Plant Pathology For Master Gardeners

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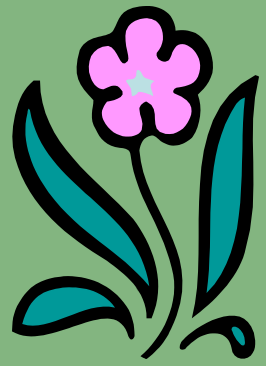
Learning Objectives

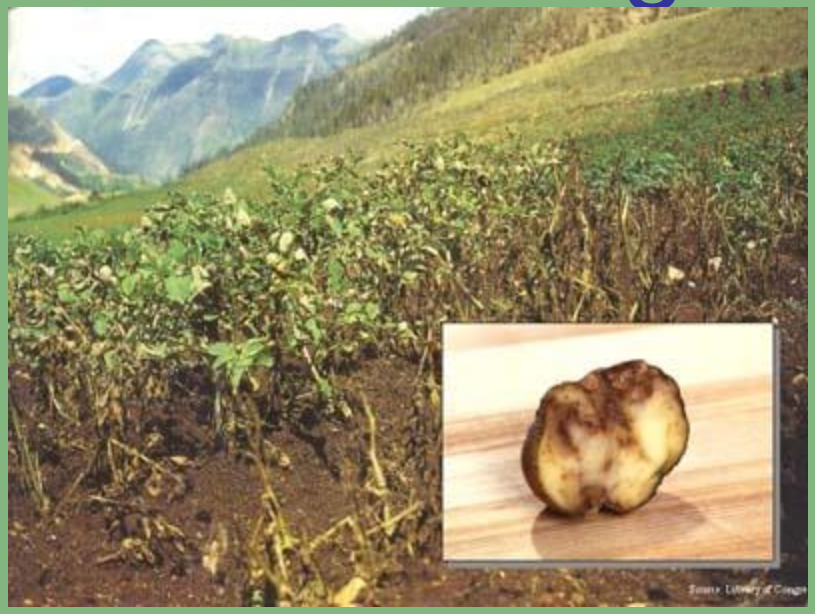


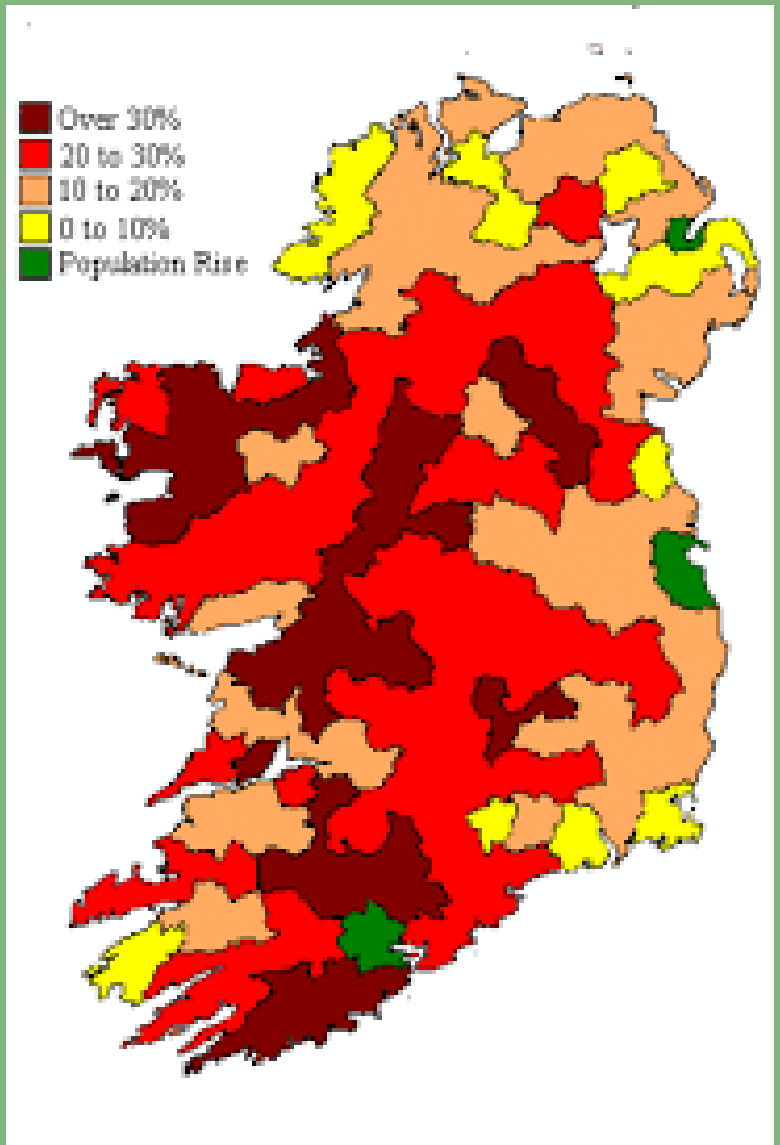
- Understand basic plant disease concepts and some of the terminology
- Learn about the major types of pathogens and environmental factors that contribute to disease
- Understand the disease triangle
- Process of diagnosis of plant disease
- Understand strategies for managing plant diseases

What is Plant Pathology?

