
# Plant Pathology For Master Gardeners

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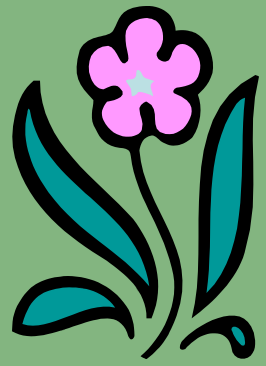
University of California

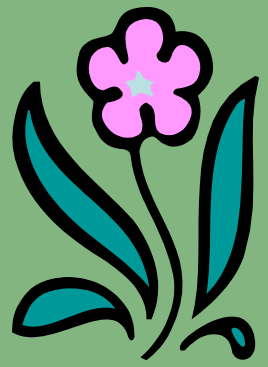
# Learning Objectives



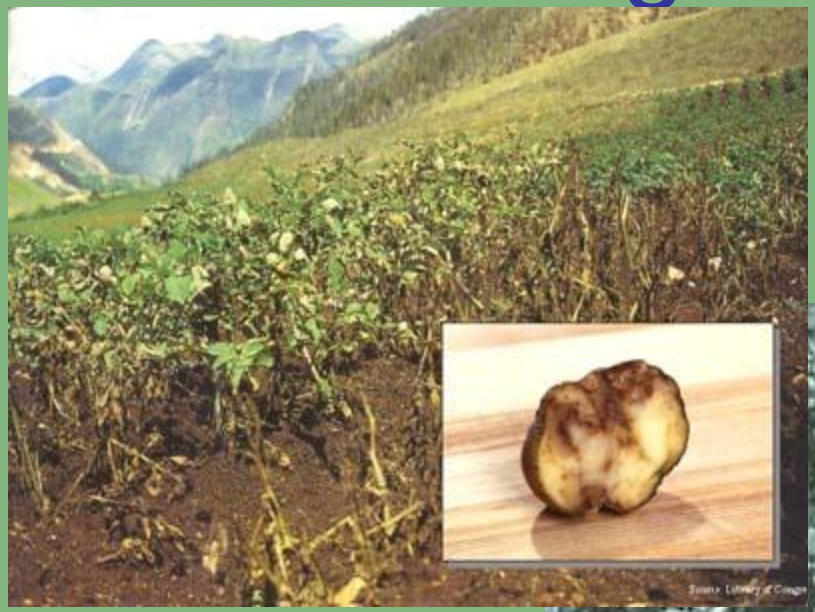
- Understand basic plant disease concepts and some of the terminology
- Learn about the major types of pathogens and environmental factors that contribute to disease
- Understand the disease triangle
- Process of diagnosis of plant disease
- Understand strategies for managing plant diseases

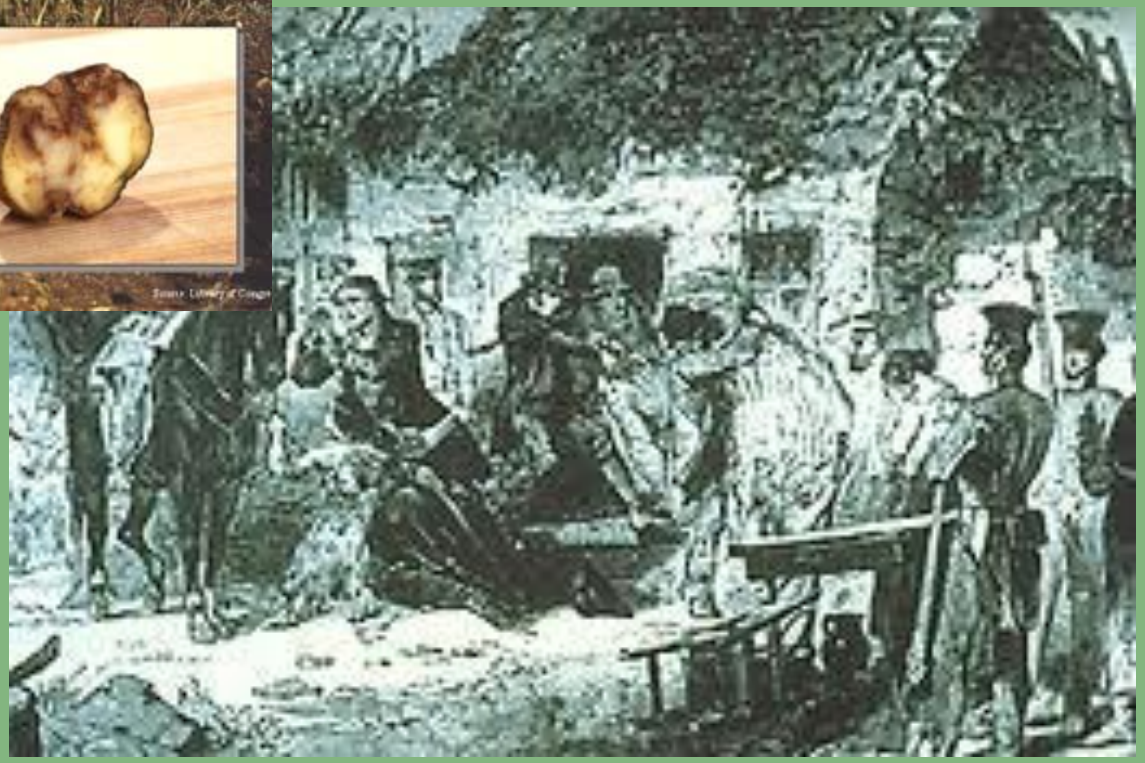
# What is Plant Pathology?

- The study of plant disease—phytopathology
- From the greek (not the geek)
  - *phyton* meaning plant
  - *pathos* meaning disease
  - *logos* meaning study

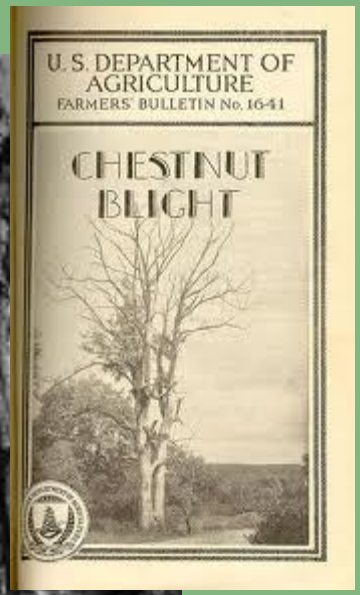


# Phytophora Infestans-Late Blight of Potato





# Chestnut blight-**Cryphonectria parasitica** (formerly *Endothia parasitica*



# Bengal Famine of 1943 Caused by Brown Spot Disease of Rice

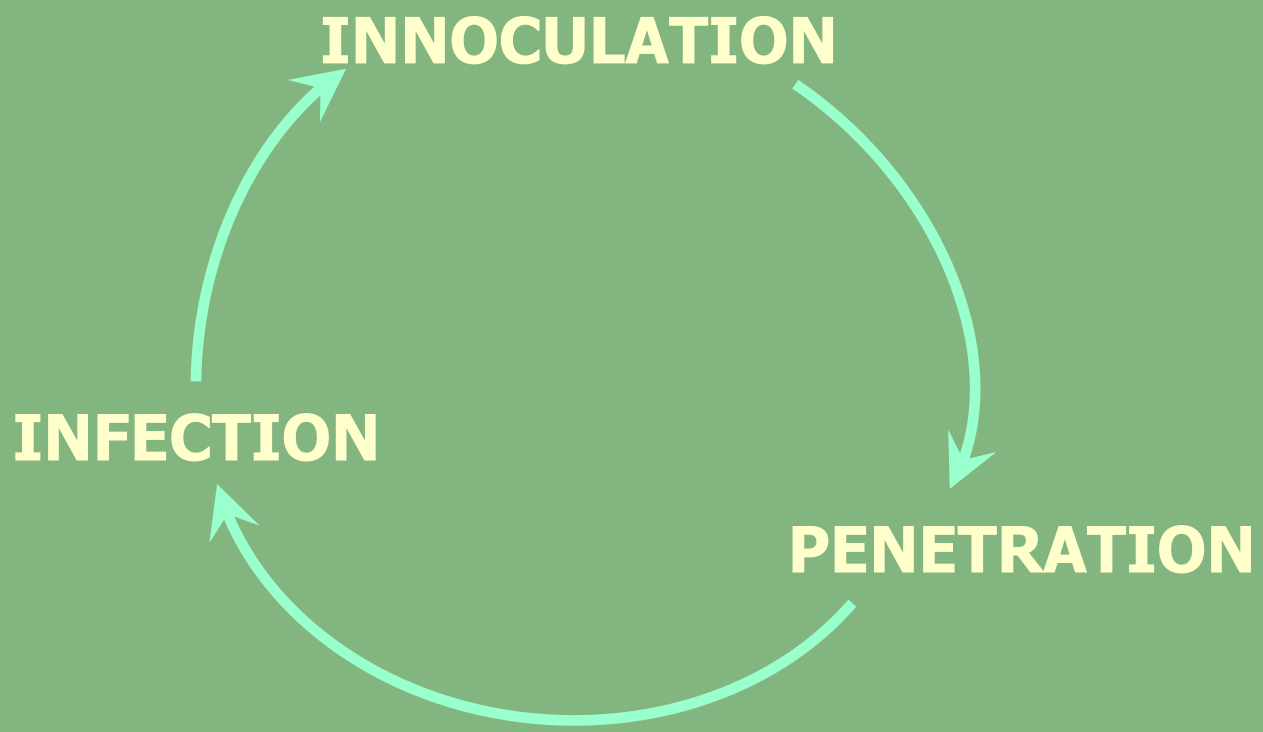
# What is Plant Disease?

