

**FUNGI**

*Sclerotinia sclerotiorum*:  
White rot of soyabeans (Sclerotinia stem rot of  
soyabeans)



# *Cercospora zeae-maydis*



Gray leaf spot

*Colletotrichum lindemuthianum*  
(Bean anthracnose)



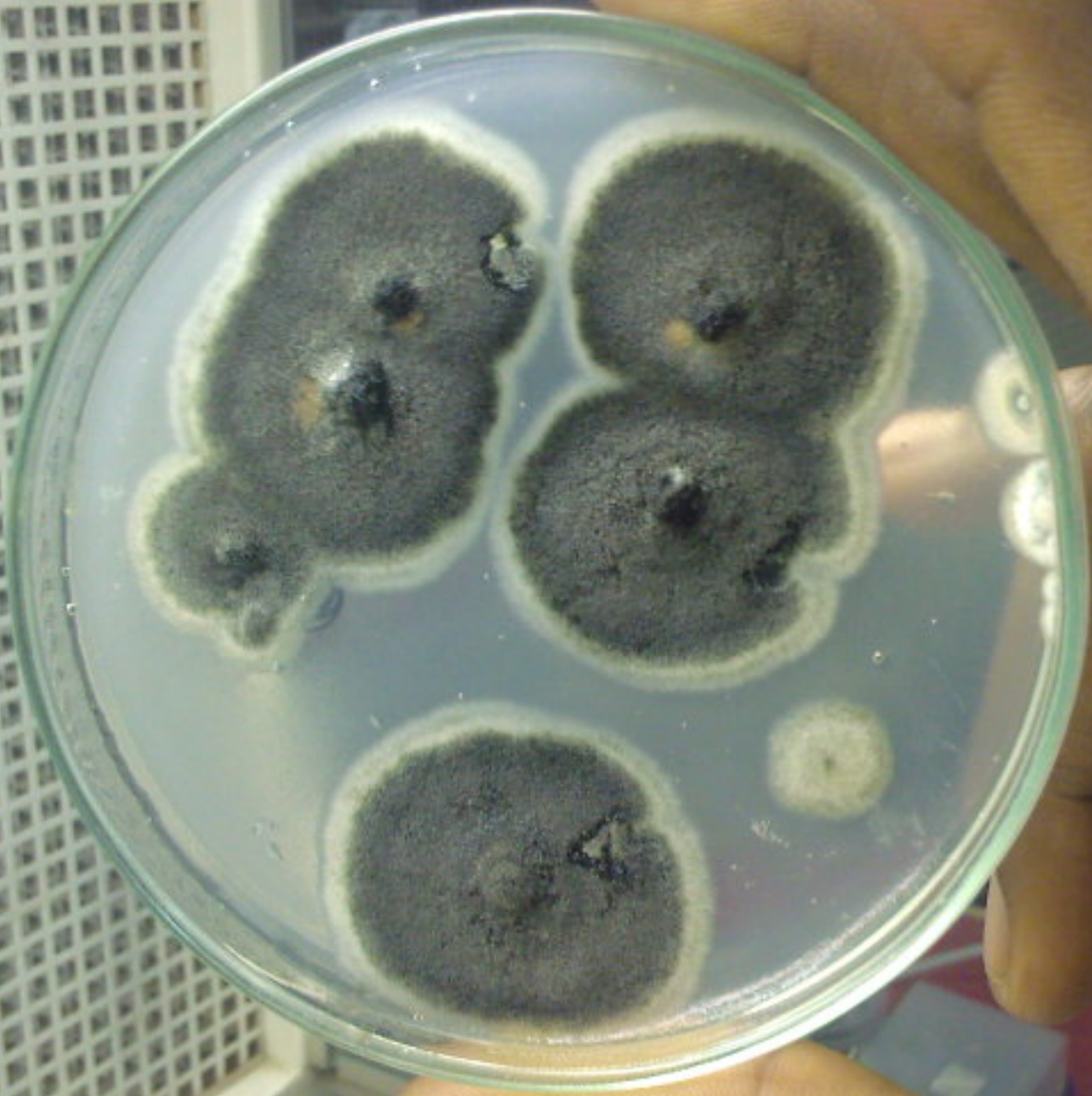


*Phytophthora  
infestans*  
(Late blight of  
tomato)



Root rot of spinach:  
*Pythium spp*,  
*Rhizoctonia solani*,  
*Aphanomyces spp*,





# WHAT ARE FUNGI?

Fungi are eukaryotic, spore bearing, achlorophyllous organisms that generally reproduce sexually and asexually, and whose usually filamentous, branched somatic structures are typically surrounded by cell walls containing chitin or cellulose, together with many other complex organic molecules. They include microorganisms such as yeasts, molds and mushrooms.

# TRUE FUNGI VS FUNGUS-LIKE MICRO-ORGANISMS (ALSO CALLED WATER MOLDS)

## TRUE FUNGI

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# TRUE FUNGI VS FUNGUS-LIKE MICRO-ORGANISMS (ALSO CALLED WATER MOLDS)

## WATER MOLDS

Are eukaryotic, spore bearing, achlorophyllous organisms that generally reproduce sexually and asexually, and whose usually filamentous, branched somatic structures are typically surrounded by cell walls containing ~~chitin~~ or cellulose, together with many other complex organic molecules. They include microorganisms such as ~~yeasts and molds, as well as the more familiar mushrooms.~~

## TRUE FUNGI

- Chitin in cell wall
- Kingdom-Fungi
- Phylla: Ascomycota, Basidiomycota, Zygomycota, Chytridiomycota,
- Examples (genera):
  - *Alternaria, Rhizopus, Colletotrichum..*

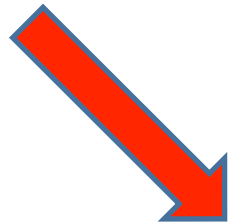
## WATER MOLDS

- Cellulose in cell wall (like plants)
- Kingdom-Chromista
- Phylum: Oomycota
- Examples (genera):
  - *Phytophthora, Pythium, Peronospora, Plasmopara*



Spore

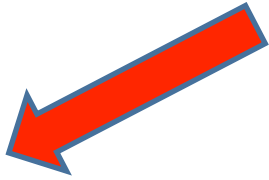
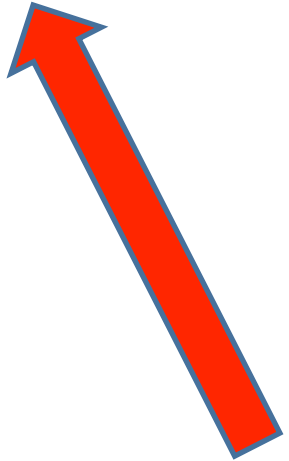
Types of mycelium