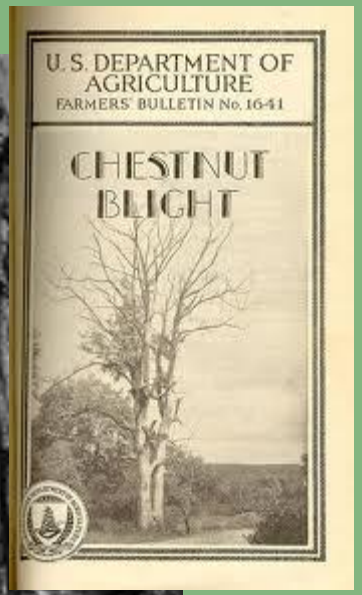
- The study of plant disease—phytopathology
- From the greek (not the geek)
  - *phyton* meaning plant
  - *pathos* meaning disease
  - *logos* meaning study

Phytophora Infestans-Late Blight of Potato





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



Bengal Famine of 1943 Caused by Brown Spot Disease of Rice

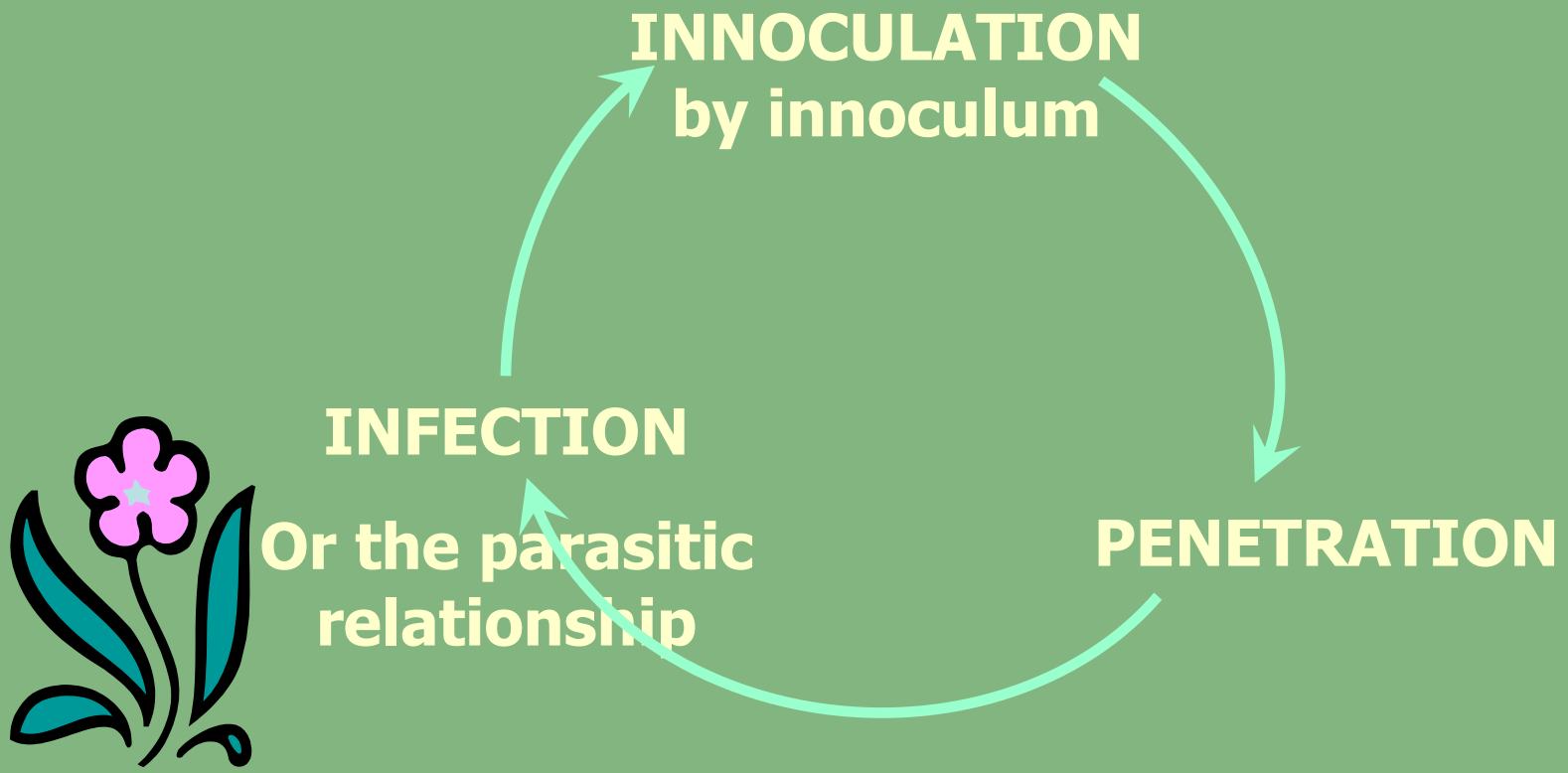
What is Plant Disease?