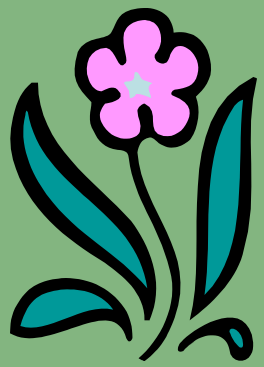
- **Malfunctioning** of host cells and tissues resulting from **continuous interaction** by a **pathogen** or **environmental factor** and leading to development of **symptoms**

***Agrios, 1997***

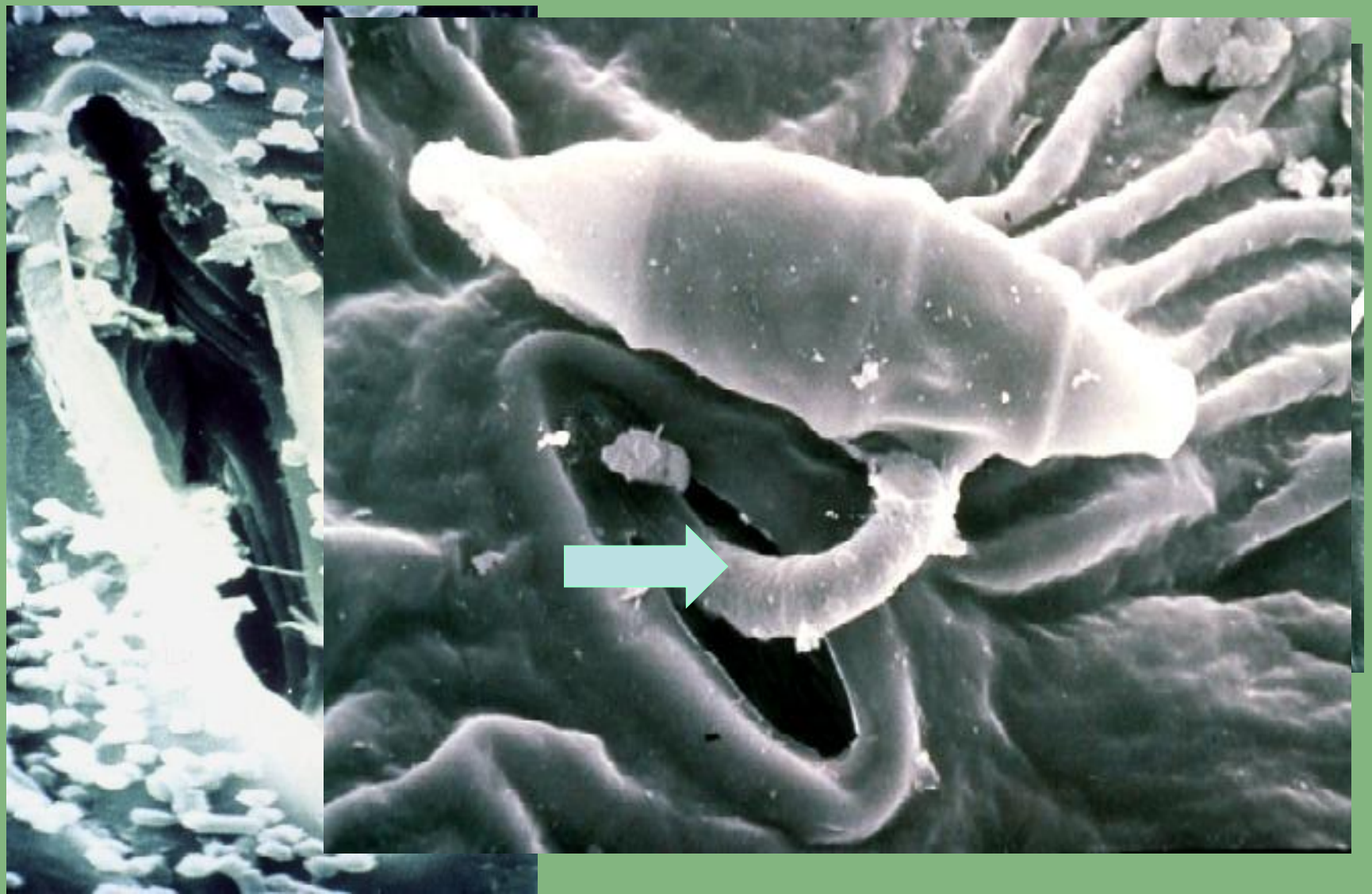
# Basic Concepts and Principles of Infectious Plant Disease

- How and When Infectious Disease Develops…the Disease Cycle



# Basic Concepts and Principles of Infectious Plant Disease



# TERMS

**Inoculum:** the pathogen or its parts that can cause disease

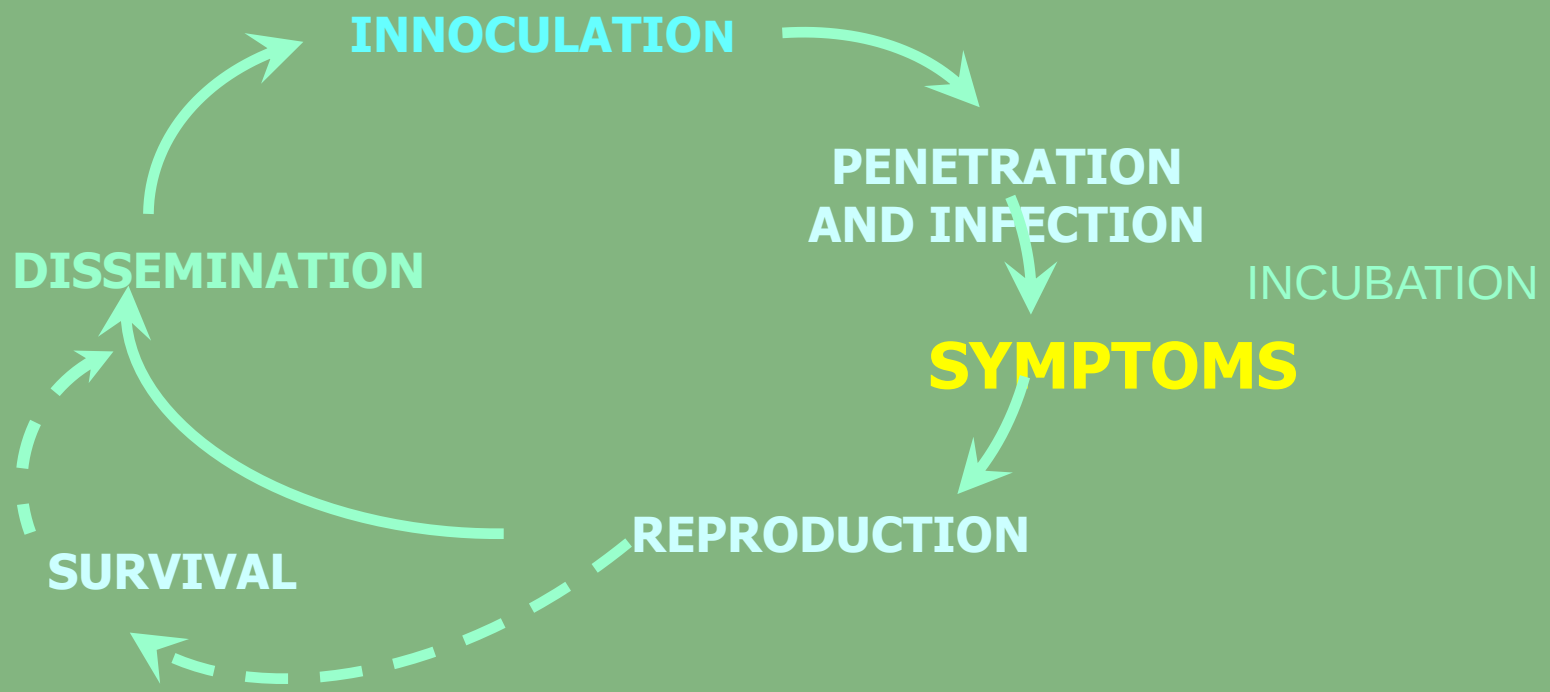
**Inoculum potential:** how much inoculum is available

**Inoculum source:** where the inoculum comes from

**Inoculation:** inoculum in contact with host

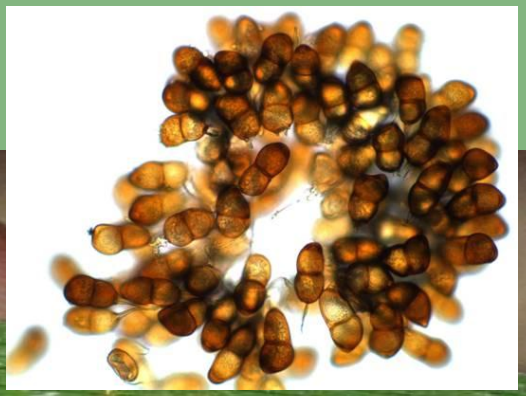
# Basic Concepts and Principles of Infectious Plant Disease

- How and When Infectious Disease Develops…the Disease Cycle



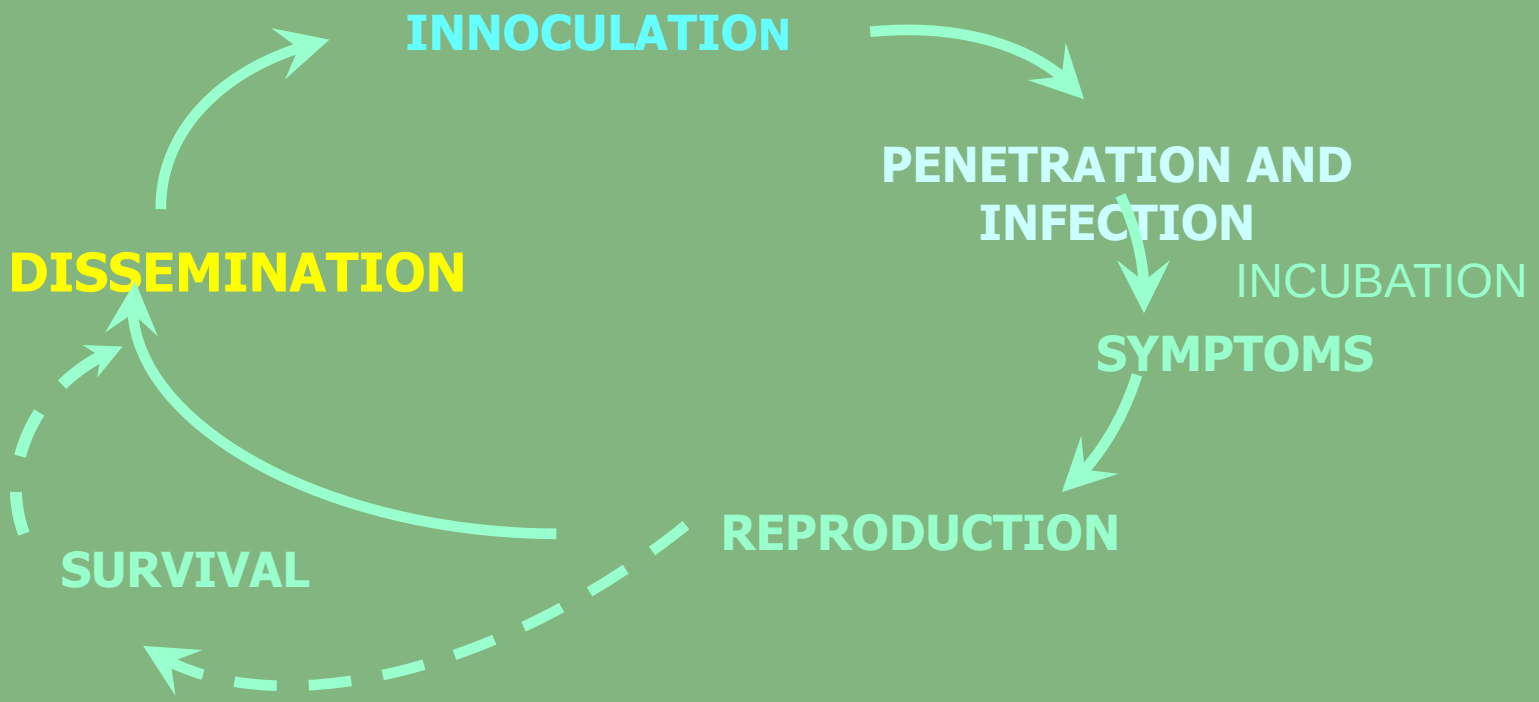
# Some terms:

- **Symptom: plant response**
- **Sign: pathogen**



# Basic Concepts and Principles of Infectious Plant Disease

- How and When Infectious Disease Develops…the Disease Cycle

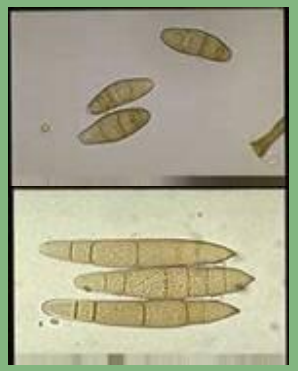


# Dispersal or Dissemination

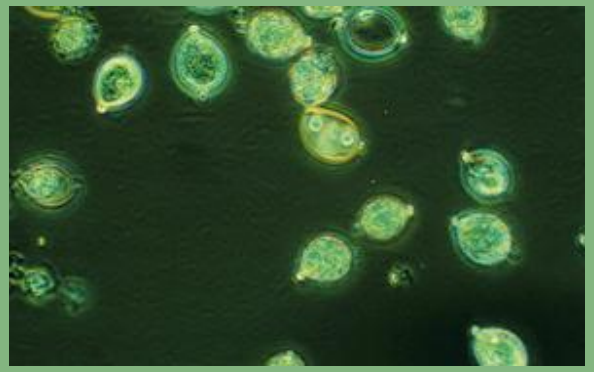
# Types of propagules or spores

Mycelia

Conidia (spores)



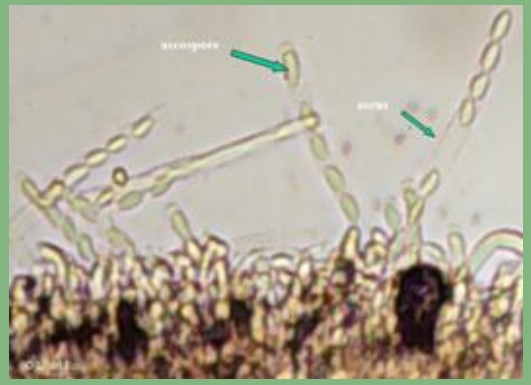
Zoospores



Oospores


Sclerotium

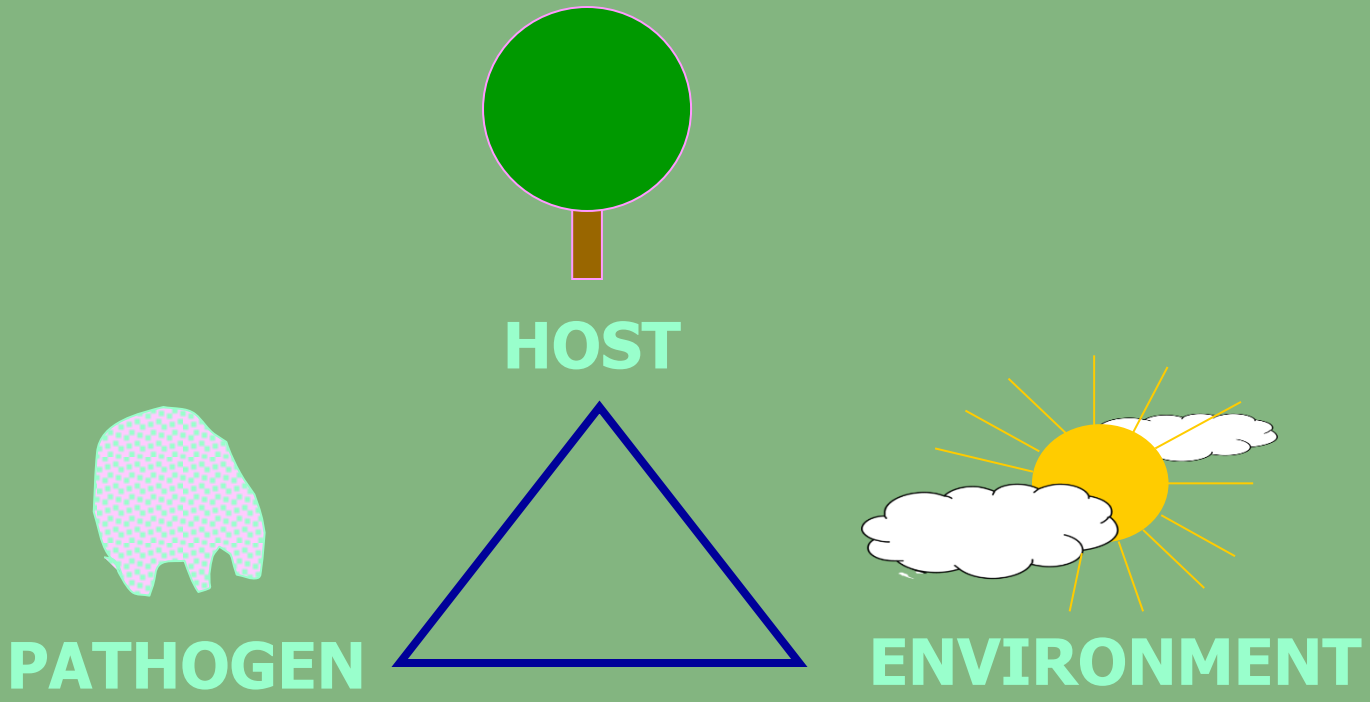
Apothecia



Ascospores

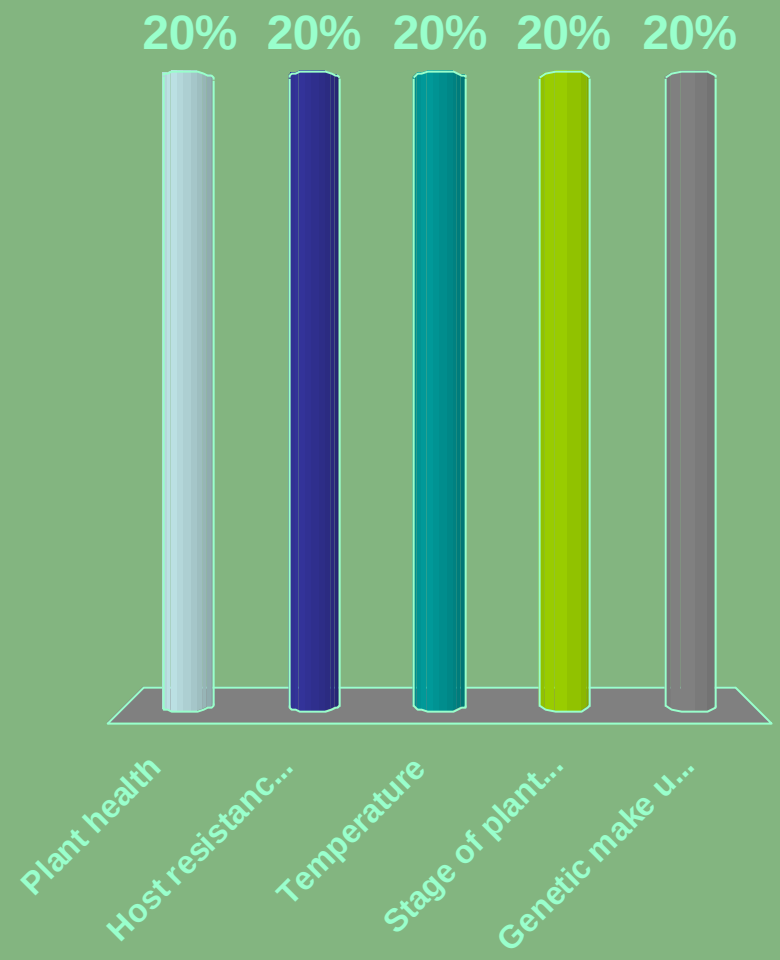
# Dispersal or Dissemination

# The Infectious Disease Triangle



# Which of the following is not a host factor in plant disease?

1. Plant health
2. Host resistance
3. Temperature
4. Stage of plant growth
5. Genetic make up of the plant



# How do you determine what is most likely causal organism? (bacteria, fungi, virus)

Pathogen Symptoms

Fungi: Usually dry with a defined border. Visible hyphae, fruiting bodies, cankers

Bacteria: Slimy, smelly, wet without defined border; Oozing or frothing cankers, galls

Virus: Colored or distorted tissue

# Disease Symptoms




- Fungi - *dry, fuzzy with a defined border*
- Bacteria - *wet, slimy, no defined border*
- Virus - *mosaic color patterns*