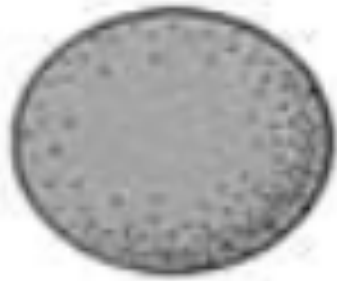


Colony

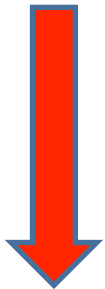


Spores





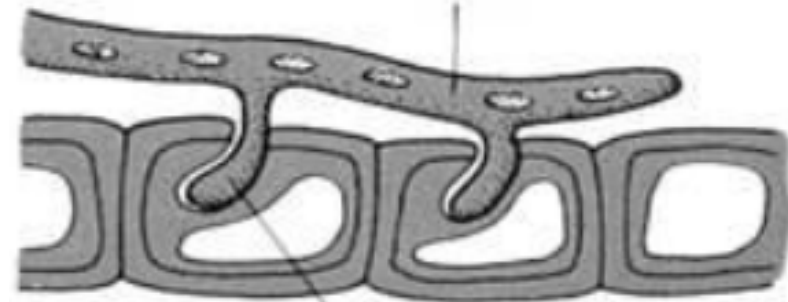
Spore



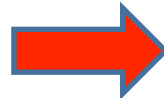
Mycelium



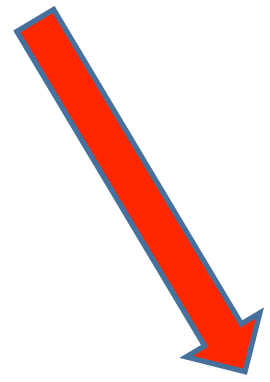
Hypha



Haustorium



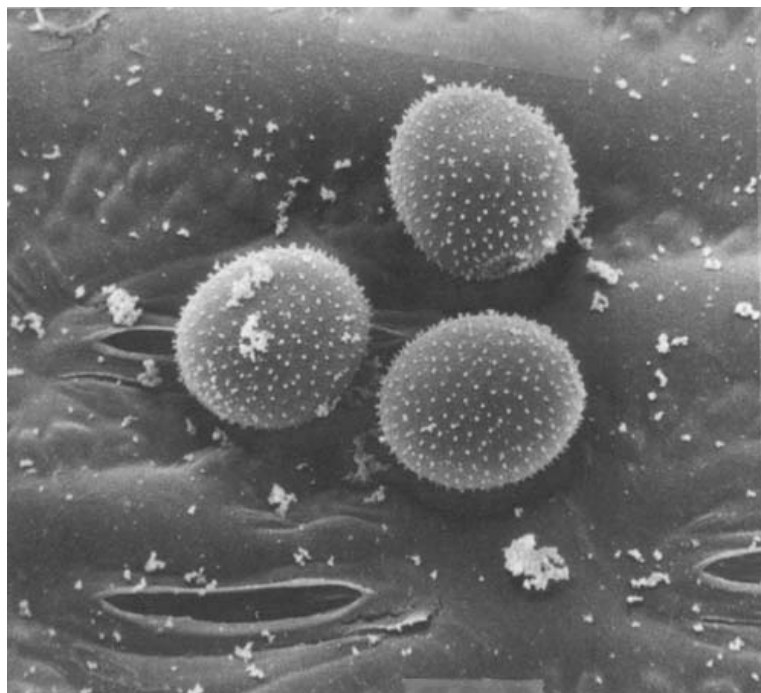
Hypha



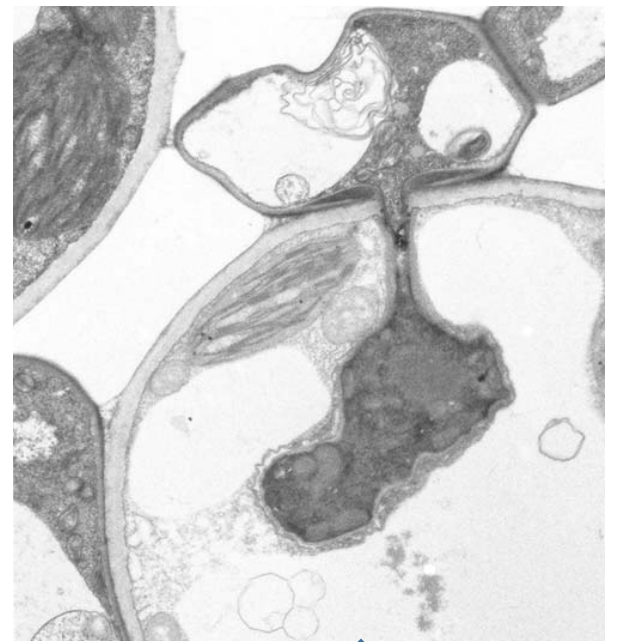
Coenocytic hypha



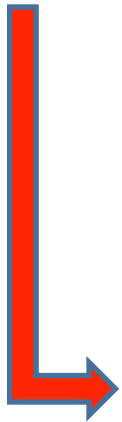
Septate hypha



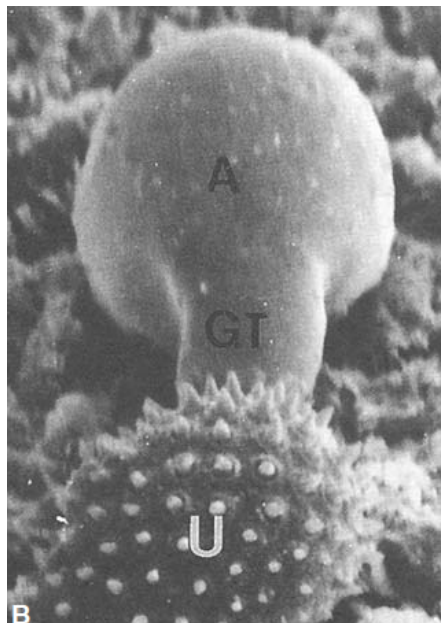
Spore near stomata



Penetration peg on appressorium



Appressorium emerging



# FUNGAL REPRODUCTION

- Vegetative-Propagation from somatic parts
- Asexual-reproduction through production of spores without fusion of hyphae or gametes
- Sexual-reproduction through fusion of gametes, gametangia or hyphae

# FUNGAL TAXONOMY

Domain *Eukaryote* – *Eukaryotic*

Kingdom *Fungi*

Phylum(Division) *Basidiomycota*

Class *Basidiomycetes*

Order *Uredinales*

Family *Pucciniaceae*

Genus *Puccinia*

Species ***Puccinia graminis***

# CLASSIFICATION OF FUNGI

The classification of fungi is generally based on the following criteria:

- ✓ Morphology of reproductive structures and/or spores
- ✓ Types of spores formed (sexual or asexual)
- ✓ Characteristics of the life cycle
- ✓ Morphology of the thallus (mycelia)
- ✓ DNA patterns: similarity/differences from known groups

# MAJOR CLASSES OF PLANT PATHOGENIC FUNGI

1. Oomycetes-aseptate fungus-like organisms characterised by production of sexual spores called oospores
2. Ascomycetes-sexually and asexually reproducing fungi with varying morphological features. Sexually reproducing ones characterised by production of ascospores.
3. Basidiomycetes-mostly smuts and rusts, characterised by production of sexual spores called basidiospores (typically 4) on a basidium.
4. Zygomycetes (old name)-sexually and asexually reproducing fungi with varying morphological features and coenocytic hyphae. Sexually reproducing ones characterised by production of zygospores

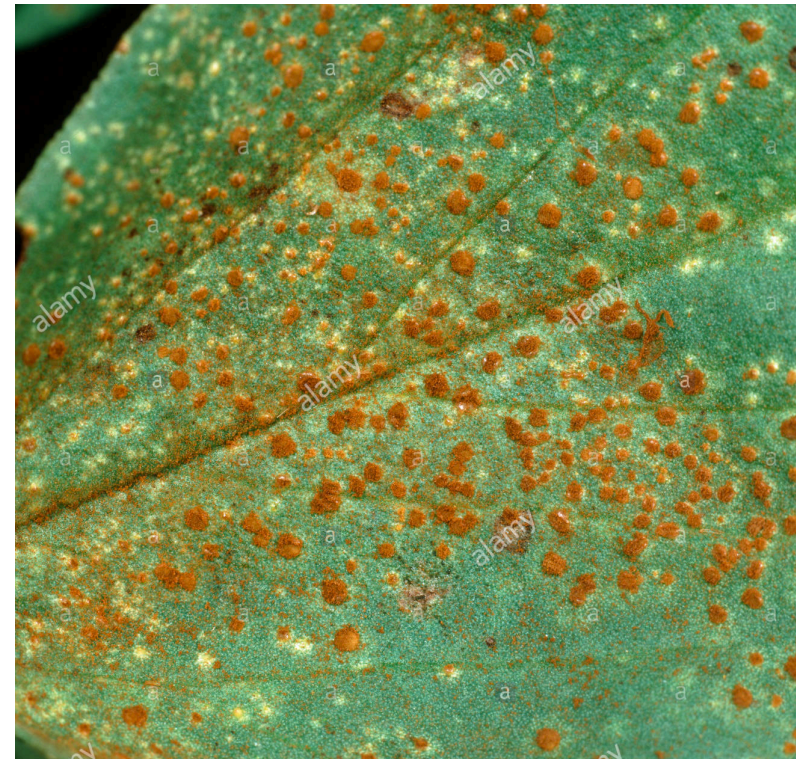
# EXAMPLES

1. Oomycetes-*Phytophthora infestans* causing late blight of tomato and Irish potatoes. (Another example is *Pythium spp*, causing several root rots)
2. Ascomycetes-*Colletotrichum lindemuthianum* causing bean anthracnose disease
3. Basidiomycetes-Smutts and rusts - *Ustilago maydis* causing maize smut disease and *Uromyces appendiculatus* causing bean rust
4. Zygomycetes-*Rhizopus stolonifer* causing soft rot of sweet potato during storage, packaging and sale.