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

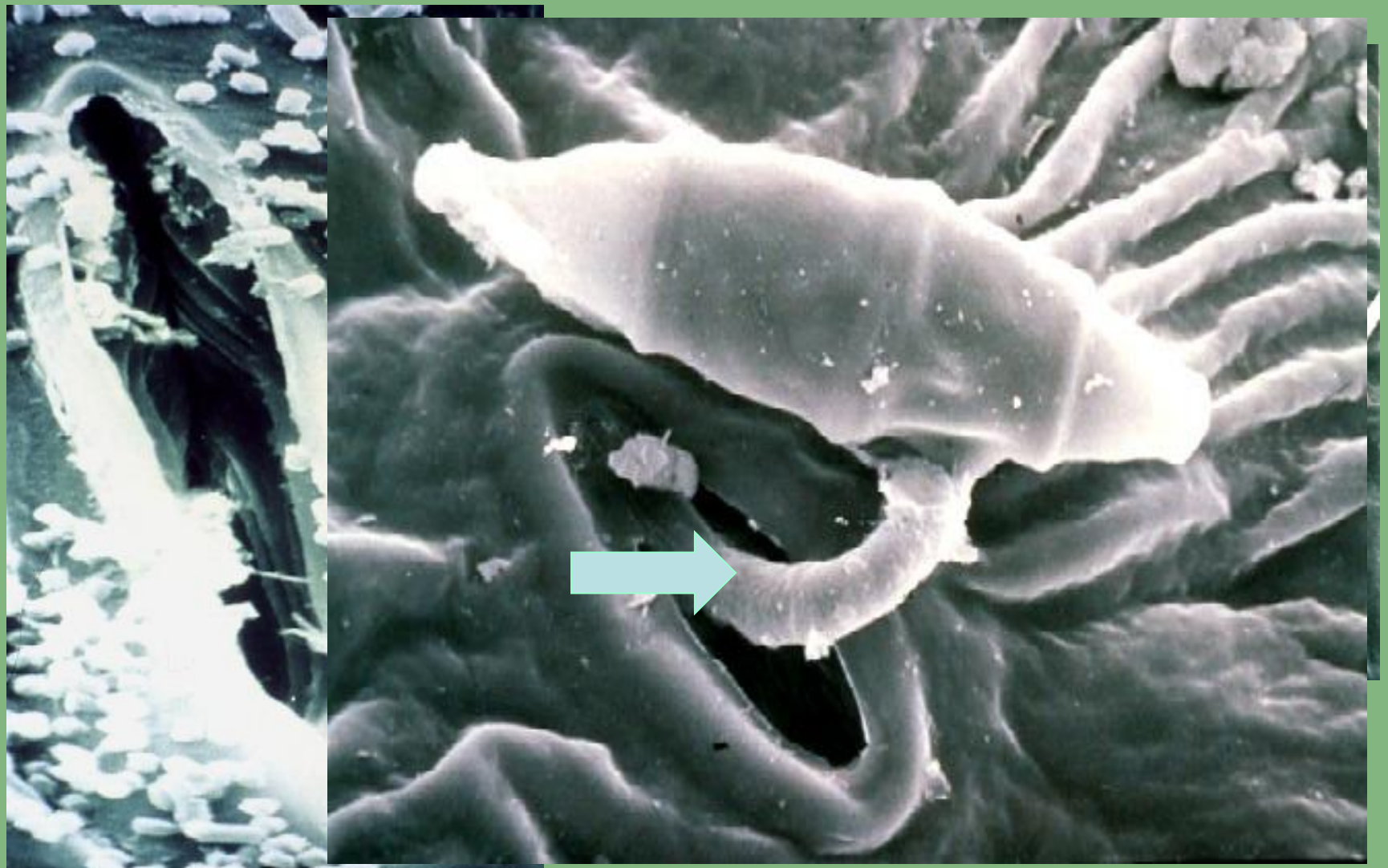
Agrios, 1997

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

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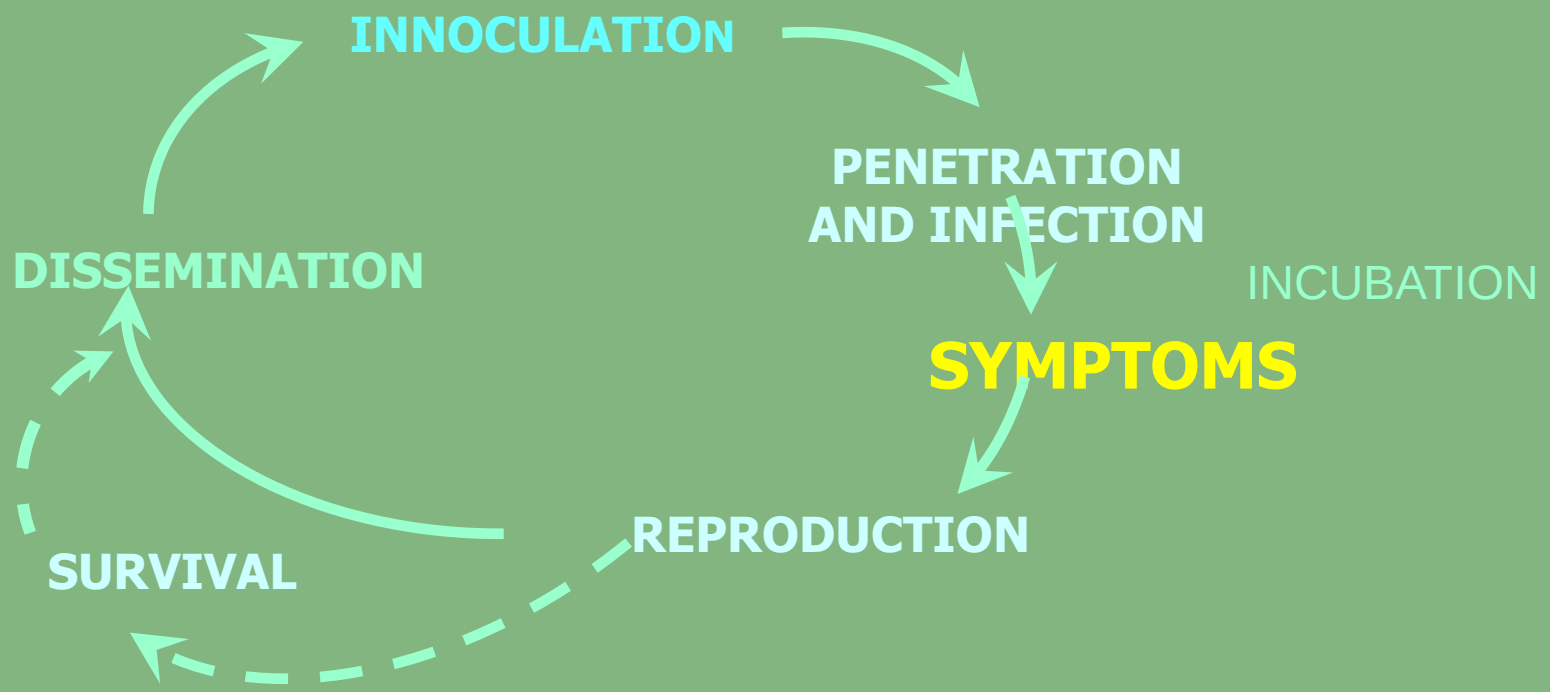
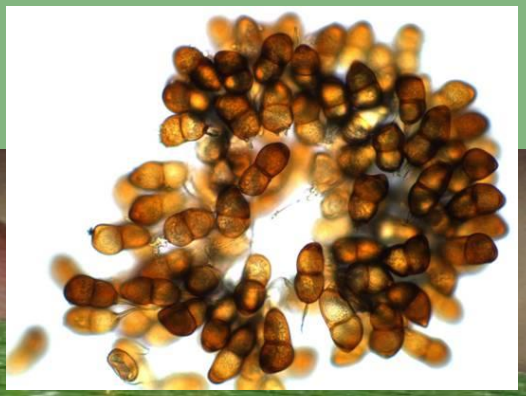