# Relative Size of Pathogens

- Nematode
- Fungi
- Bacteria
- Virus

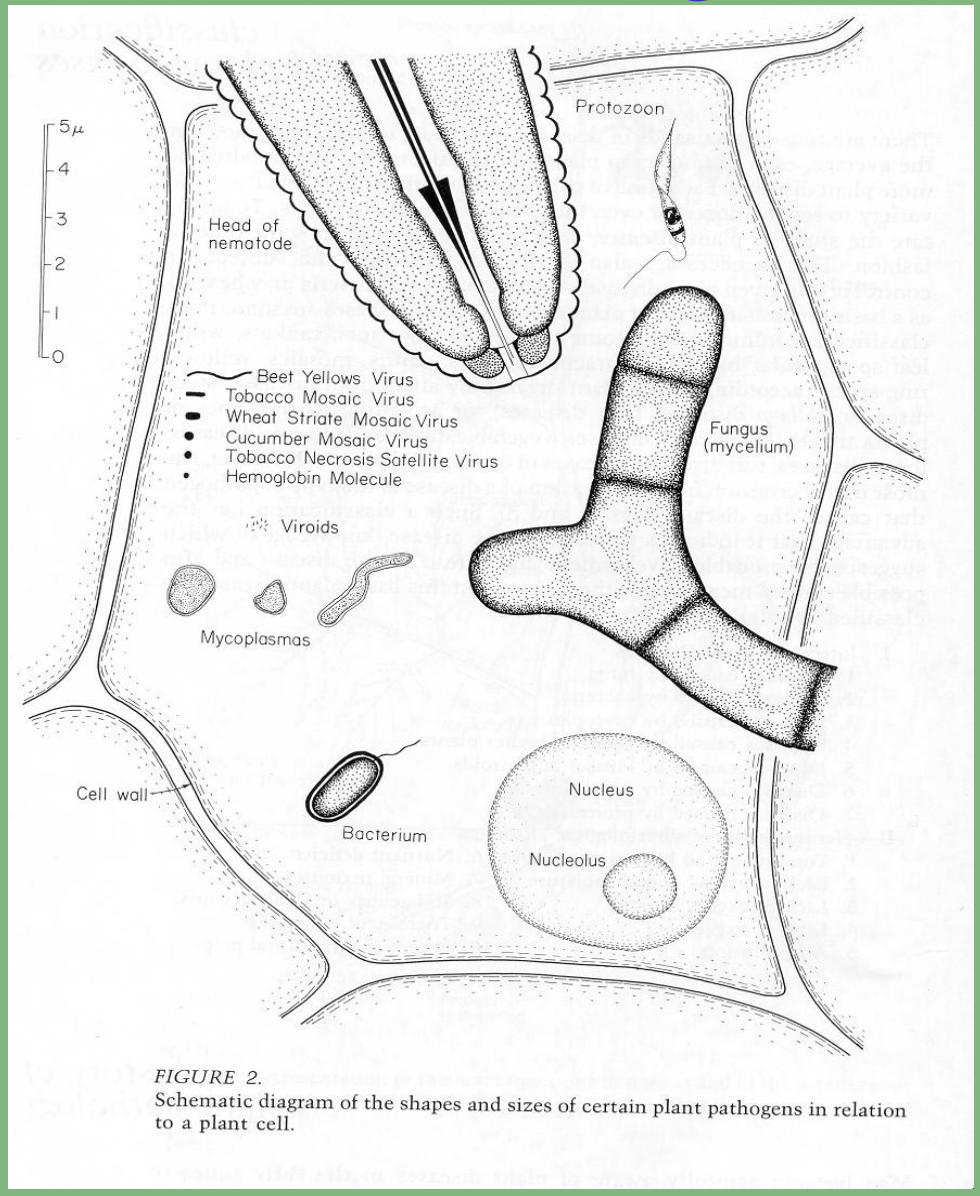
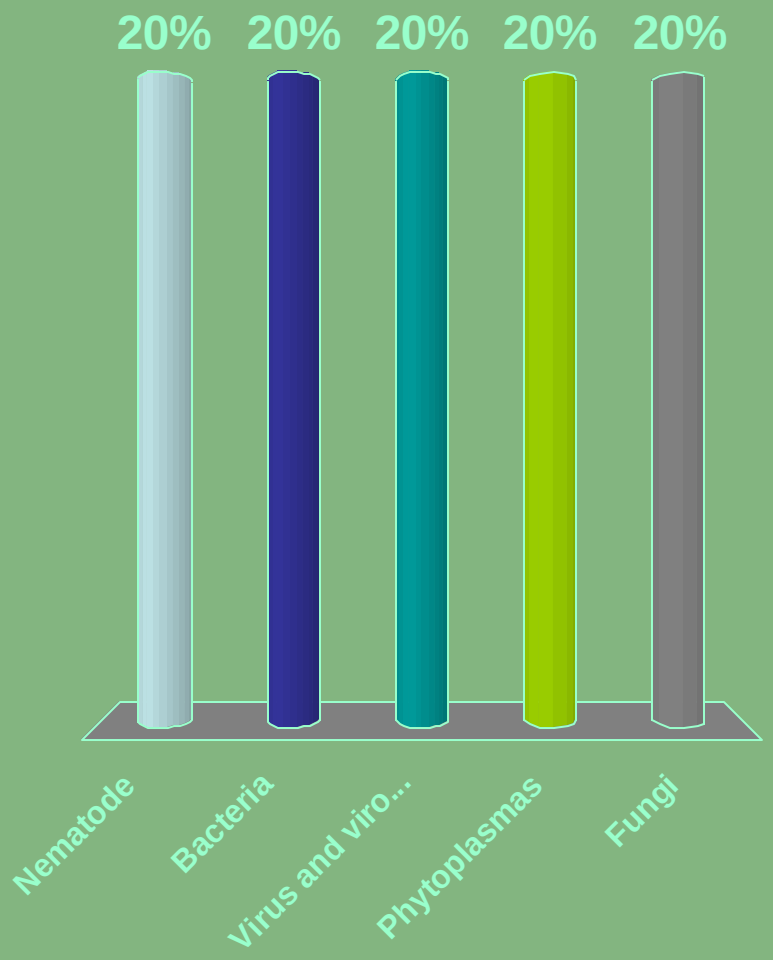



*FIGURE 2.*
Schematic diagram of the shapes and sizes of certain plant pathogens in relation to a plant cell.

# Which is largest?

1. Nematode
2. Bacteria
3. Virus and viroids
4. Phytoplasmas
5. Fungi



# Causes of Infectious Plant Disease

- Pathogens
  - Fungi
  - Bacteria
  - Phytoplasmas
  - Spiroplasmas
  - Viruses
  - Nematodes
  - Parasitic Seed Plants

Some may attack many species of plants others may only attack certain cultivars of plants.

# Fungi

- Saprophytes-beneficial
- Pathogenic fungi
  - Spread through plant via hyphae that form a network called **mycelium**
  - Reproduce through a number of structures but collectively can be called **spores**
- Common fungal disease symptoms
  - Smuts, rusts, molds, sooty mold, powdery mildew (fungal)
  - Galls, cankers, leaf spots, leaf curls, scabs, blights, soft rots and root rots. (could be fungal or bacterial)

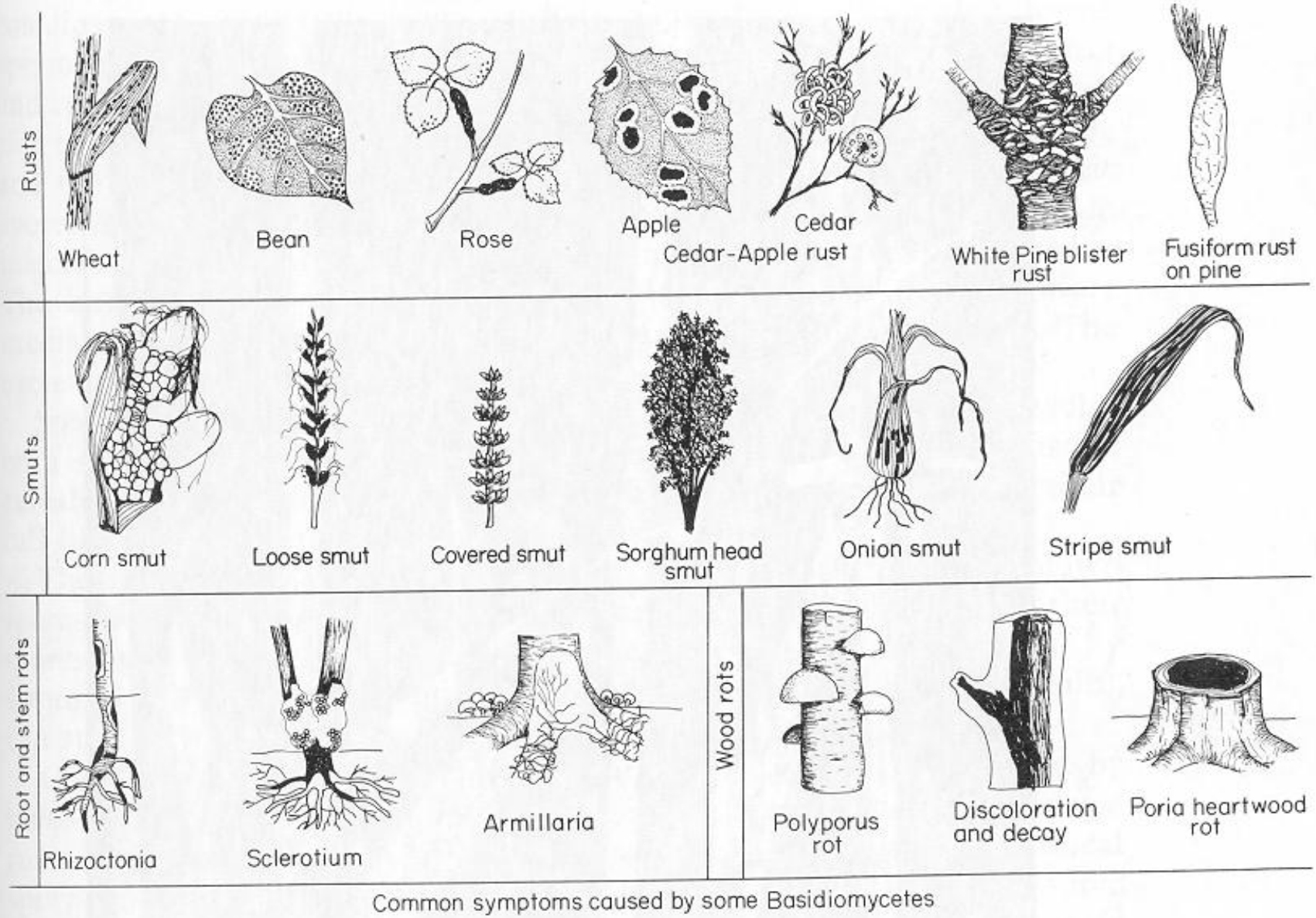
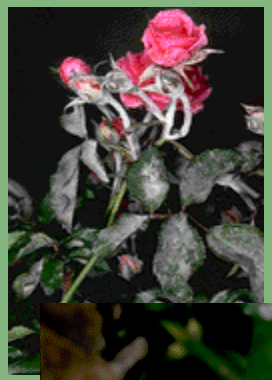



*FIGURE 120.*
Common symptoms caused by Basidiomycetes.

# Some examples: Fungi

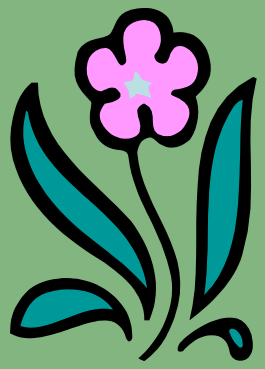




- Powdery Mildew (rose)
- Leaf Curl (peach)
- Black Spot (rose)
  - dry with defined border
  - fruiting bodies
  - cankers
  - spread by wind, rain, insects, relocation of infected plant tissue

# WHAT'S IN A NAME?

- Common name: refers to the disease
  fire blight (bacterial disease)
  Verticillium wilt
  Brown Rot
- Scientific name: refers to the pathogen
  *Erwinia amylovora*
  *Verticillium dahliae*
  *Monilinia laxa or fruiticosa*