# Basidiomycetes

Corn/maize smut

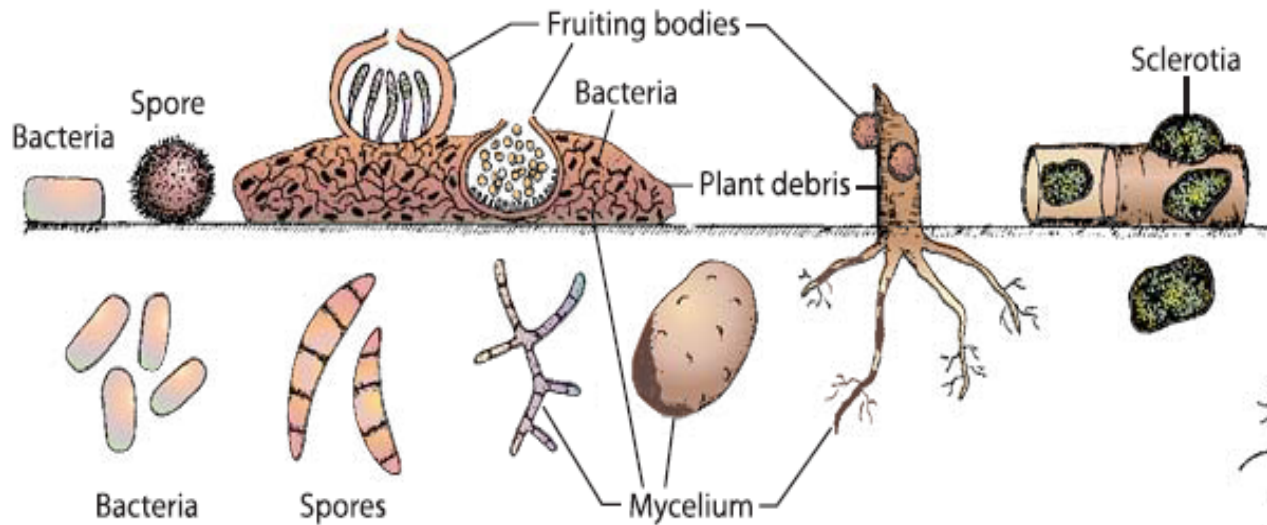
Bean rust



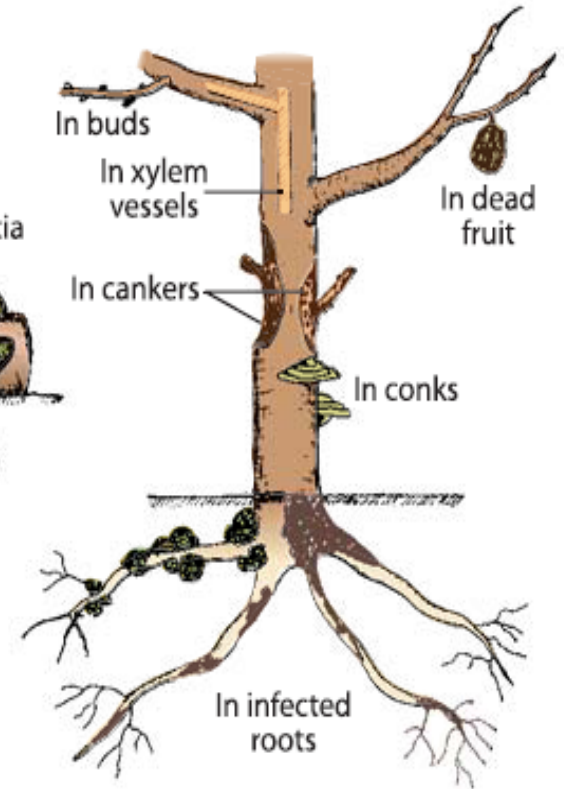
*Ustilago maydis*

*Uromyces  
appendiculatus*

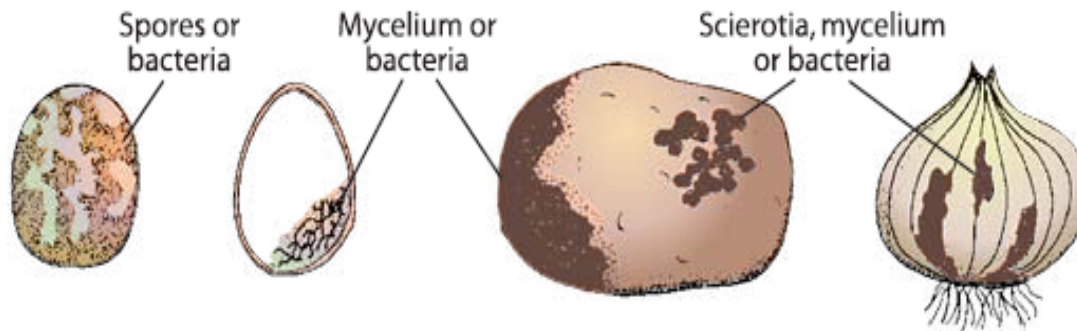
# FUNGAL/PATHOGEN SURVIVAL



**On or in soil**



**On perennial plants**



**On or in seed**

**On or in vegetative propagative organs**



**On or in insects**

**FIGURE 2-21** Forms and locations of survival of fungi and bacteria between crops.

# FUNGAL/PATHOGEN DISSEMINATION

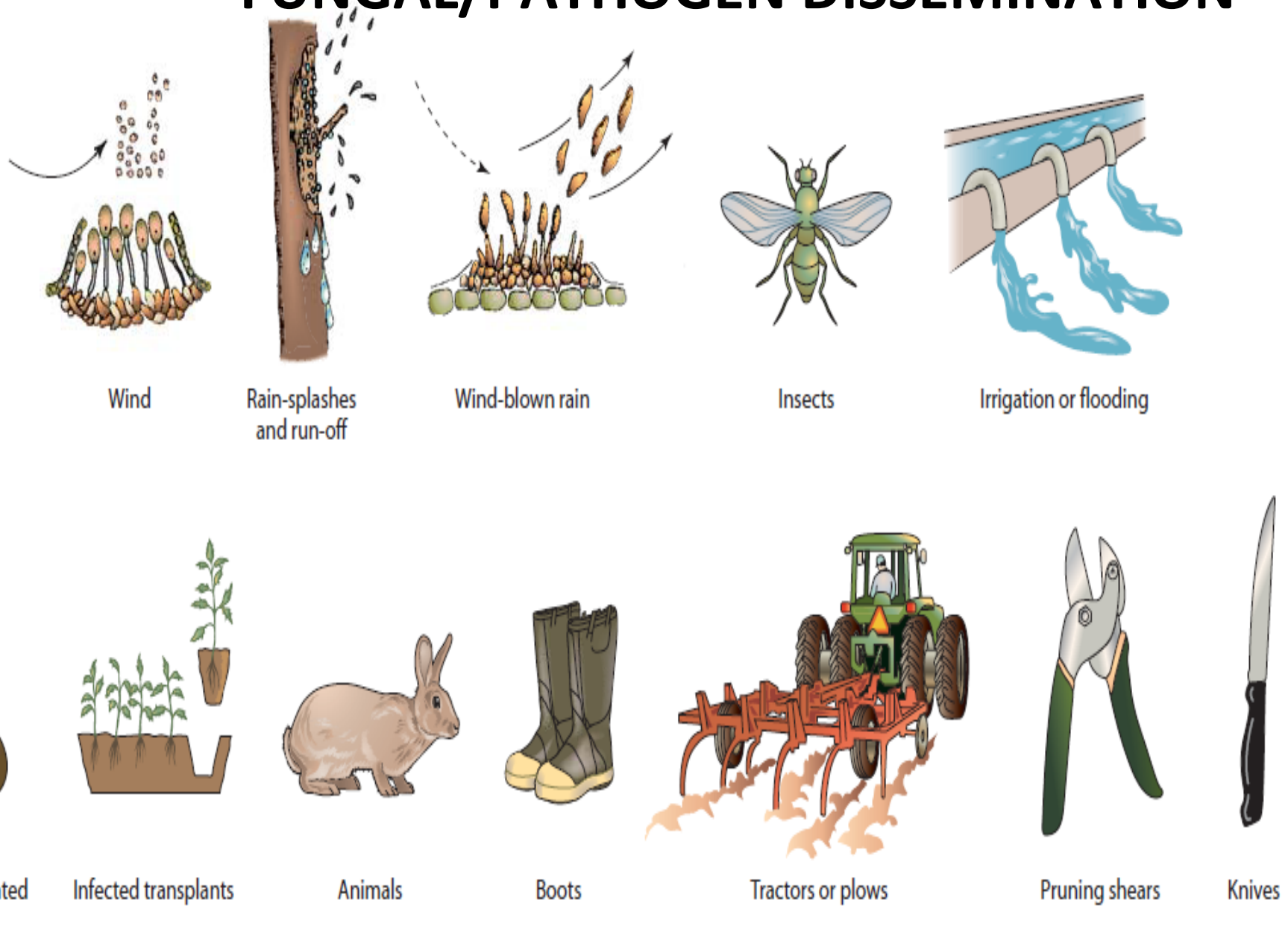


FIGURE 2-15 Means of dissemination of fungi and bacteria.

# CONTROL OF FUNGAL PATHOGENS

Choice of most effective means of control of a fungus disease depends on detailed knowledge of the crop and the pathogen and a consideration of the economic factors.