Some terms:

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



Basic Concepts and Principles of Infectious Plant Disease

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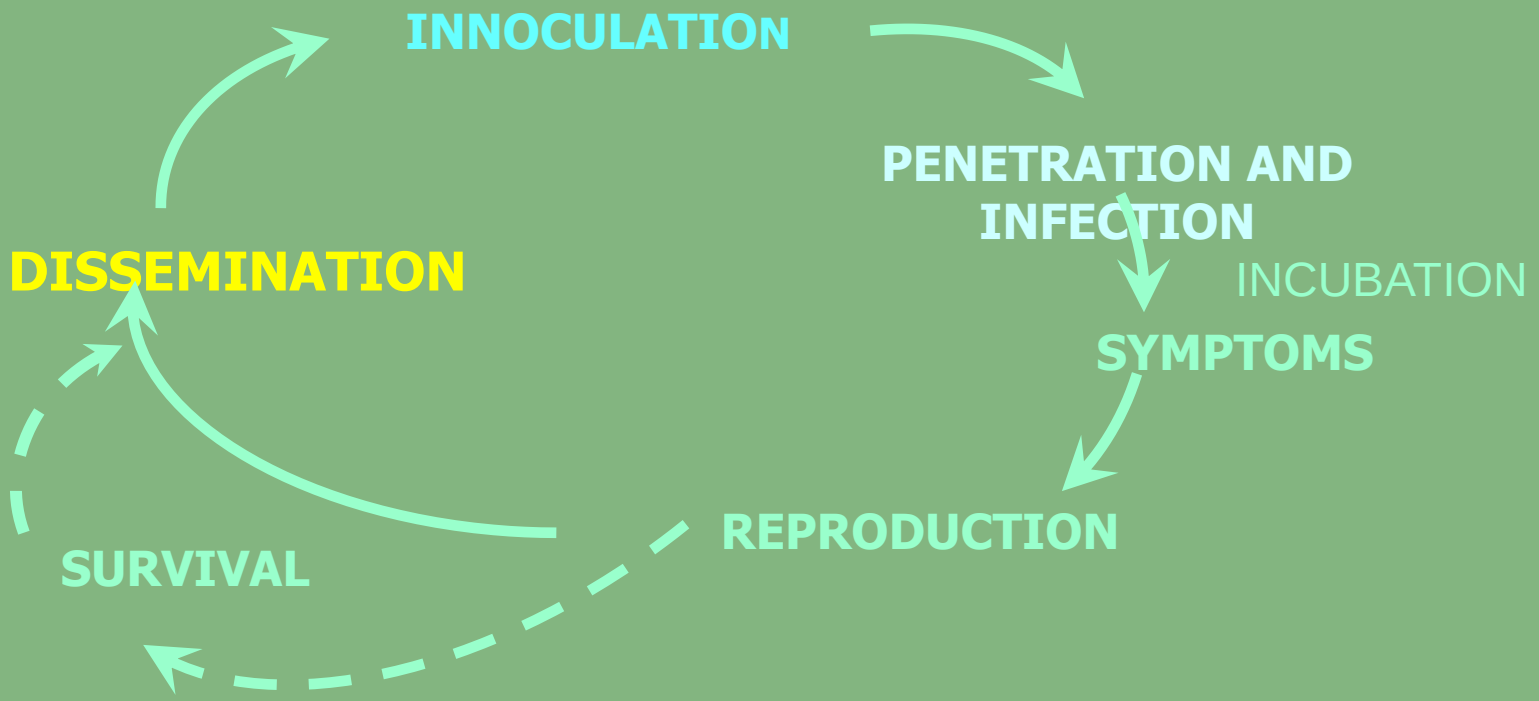
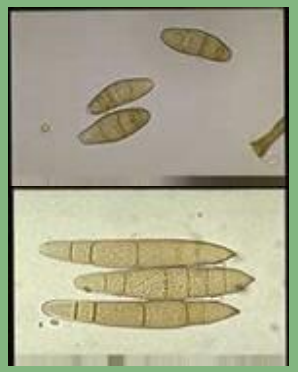


Dispersal or Dissemination

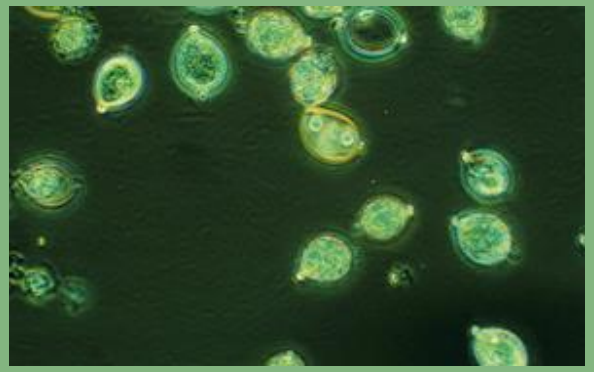
Types of propagules or spores

Mycelia

Conidia (spores)



