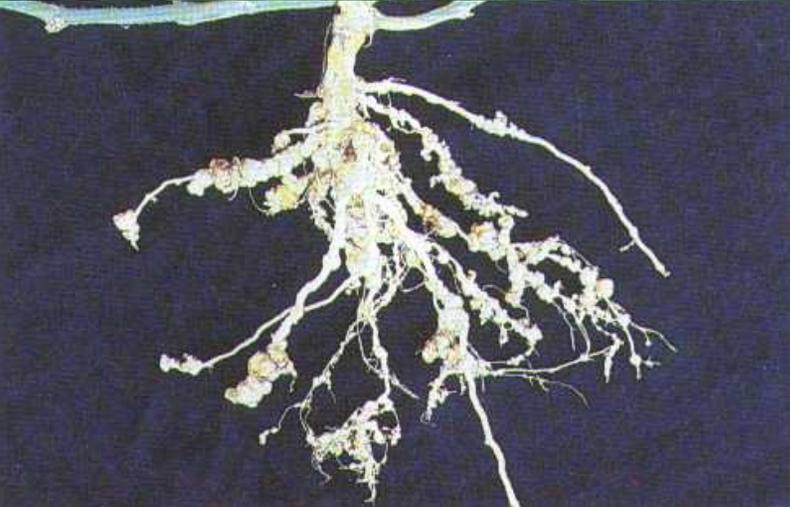
They can live inside the plants and roots (endoparasitic) or in the outside (ectoparasitic)

Spear-like structures (stylet) in their mouths

Feed on plants (roots) and extract nutrients from them

Several species



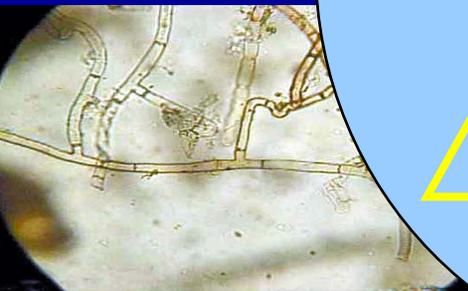
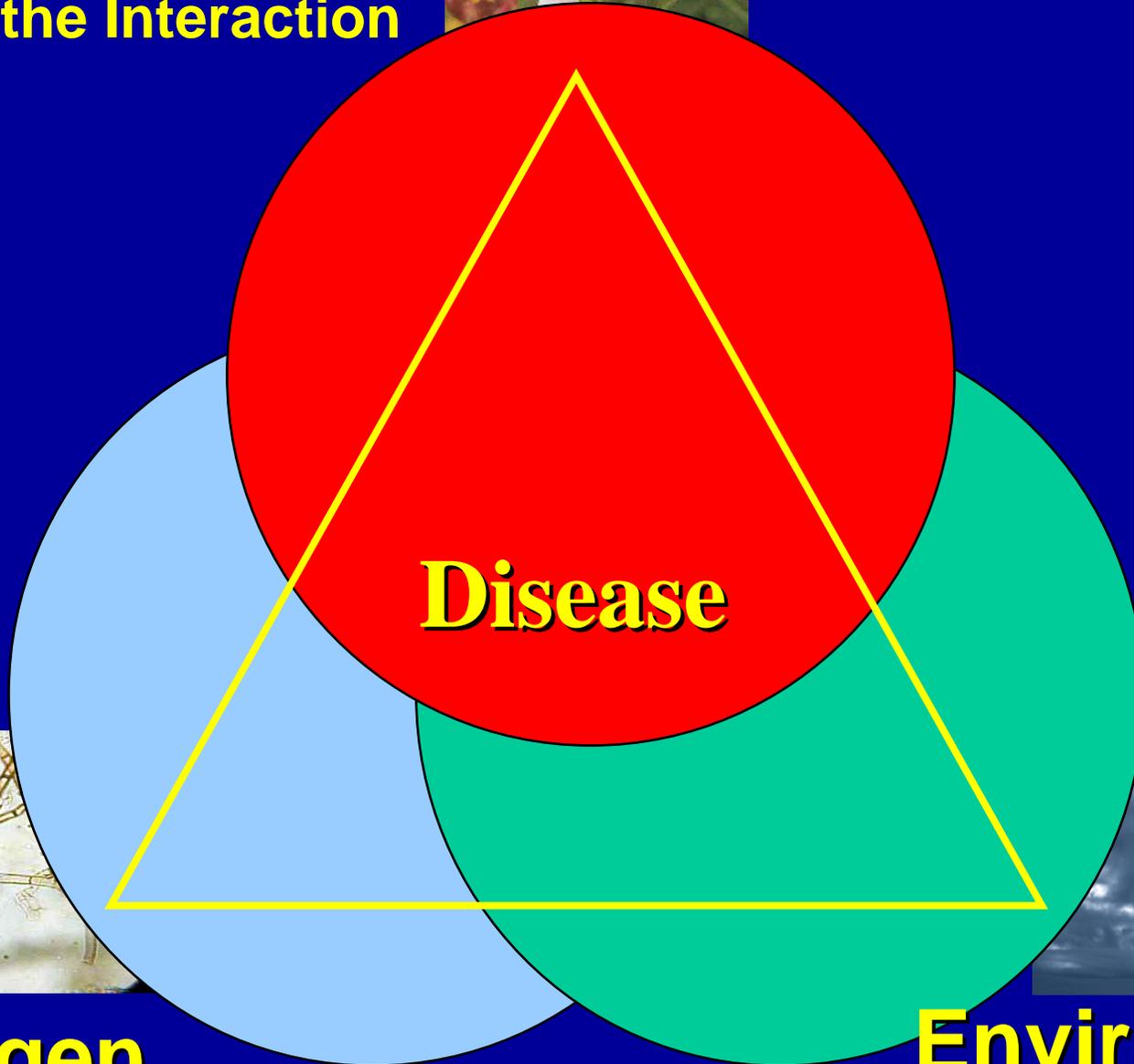