# CONTROL OF FUNGAL PATHOGENS CONT...

**Exclusion**- Plant quarantine, port inspection, restriction of movement, certification.

**Eradication**- destruction of alternative hosts, roguing, excision of infected parts, and other sanitary measures, rotation, sterilization or disinfection

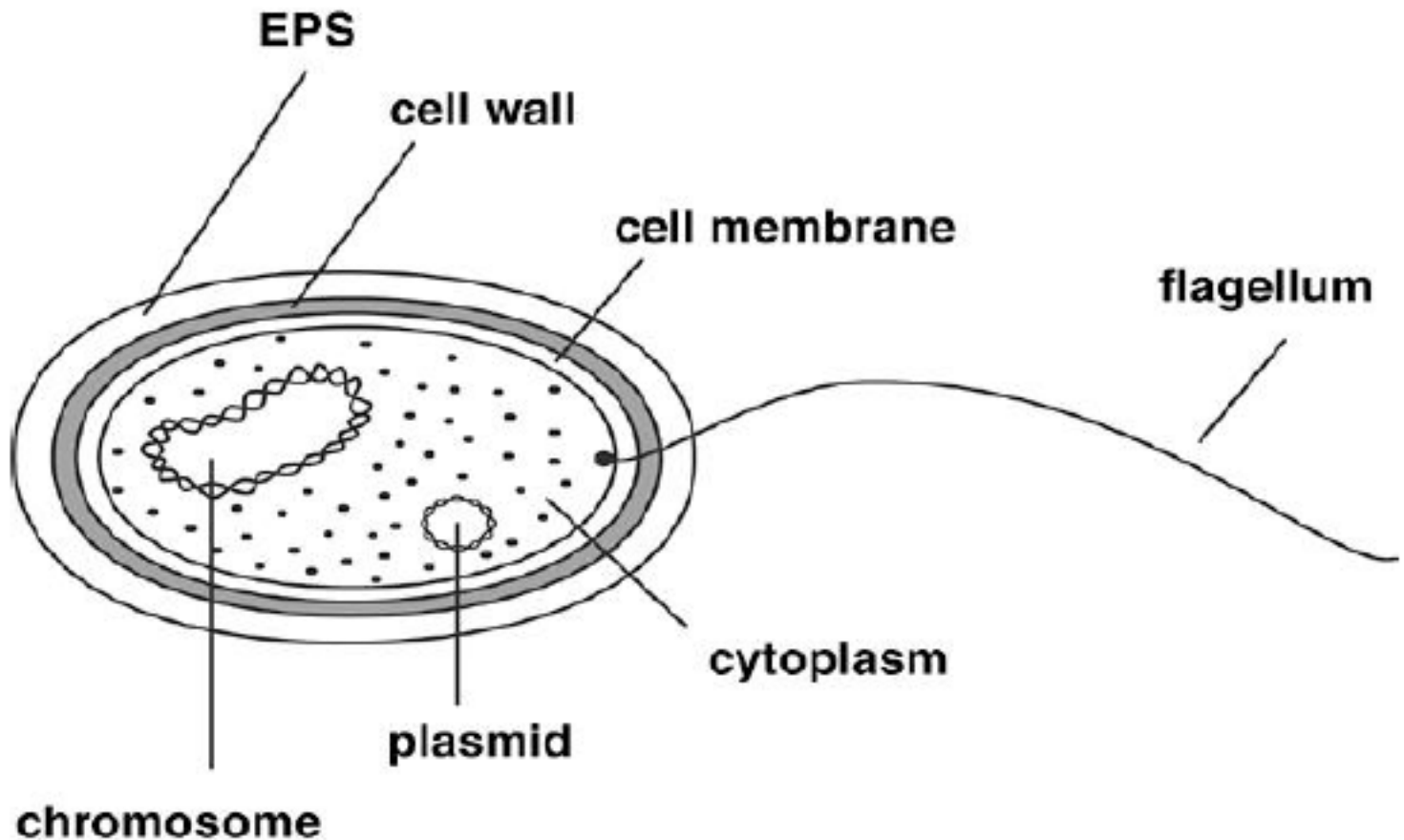
**Protective measures**- spraying or dusting plants exposed to disease outbreaks, seed treatment, treatment of stored products

**Cultural measures**- timing of planting and harvest, modification of soil conditions

**Plant Resistant cultivars**

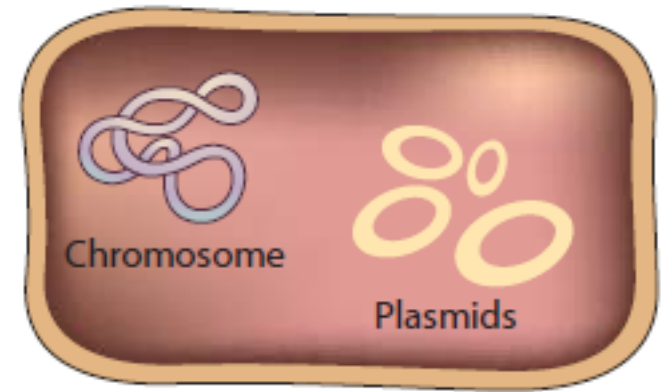
# WHAT ARE BACTERIA?

Microscopic prokaryotes with a cell membrane, rigid cell wall and one or more flagella

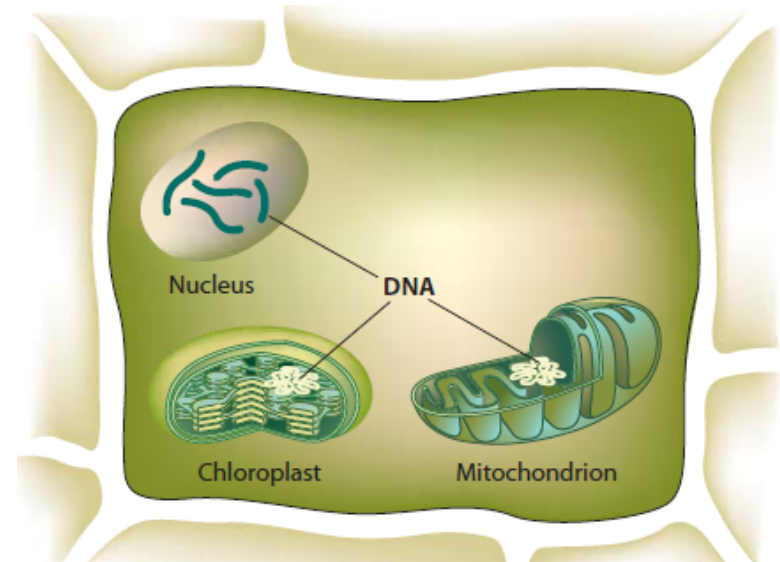


## Bacteria

- prokaryotic
- single-celled
- Genetic material single stranded.
- No true nucleus
- Some have plasmids (small gene carrying entities)