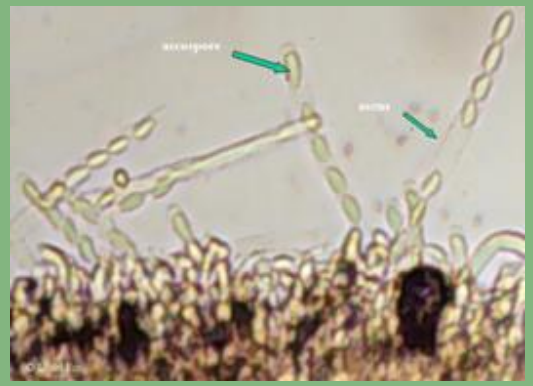
Zoospores



Oospores

Sclerotium

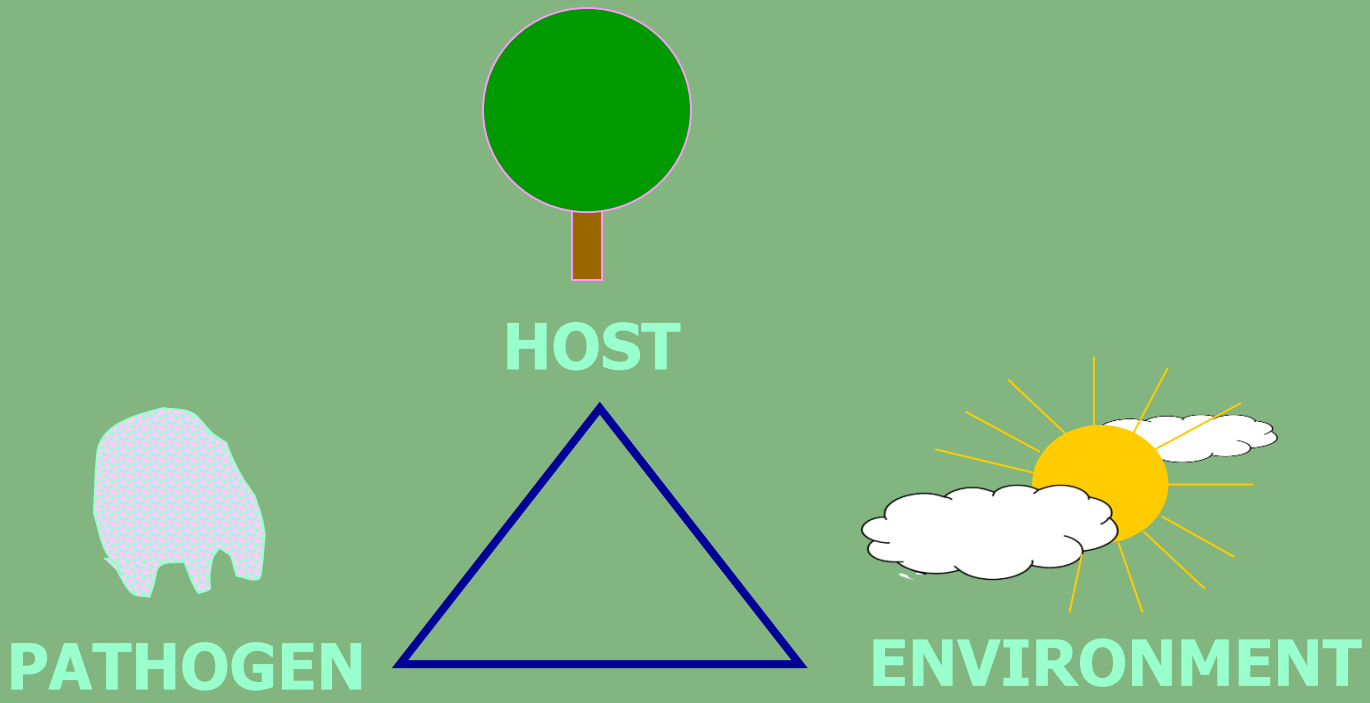
Apothecia



Ascospores

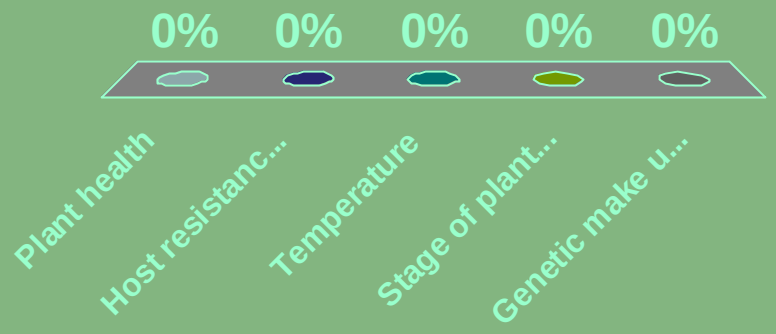
Dispersal or Dissemination

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



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.