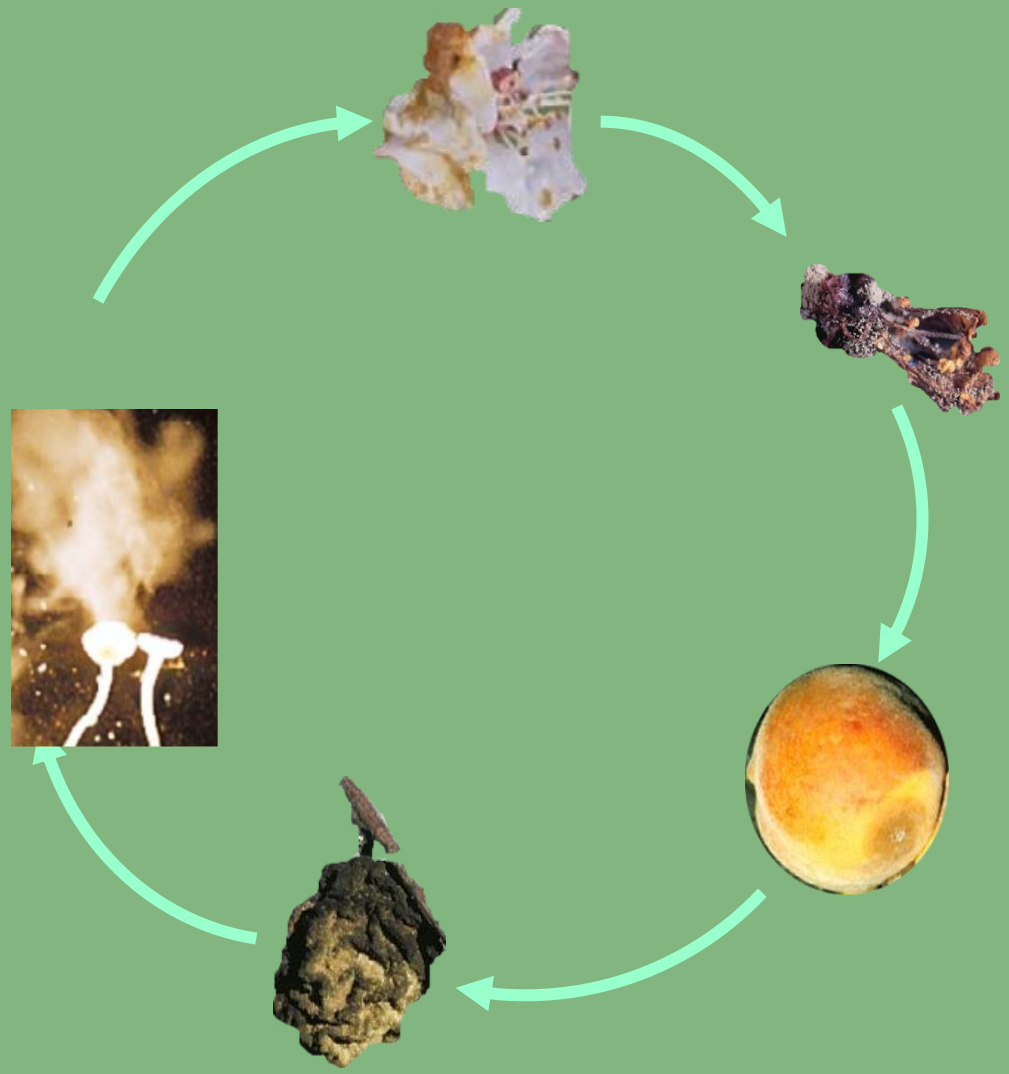


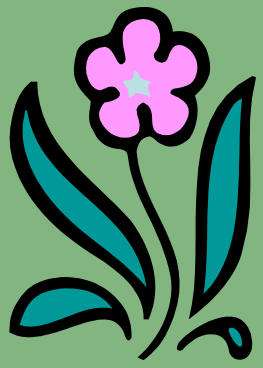
# BROWN ROT

***Monilinia laxa***

***Monilinia fructicola***

# BROWN ROT DISEASE CYCLE





# BROWN ROT

## Management

Sanitation

Nitrogen

Fungicides

# Other Fungal Diseases

Peach Leaf Curl
*Taphrina deformans*

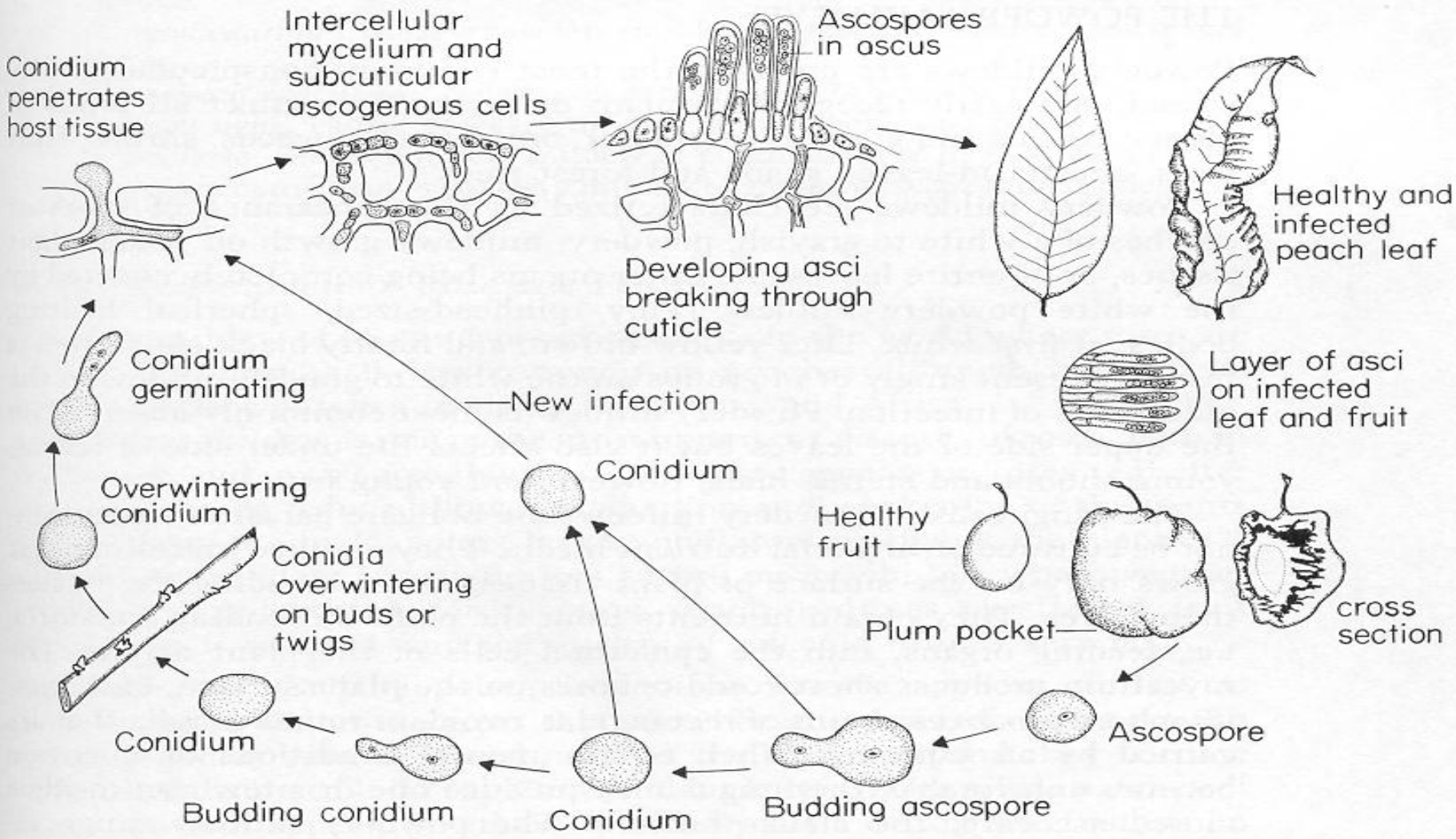



*FIGURE 71.*
Disease cycle of diseases caused by *Taphrina* sp.

# Shot Hole

# Noninfectious shothole on plum

# Iris Leaf Spot

# Snapdragon Rust

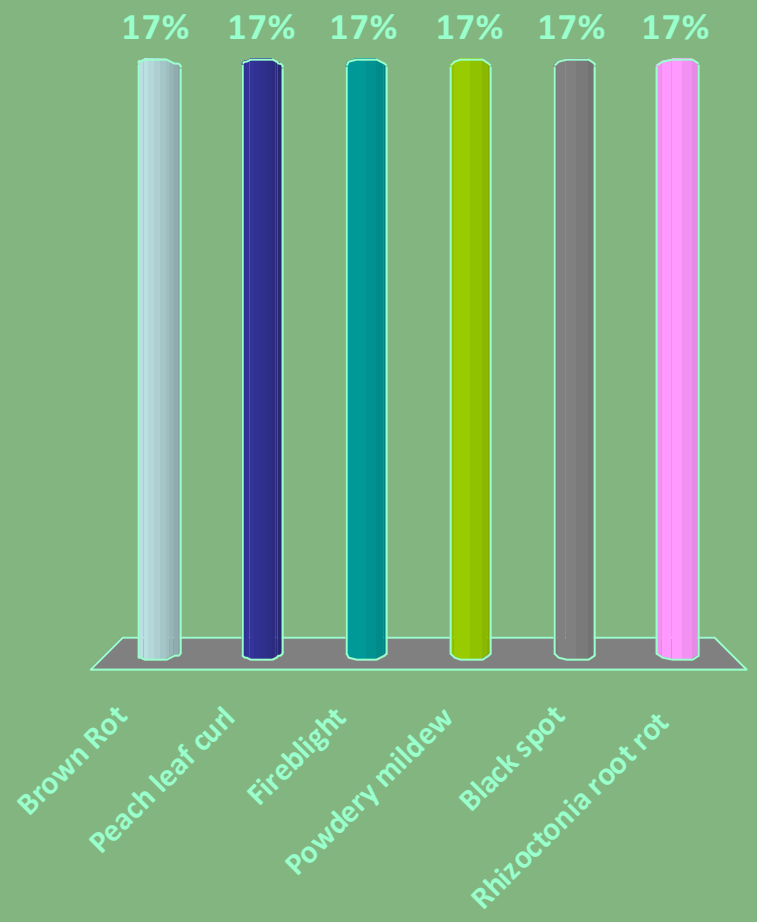
Puccinia antirrhini)

# *Sclerotinia* on Gazania

# *Rhizoctonia* on *Lisianthus* seedlings

# Which of the following are not fungal diseases?

1. Brown Rot
2. Peach leaf curl
3. Fireblight
4. Powdery mildew
5. Black spot
6. Rhizoctonia root rot



# Causes of Infectious Plant Disease

- Pathogens
  - Fungi
  - Bacteria
  - Phytoplasmas
  - Spiroplasmas
  - Viruses
  - Nematodes
  - Parasitic Seed Plants