↓ Unlike



# Plant Pathogenic Bacteria cont...

- Some have Flagella

e.g *Pseudomonas sp*

- monotrichous



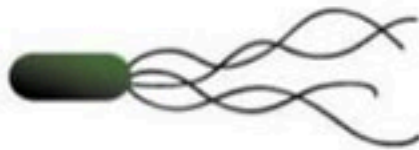
e.g *Erwinia sp*

- peritrichous

# Types of Flagellar Arrangement



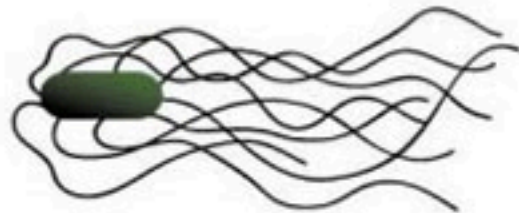
**Polar/ Monotrichous** – single flagellum at one pole



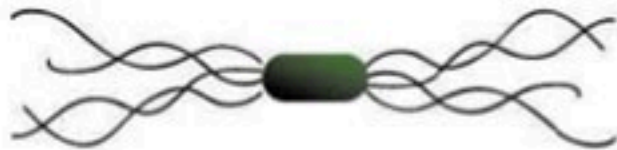
**Lophotrichous** – tuft of flagella at one pole