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

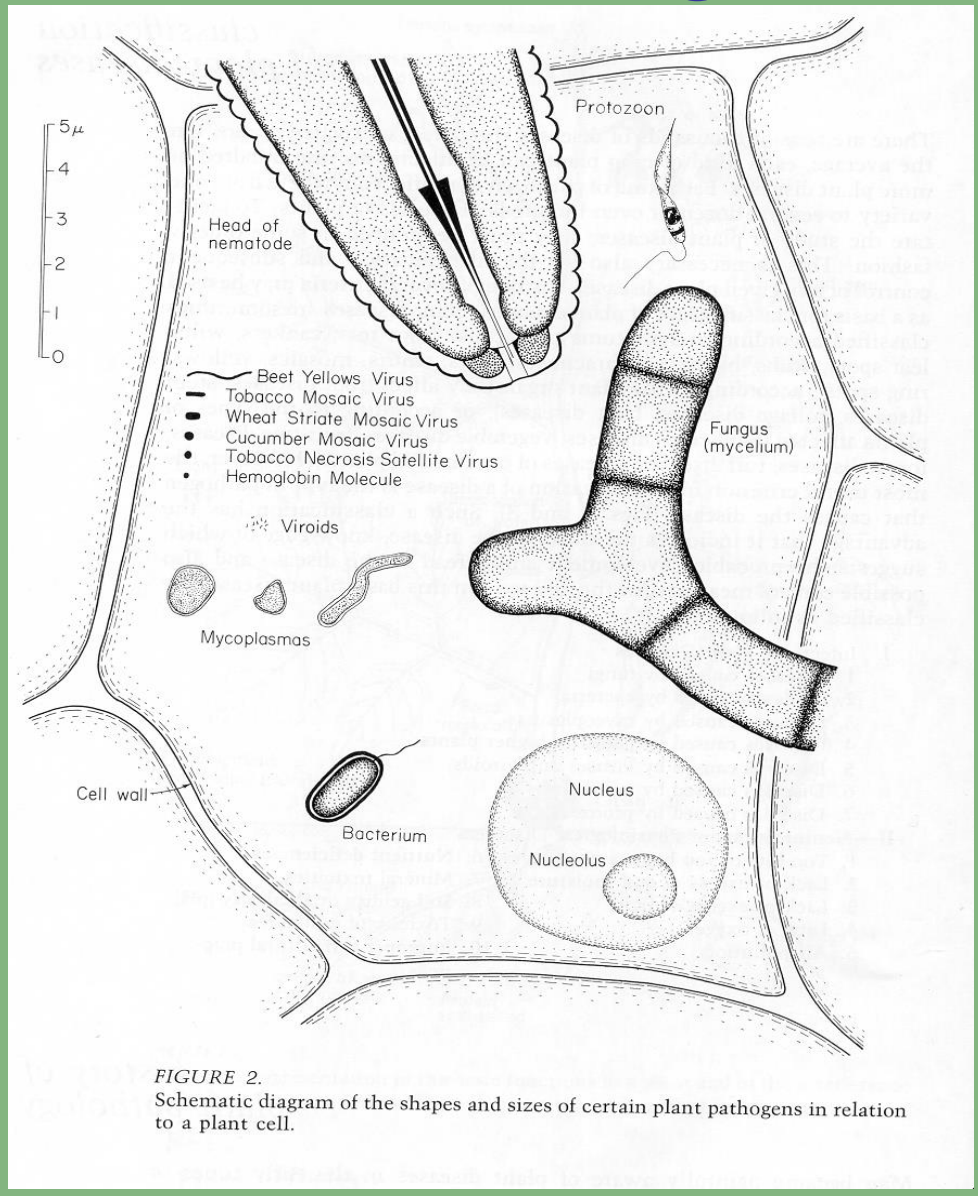
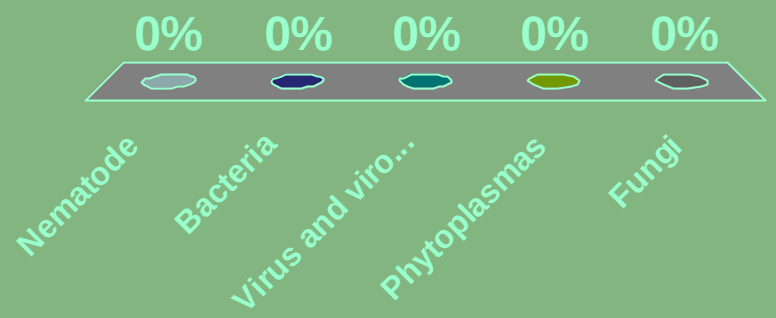


FIGURE 2.
Schematic diagram of the shapes and sizes of certain plant pathogens in relation to a plant cell.

Which is largest in size?

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



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  - Spiroplasmas
  - Viruses
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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)