Microscopic, single celled prokaryotes

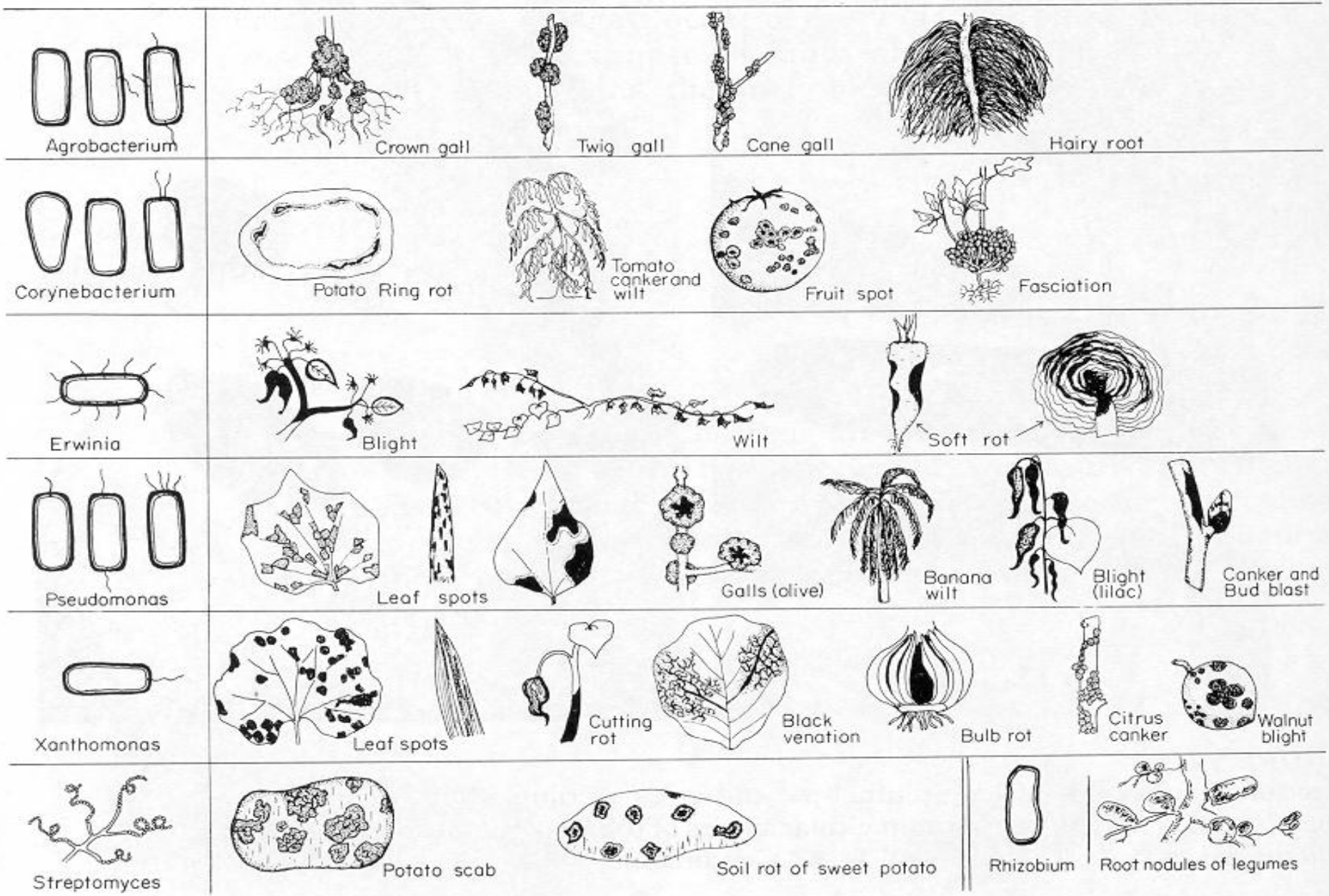


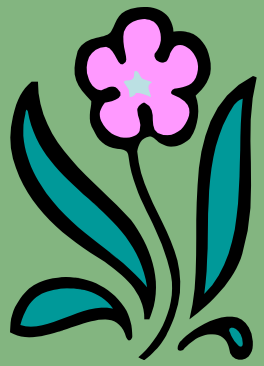

*FIGURE 148.*
Genera of bacteria and kinds of symptoms they cause.

# Some Examples: Bacteria



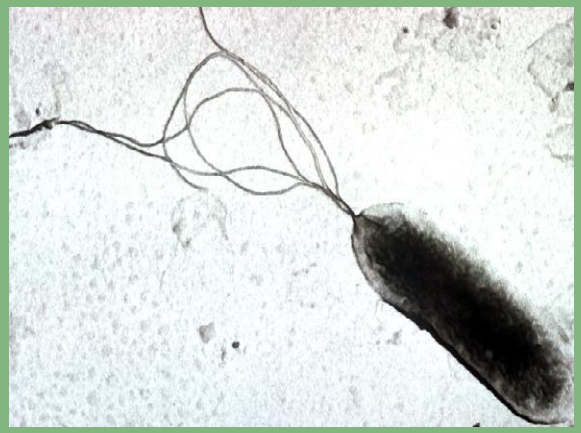

- Bacterial Gall
- Bacterial Canker
- Fire Blight
  - ooze, wet, slimy, smelly
  - without defined border
  - spread by insects, tools, animals, people

# Bacteria



## FIRE BLIGHT

## *Erwinia amylovora*



Single cell, one colony


Apple Flower
Stigma
Style
Anther
Filament
Nectar-secretory
Sepal
Ovary
Ovule

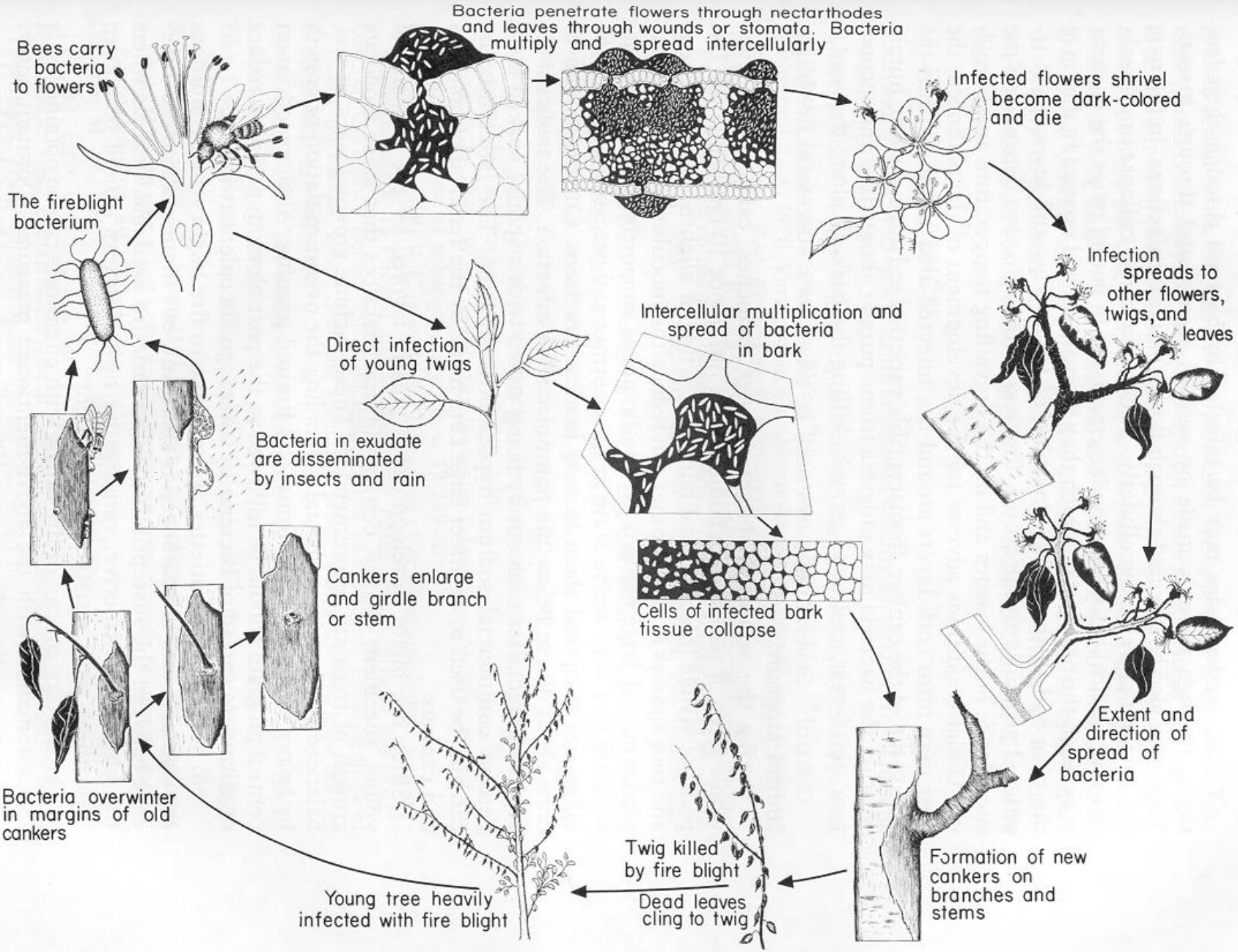
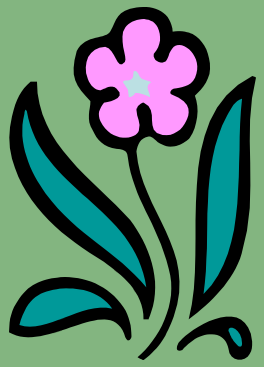



*FIGURE 159.*
Disease cycle of the fire blight of pear and apple caused by *Erwinia amylovora*.



# FIRE BLIGHT

## Control

- Pruning
- Nitrogen
- Irrigation
- Bactericides

# Causes of Infectious Plant Disease

- Pathogens
  - Fungi
  - Bacteria
  - Phytoplasmas
  - Spiroplasmas
  - Viruses
  - Nematodes
  - Parasitic Seed Plants