**Amphitrichous** – flagella at both poles



**Peritrichous** – flagella all over



**Amphilophotrichous** – tuft of flagella at both ends

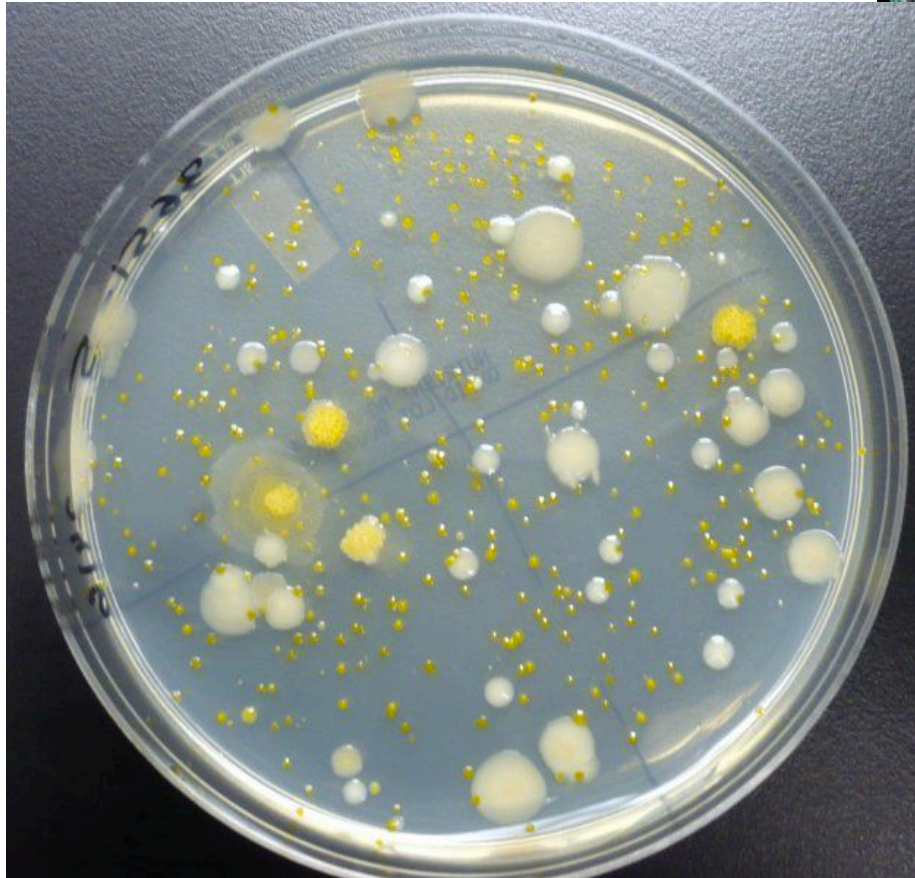
# Bacteria vs Fungi – Colony morphology

Fungal colonies

Bacterial colonies



# Bacteria vs Fungi – Colony morphology

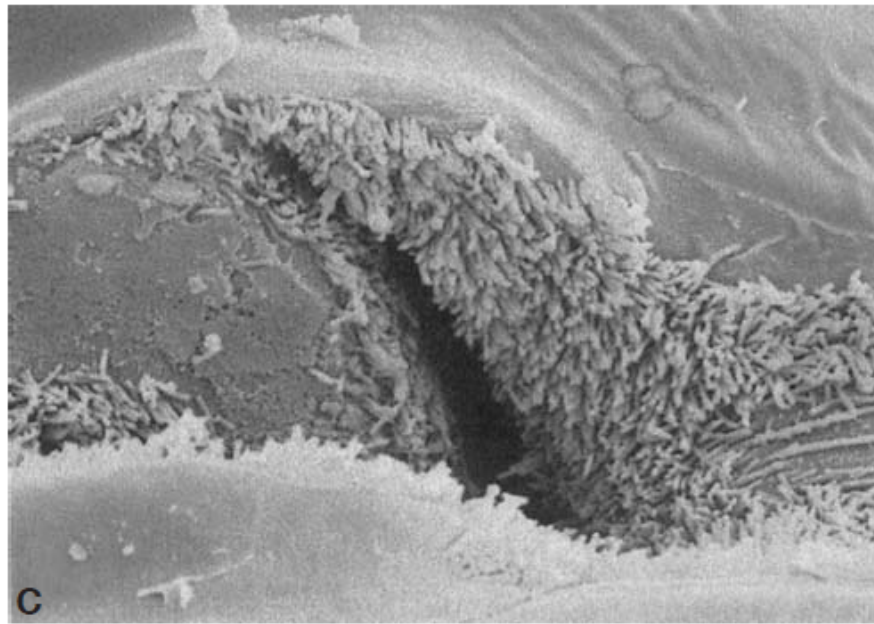
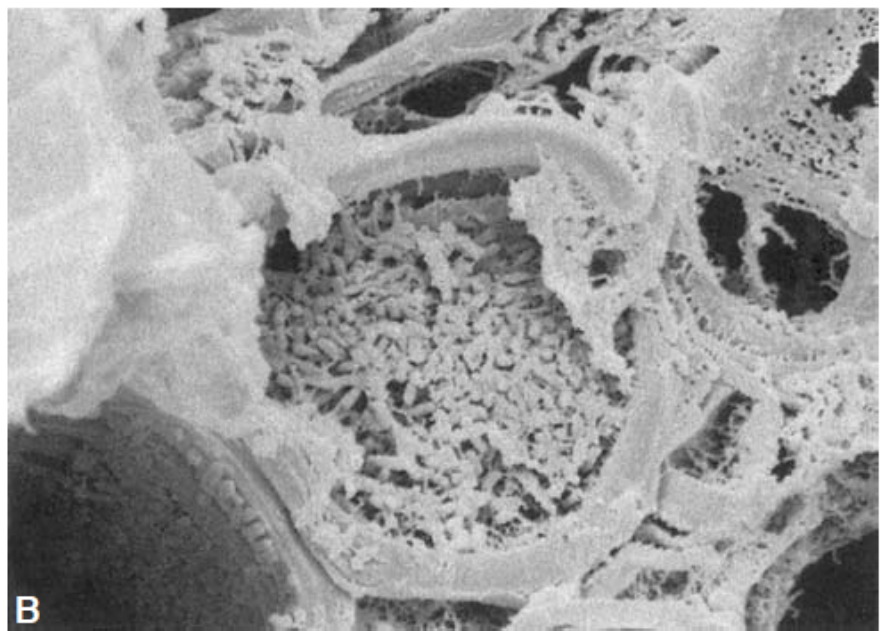
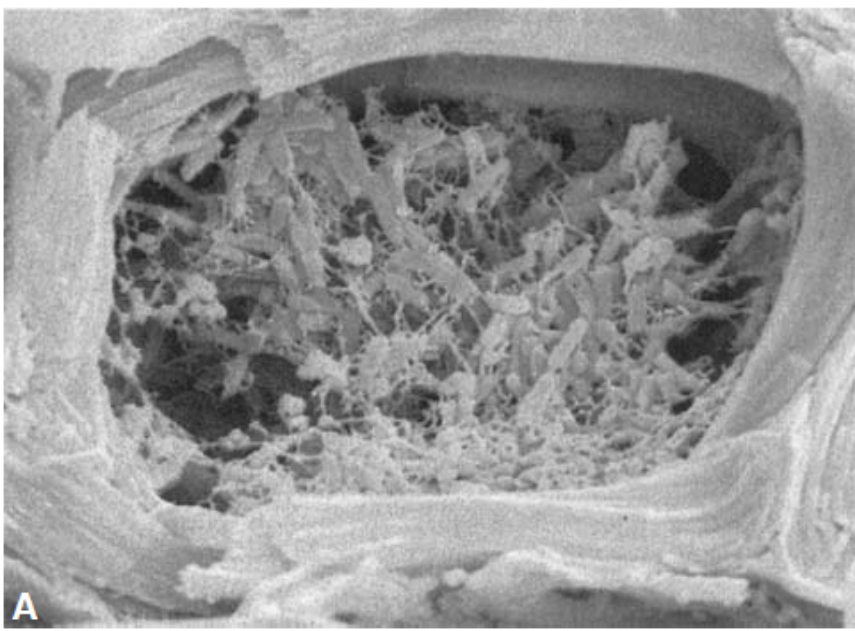


# Survival, Dissemination & infection of Bacteria

- Knowledge on this is crucial for mgt of bacterial diseases:
  - ✓ Survive in the plant, on the surface, in debris or in the soil as saprophytes.
  - ✓ Survive on inanimate surfaces, in water, inside insects
  - ✓ Transmission: Air, insects, water, soil movement, humans, swimming (flagella).

# Survival, Dissemination & infection cont..

- Wounds facilitate infection
  - ✓ (weeding, irrigation, pruning)
- Once inside:
  - Enzymes that degrade cell walls
  - Growth regulators that alter the plants normal growth, toxins that degrade cell membranes and
  - Complex sugars that plug water conducting tissue.



**FIGURE 12-47** (A) *Xylella* bacteria exhibiting numerous thread-like connections in xylem vessel of coffee plant. (B) *Xylella* bacteria clogging a xylem vessel of a grape leaf. (C) *Xylella* bacteria in a tissue of its sharpshooter insect vector. Photos courtesy E. Alves, Federal Univ. Lavras, Brazil

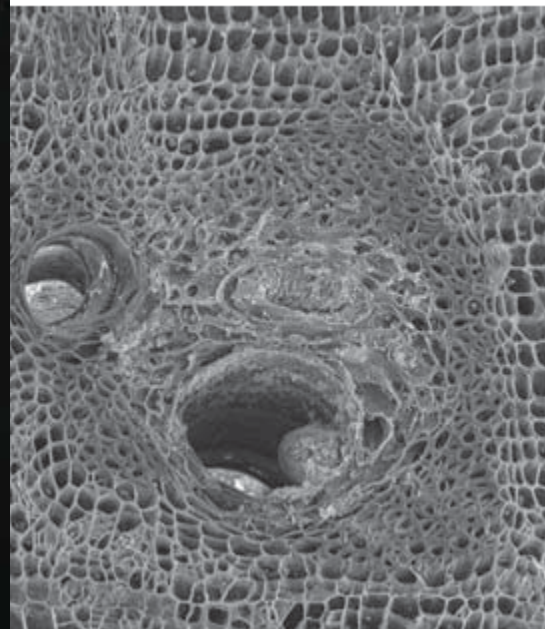
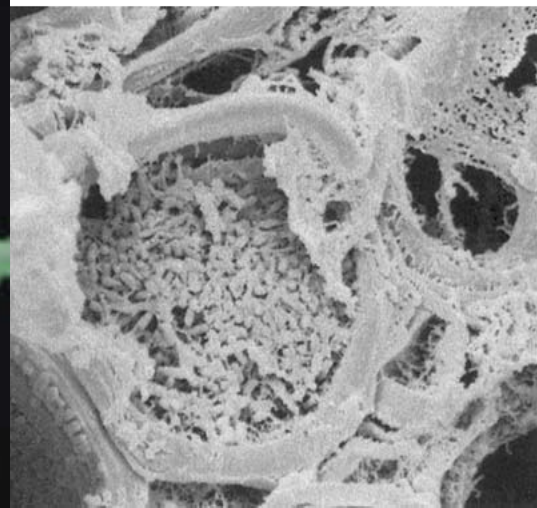
# Diagnostics Symptoms of Bacterial Infections

- Leaf spots (with yellow hallow....vs fungi?)
- Rots (wet.....vs fungi?)
- Blights
- Wilts
- Scabs
- Cankers and soft rots of roots, storage organs and fruit
- Overgrowth/galls

# Diagnosics Symptoms of Bacterial Infections



Wilting & discoloration of vascular tissue



Bacterial wilt of cucurbits caused by *Erwinia tracheiphila*.