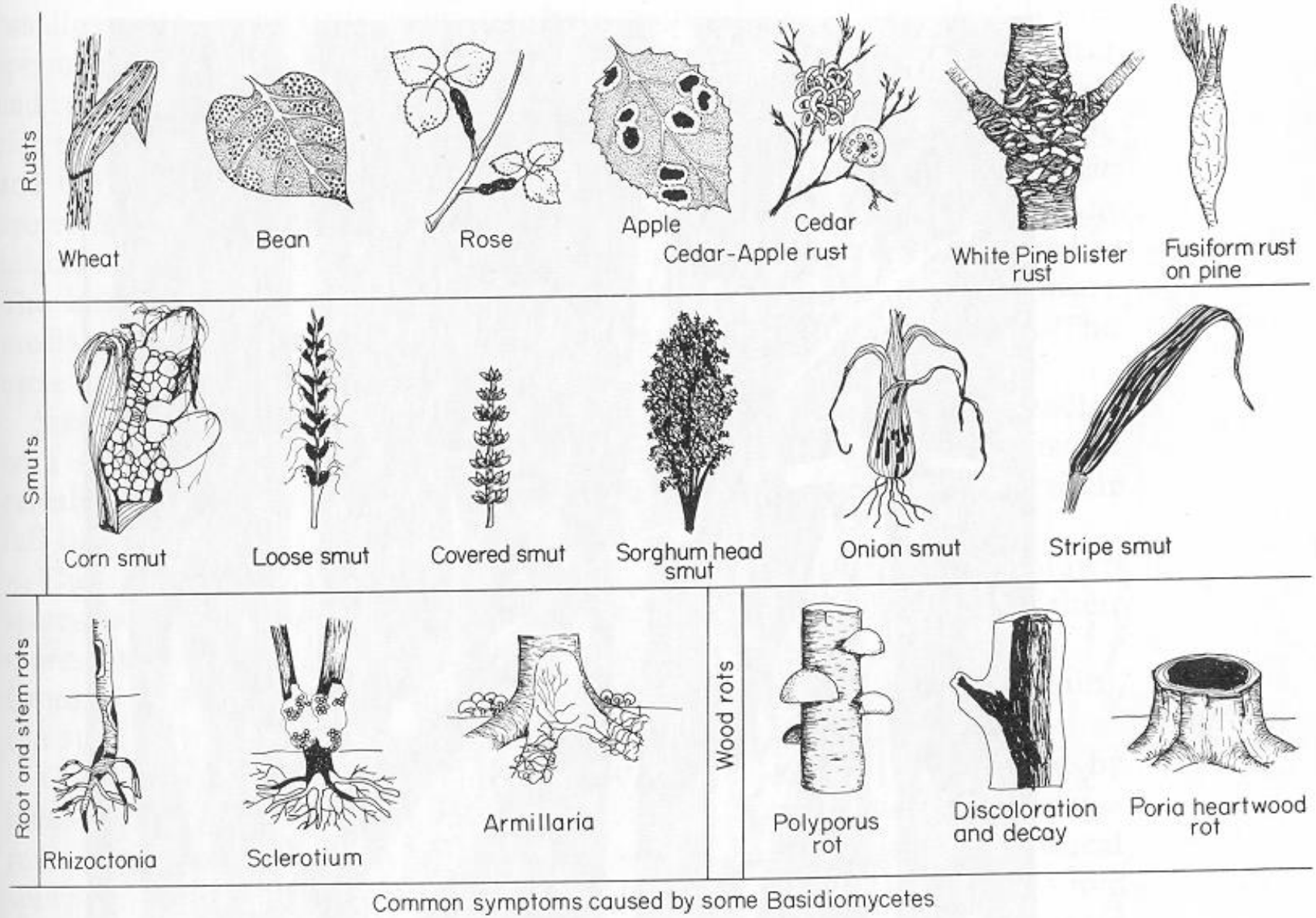
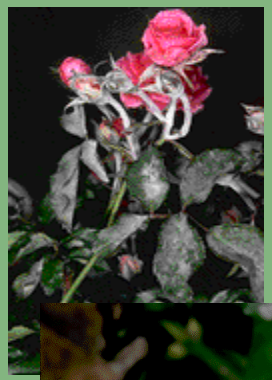


FIGURE 120.
Common symptoms caused by Basidiomycetes.