Formerly known as Mycoplasma like organisms,

Helical shaped prokaryotes…

DNR or RNA surrounded by a protein coat

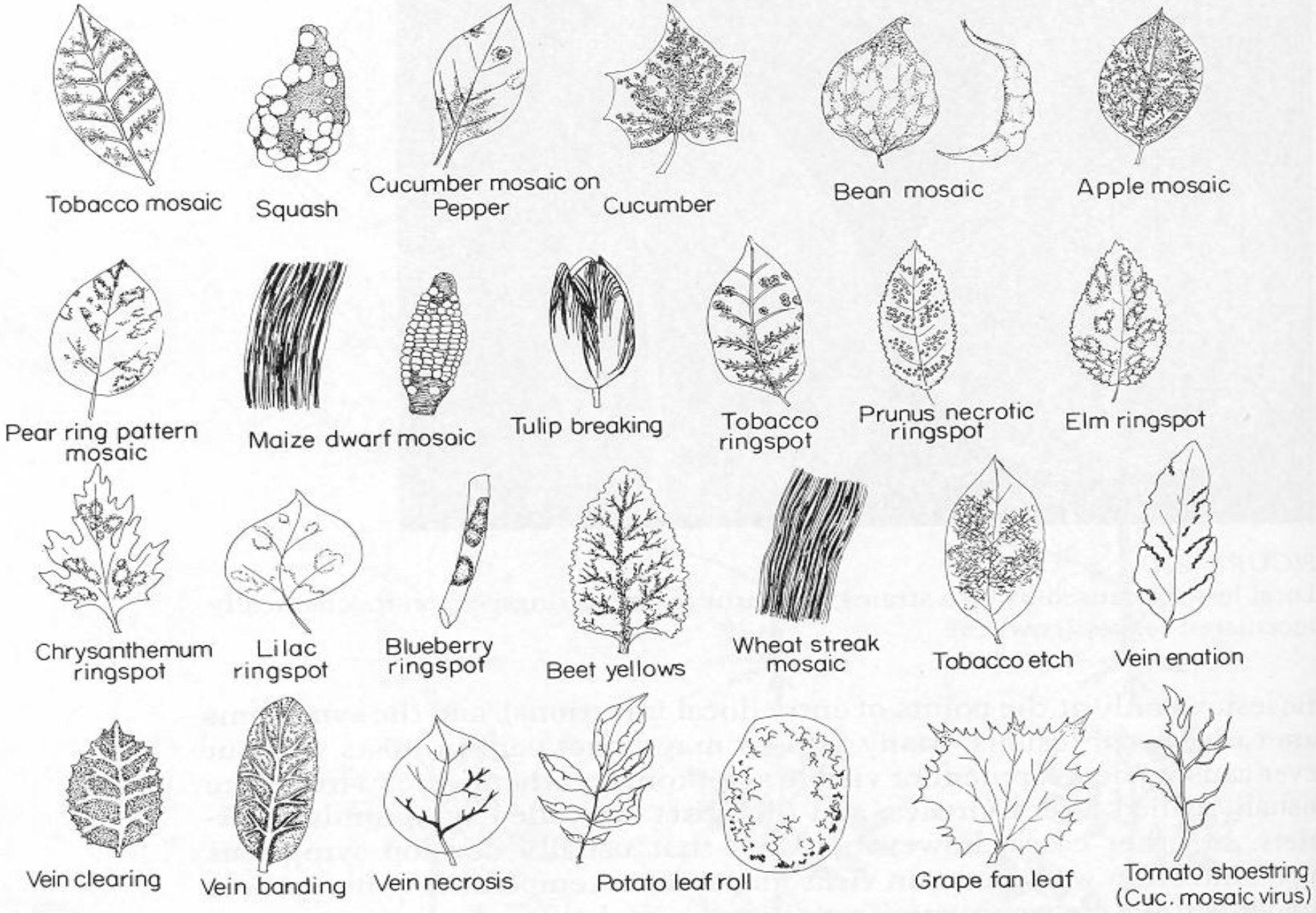



*FIGURE 211.*
Kinds of symptoms caused by viruses in plants.

# Phytoplasma Diseases


UGA1525631

# Impatiens necrotic spot virus (INSV) on *Lisianthus*

# Some Examples: Virus

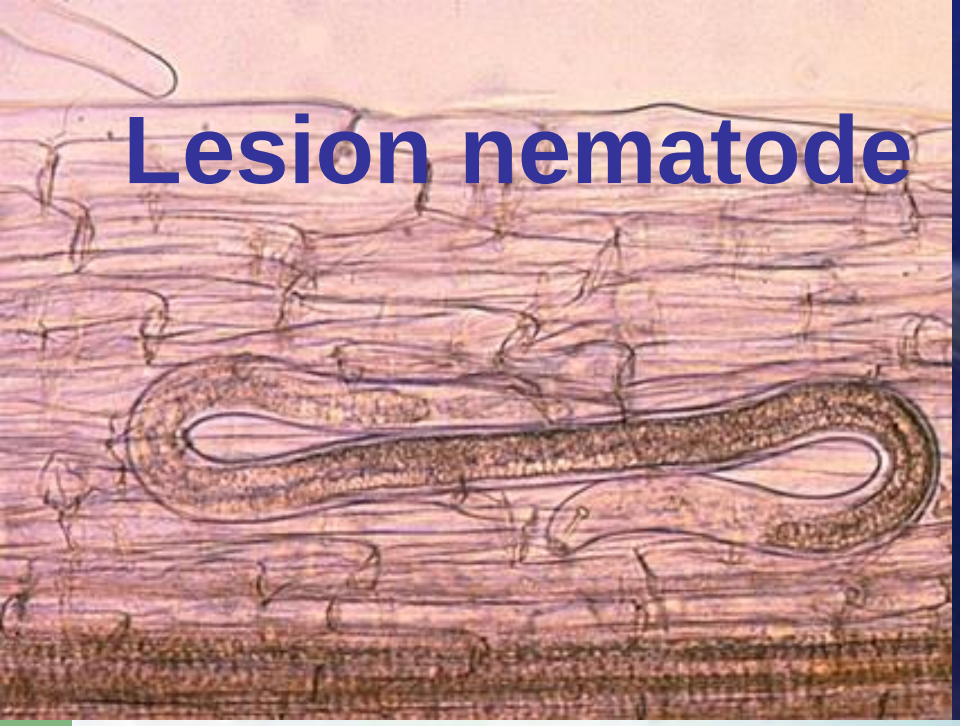


- Rose Mosaic (rose)
- Cucumber Mosaic (tomato)
- Tomato Spotted Wilt (tomato)
  - discolored tissue
  - distorted tissue
  - strange growth, stunting

# Causes of Infectious Plant Disease

- Pathogens
  - Fungi
  - Bacteria
  - Phytoplasmas
  - Spiroplasmas
  - Viruses
  - Nematodes → Microscopic segmented roundworms
  - Parasitic Seed Plants

# Root knot nematode on roots


Lesion nematode


Cyst nematode


Cyst nematode


Cyst nematode

# Causes of Infectious Plant Disease

- Pathogens
  - Fungi
  - Bacteria
  - Phytoplasmas
  - Spiroplasmas
  - Viruses
  - Nematodes
  - Parasitic Seed Plants

Higher plants that depend on other plants for food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Flowers

mature plants



Mature dodder

# Fill in the Blanks….

| Disease | Organism (e.g. bacteria) |
|---|---|
| Fireblight | |
| Rose mosaic | |
| Brown Rot | |
| Powdery Mildew | |
| Sudden Oak Death | |
| Phytophera Root Rot | |
| Shot hole in Plums | |

# Fill in the Blanks….

| Disease | Organism (e.g. bacteria) |
|---|---|
| Fireblight | **Bacteria** |
| Rose mosaic | **Virus** |
| Brown Rot | **Fungi** |
| Powdery Mildew | **Fungi** |
| Sudden Oak Death | **Fungi** |
| Phytophera Root Rot | **Fungi** |
| Shot hole in Plums | **Non-infectious disorder** |

# Basic Concepts and Principles of Noninfectious Plant Disease

- Abiotic Disorders
  - Extremes in important environmental components
    - Nutritional deficiencies
    - Air pollution
    - Light extremes
    - Temperature extremes
    - Moisture extremes


Salt damage

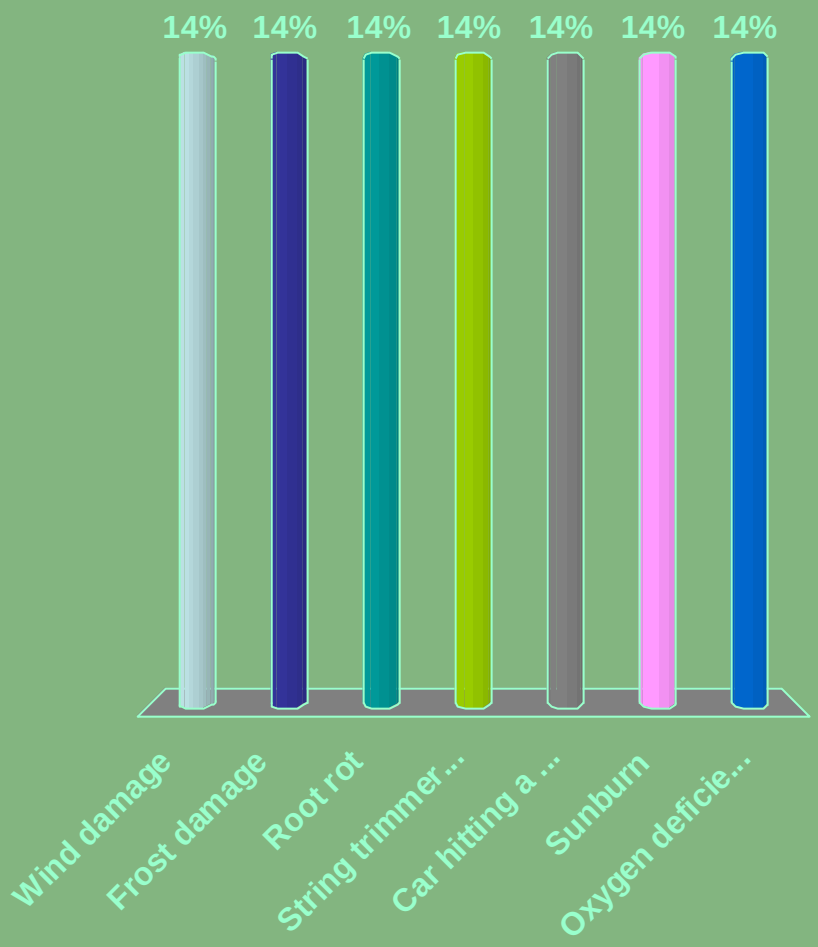

Ozone damage


Nitrogen deficiency


Drought damag

# Which of the following would not be considered an abiotic disorder?

1. Wind damage
2. Frost damage
3. Root rot
4. String trimmer injury
5. Car hitting a tree
6. Sunburn
7. Oxygen deficiency



# Most Common Abiotic Disorders

- Moisture Extremes
- Temperature extremes
- Wind
- Light intensity
- Nutritional deficiencies and excesses

Acute Water deficits cause wilting or scorching

Prolonged water deficit causes branch dieback or canopy thinning.

# Principles of Plant Disease Diagnosis

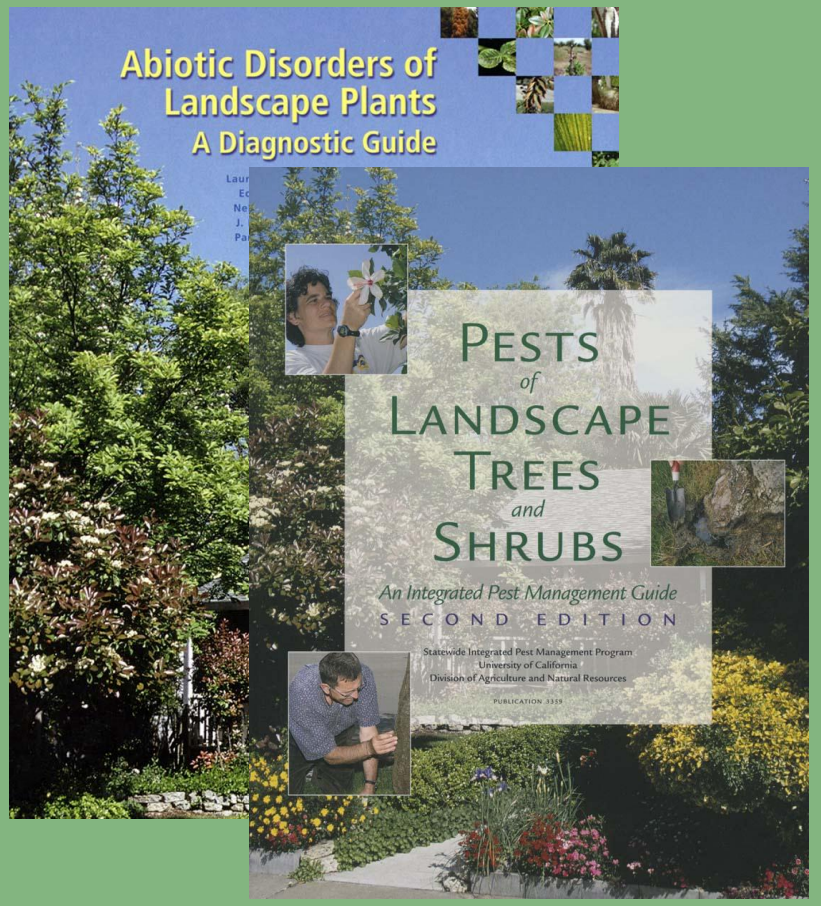
- **The methodical act or process of determining the nature or cause of a diseased or disordered condition**