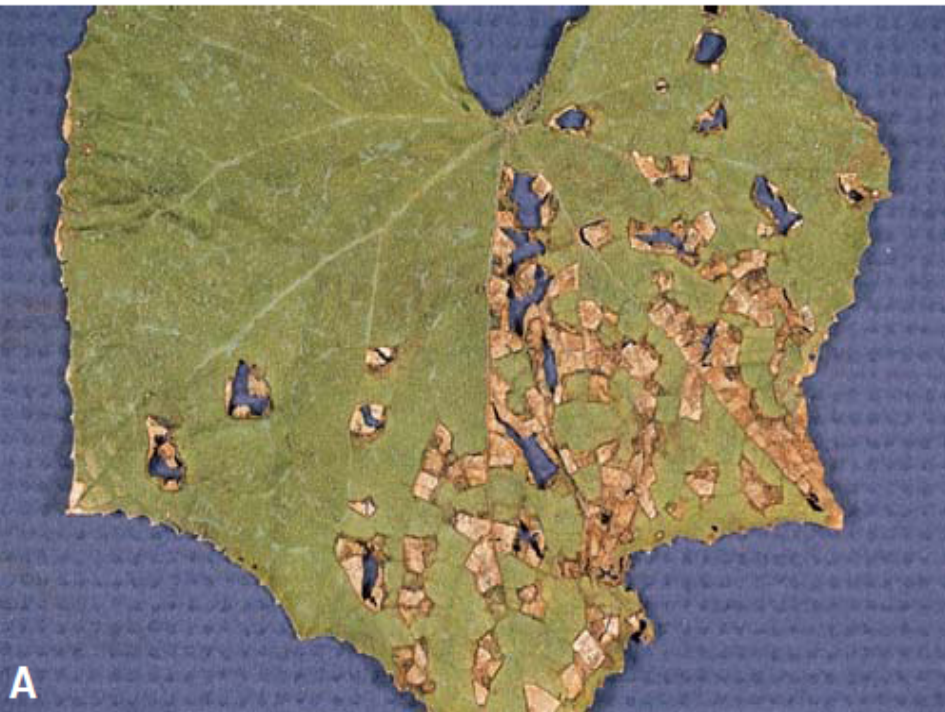
**Halo surrounding lesion/leaf spot on leaf of plant-fungi usually no yellow hallow**



Bean common blight  
caused by the  
bacterium  
*Xanthomonas*  
*phaseoli*

Bean halo blight  
caused by bacterium  
*Pseudomonas*  
*phaseolicola*.





**Angular leaf spots** on cucumber leaf (A) and small **circular spots** with halo on cucumber fruit (B) caused by the bacterium *Pseudomonas lacrymans*.



Angular spots and necrotic veins on cotton leaves (A) and sunken circular spots on cotton bolls (B) caused by the cotton blight bacterium *Xanthomonas campestris* pv. *malvacearum*.

Bacterial spot  
on tomato

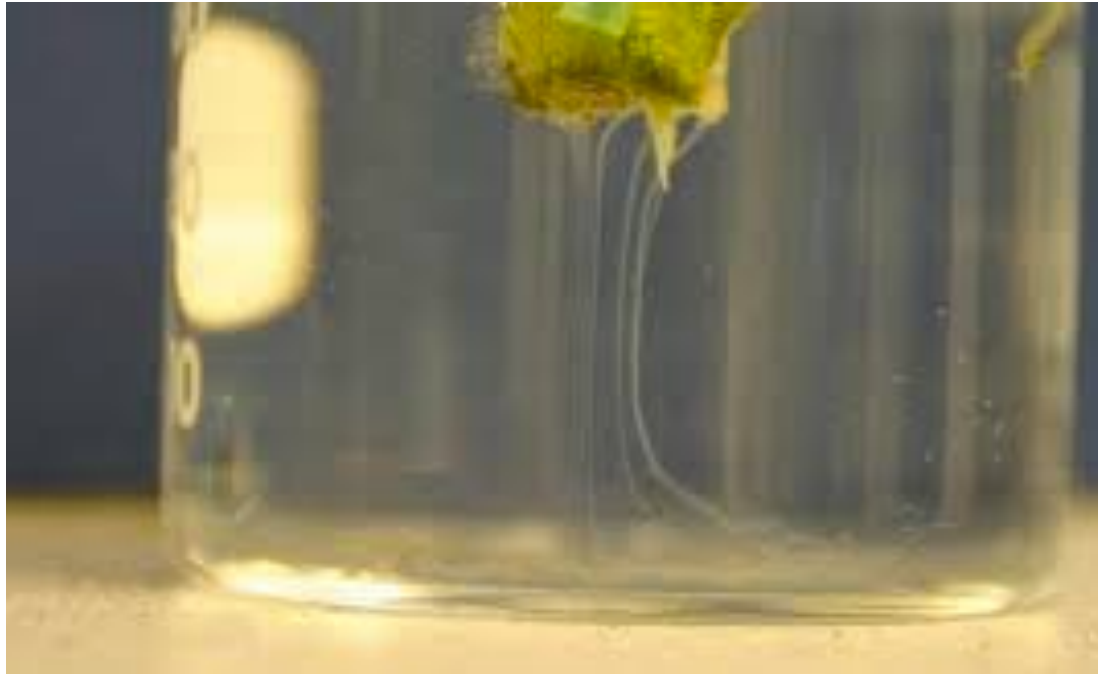
caused by  
*Xanthomonas*  
*campestris* pv.  
*vesicatoria*.



Bacterial speck  
on tomato  
caused by  
*Pseudomonas*  
*syringae* pv.  
*tomato*.



# OOZE TEST FOR BACTERIA



# MANAGEMENT OF BACTERIAL DISEASES

## 1. Genetic host resistance

- ✓ resistant varieties (most important control measure)

## 2. Cultural Practices

- ✓ Bacteria-free planting material
- ✓ Sanitation (tools)
- ✓ Crop rotation
- ✓ Prevent surface wounding

# MANAGEMENT OF BACTERIAL DISEASES cont...

## 3. Chemical applications

- ✓ copper-containing compounds or Bordeaux mixture (copper sulfate and lime)
  
- ✓ Antibiotics
  - Streptomycin and/or oxytetracycline (prior to infection)
  
  - Tetracycline
  
- ✓ Applications to be made in the early stages of infection
  
- ✓ Eliminate vectors or reduce feeding wounds that can provide points of entry.

# MANAGEMENT OF BACTERIAL DISEASES cont...

## 4. Biological control

- ✓ Antagonistic or biological control products

## 5. Exclusion

- ✓ Strict quarantine that exclude or restrict the introduction or movement of pathogens or infected plant material.