**Disease Prevention/
Management:
Breaking the Interaction**



Host



Pathogen



Environment

Disease Prevention/Management: Breaking the Interaction

Pathogen:

Do not introduce it (clean plants from greenhouse/nursery)

Sanitation (Remove as much as possible)

Environmental “Manipulation”

Correct Microenvironments

Correct over-watering

Preventing host stress

Avoid over Fertilization

Drought

Host Resistance

Appropriate species

(right plant in the right place)

Resistance

(plant tolerant to certain pathogen)

Chemical Control

Fungicides

Antibiotics

Friends and Foes

- **Potato Blight (*Phytophthora infestans*)-
Irish Famine-
Irish Migration. 1800's**
- **Southern Corn Blight
(*Helminthosporium*) -USA-
Threatened entire Maize Production
1970's**
- **Dutch Elm Disease-Wipe out entire Elm
population in the
US. 70-90's**

Sudden Oak Death

Phytophthora ramorum

Discovered in CA (2000). Now in Oregon,
New Zealand, The Netherlands

Oaks, Tanoaks, Rhododendrons, Huckleberry, Madrone

Confirmed on Douglas Fir and Coast Oaks in 2002

On Rhododendrons- Paralyzed CA Production and exports



Daylily Rust



Discovered in Summer 2000

14 States in 2001, 35 States in 2003

Costa Rica, Australia, New Zealand in 2002

Turfgrass disease control in Georgia in 2007 was close to 187 million

Due to a bacterial disease-Citrus canker-, most of citrus trees in the Miami Area have been cut down. 2003

2004 New Diseases in Georgia-Vidalia Onions

2005 Soybean Rust in the USA (Kudzu connection, other ornamentals?)

2007 Disease losses in vegetables for 34 million

2008 Bacterial leaf scorch newly-identified disease affecting blueberries

2009 Citrus Greening = Phloem limited bacterium, carried by a Psyllid insect

2010= Martinez (working on a new disease in Seashore paspalum) Phyllachora sp



Friends

**Agrobacterium
tumefaciens
(Crown Gall)**

**Initiation of
Biotechnology**

**Disease and insect resistant potatoes
Aluminum (heavy metals) tolerant plants
Viral diseases Resistant Papaya
Disease resistant Cassava (sweet potato)**

Papaya



- **Important Food Crop in SE Asia - Daily Staple**
- **Papaya Ringspot Virus is destroying the Crop**
- **Dennis Gonsalves - Cornell University developed transgenic virus-resistant strains and transferred to SE Asian countries**