# Steps to Diagnosis

- Identify the plant
- Identify the symptoms
- Inspect entire plant
- Inspect the site for factors that may contribute to injury
- Look for patterns
- Investigate the history
- Pull information together and list likely causes
- Test your hypothesis

# Steps to Diagnosis:

- Identify the plant
  - Pests by species
  - Know what is normal
  - Climatic adaptations



# Steps to Diagnosis

- Identify the plant
- Identify the symptoms
- Inspect entire plant
- Inspect the site for factors that may contribute to injury
- Look for patterns
- Investigate the history
- Pull information together and list likely causes
- Test your hypothesis

# Why Diagnose Plant Diseases?

- **Develop management strategies**
- **Phytosanitary certification**
- **Quarantine requirements**
- **Litigation**

# Principles of Plant Disease Management -cont.

- Exclusion
- Eradication or reduction of inoculum
  - Sanitation
  - Roguing and pruning
  - Crop rotation
  - Elimination of weeds and other alternate hosts
  - Disfavor insect vectors (reflective mulches)
  - Soil solarization

# Principles of Plant Disease Management -cont.

- Plant Protection
  - Optimum planting time
  - Correct conditions for the species
  - Species appropriate for the site
  - Plant spacing
  - Correct cultural conditions (fertilizer and water)
  - Avoid injuries and wounding
  - Use disease free planting stock
  - Resistant plant varieties

# Principles of Plant Disease Management -cont.

IPM Strategies

- **Biological control**
- **Habitat manipulation**
- **Modification of cultural practices**
- **Use of resistant varieties**
- **Pest monitoring for timing pesticide application**
- **Rational use of pesticides**
    - Chemical control
        - Fungicides/Bacteriacides—protectant or eradicant

# Chemical Control

- Effective material
- Correctly timed
- Proper rate
- Good coverage

# TREATMENT TIMING

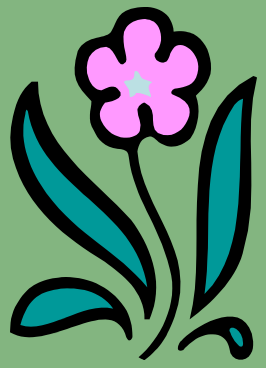
| Disease | Dormant | Bloom | | | Spring[a] | | Summer | |
|---|---|---|---|---|---|---|---|---|
| | | Pink bud | Full bloom | Petal fall | 2W | 5W | May | June |
| Alternaria | ---- | ---- | ---- | ---- | ---- | +++ | +++ | +++ |
| Anthracnose | ---- | +++ | +++ | +++ | +++ | +++ | +++ | +++ |
| Brown rot | ---- | ++ | +++ | + | ---- | ---- | ---- | ---- |
| Green fruit rot | ---- | ---- | +++ | ---- | ---- | ---- | ---- | ---- |
| Leaf blight | ---- | ---- | +++ | ++ | + | ---- | ---- | ---- |
| Scab | + | + | + | + | +++ | +++ | ++ | + |
| Shot hole | + | + | ++ | +++ | +++ | ++ | ---- | ---- |
| Rust | ---- | ---- | ---- | ---- | ---- | +++ | +++ | + |

# FUNGICIDE EFFICACY

| Fungicide | Brown rot | Jacket rot | Leaf blight | Shot hole | Scab | Rust[a] | Anthracnose | Alternaria |
|---|---|---|---|---|---|---|---|---|
| Benlate[b] | ++++ | ++++ | +++ [g] | ---- | +++ | + | ---- | ---- |
| Rovral + oil[c] | ++++ | ++++ | ? | ++ | +/- | ++ | ---- | +++[i] |
| Topsin M[c] | ++++ | ++++ | +++ [g] | ---- | +++ | + | ---- | ---- |
| Abound | ++ | ----- | +++ | ++ | ++++ | +++ | ++++ | +++ |
| Rally[d] | +++ | ---- | +++ | +/- | ---- | ---- | ++ | ---- |
| Rovral | +++ | +++ | ? | ++ | ---- | ---- | ---- | +++[i] |
| Vangard | +++ | ++++ | ? | ++ | ? | ? | ? | ---- |
| Captan[e] | ++ | ++ | +++ | +++ | +++ | ---- | ++ | ---- |
| Funginex[f] | ++ | ---- | ? | ---- | ---- | ? | ? | ---- |
| Maneb | ++ | + | ++ | ++ | +++ | +++ | + | ---- |
| Ziram | ++ | + | ++ | +++ | +++ | ---- | ---- | + |
| Copper | +/- | +/- | ---- | +[h] | ---- | ---- | ---- | ? |
| Sulfur | +/- | +/- | ---- | ---- | ++ | ++ | ---- | ---- |

# Chemical Control

- Effective material
- Correctly timed
- Proper rate
- Good coverage



# CONTROL

**USUALLY:**

**Control measures are preventive**

**By the time you see it -- too late**

**Plan for next year**

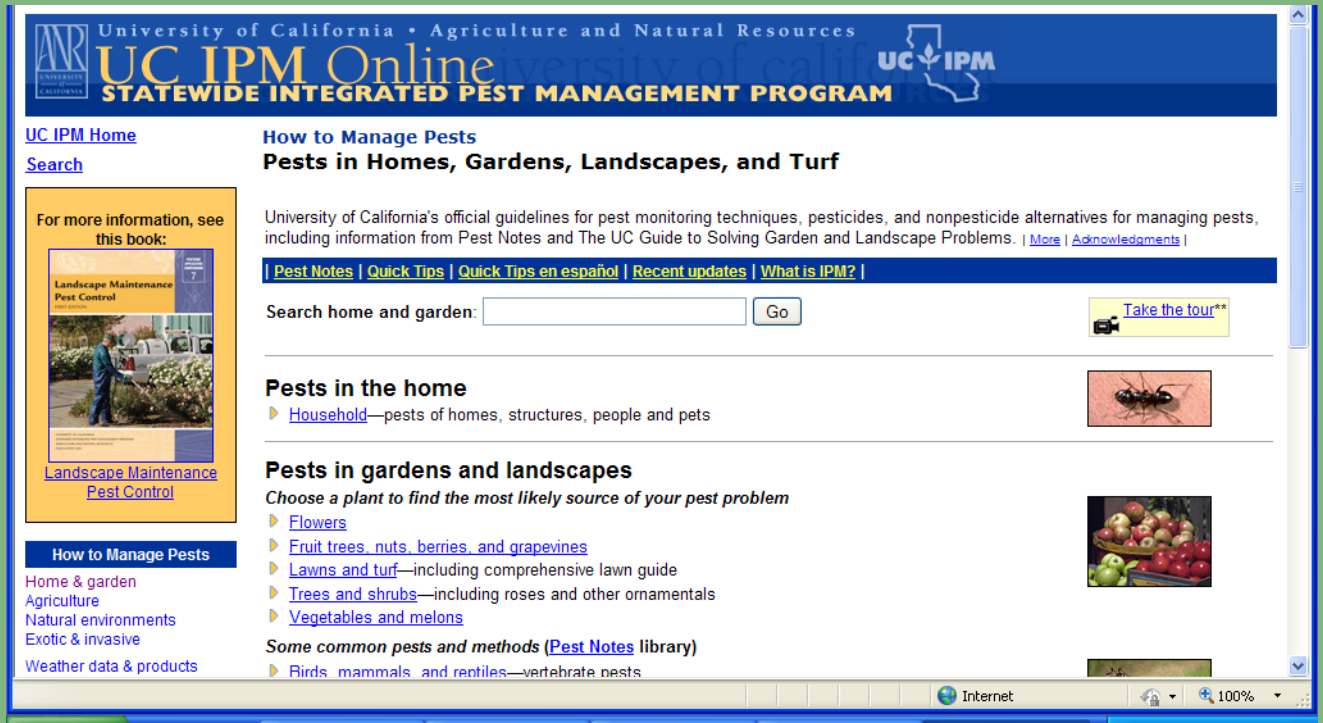
# LAB ASSIGNMENT: OBSERVE AND DESCRIBE

Observe samples under microscopes:

- Fungi – look for hyphae, fruiting bodies, pustules
  - mildew, bread mold, rust
- Bacteria – colonies are small round growths, single bacteria too small to see under this magnification
  - Slimy lettuce, yogurt with pink and yellow colonies
- Virus – note distorted or discolored tissue
  - Camellia and/or Rose leaves
- Other – compare & contrast: insect damage, fungi, environmental (abiotic)

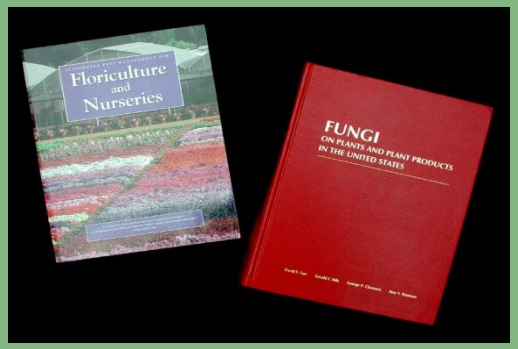
# Resources for Plant Pathology Information

- http://ipm.ucdavis.edu
  - Pest Notes
  - Pest Management Guidelines



# Publications

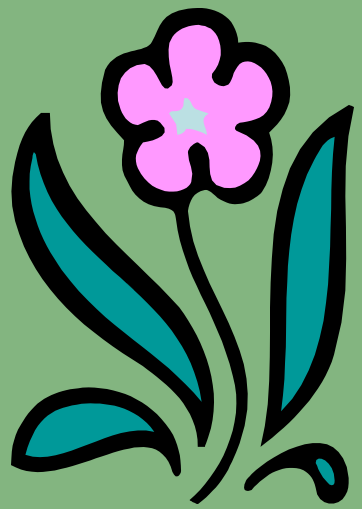
- Agrios, G.M. 1997 Plant pathology, 5th ed. New York: Academic Press.
- http://anrcatalog.ucdavis.edu
  - Pests Of The Small Farm And Garden
  - Pests Of Landscape Trees And Shrubs
  - Abiotic Disorders Of Landscape Plants



# Special Thanks

- Maria De La Fuente, County Director in Santa Clara County
- Beth Teviotdale, Emeritus Extension Plant Pathologist & Master Gardener
- Deb. Giraud, Farm Advisor in Humbolt/Del Norte Counties
- Yvonne Rasmussen, Napa County MG Coordinator
- UCIPM
- California Master Gardener Handbook


# Thank You



Any Questions?