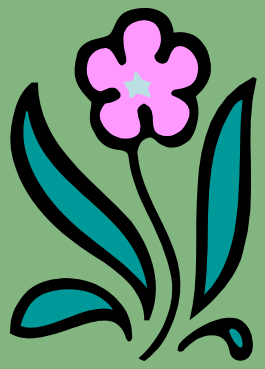
Some examples: Fungi



- 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

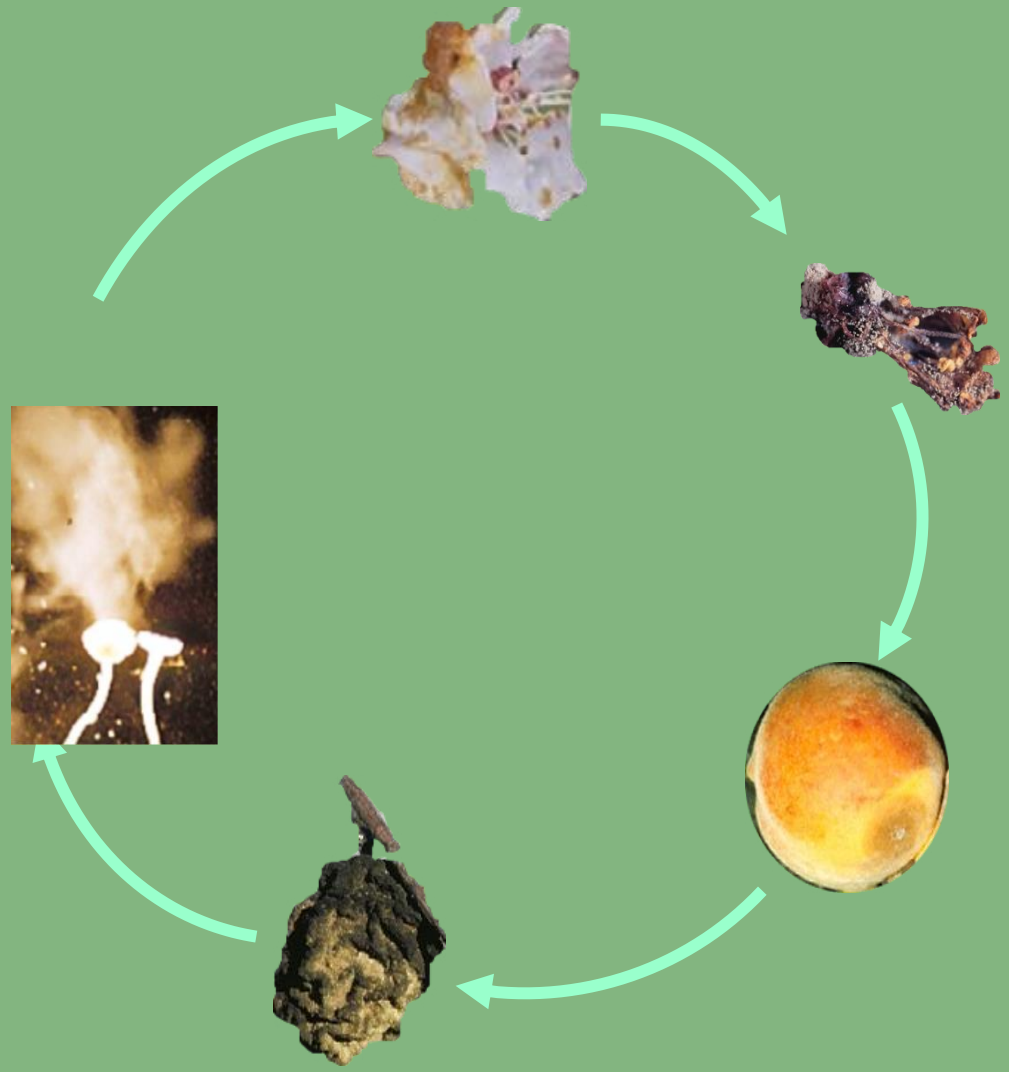


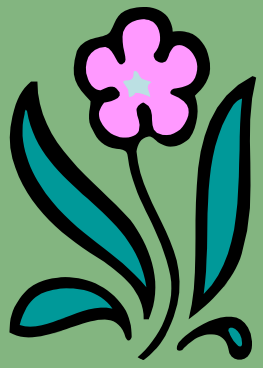
BROWN ROT

Monilinia laxa

Monilinia fructicola

BROWN ROT DISEASE CYCLE





BROWN ROT

Management

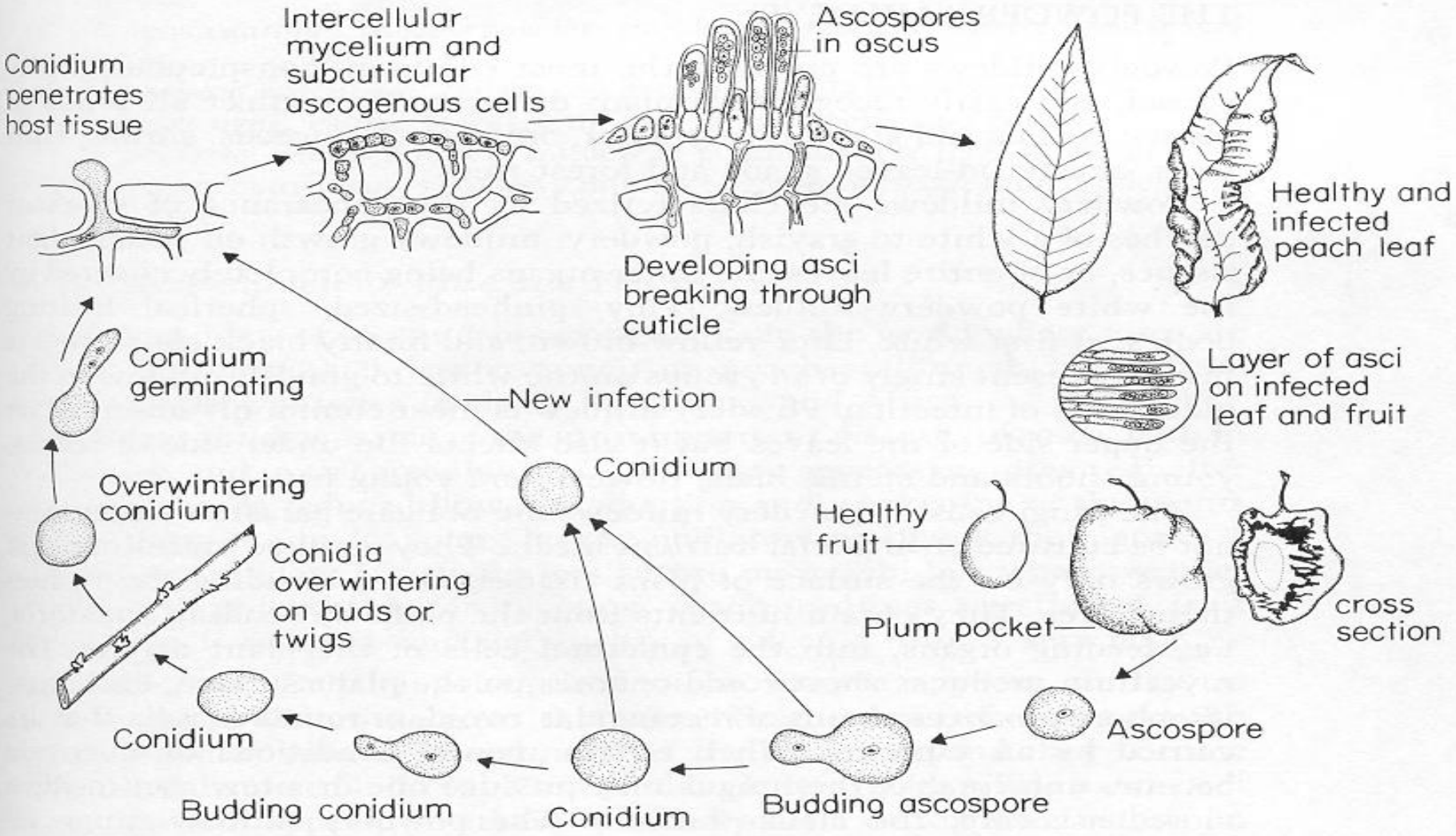
Sanitation

Nitrogen

Fungicides

Other Fungal Diseases

Peach Leaf Curl
Taphrina deformans



Disease cycle of diseases caused by *Taphrina* sp.

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

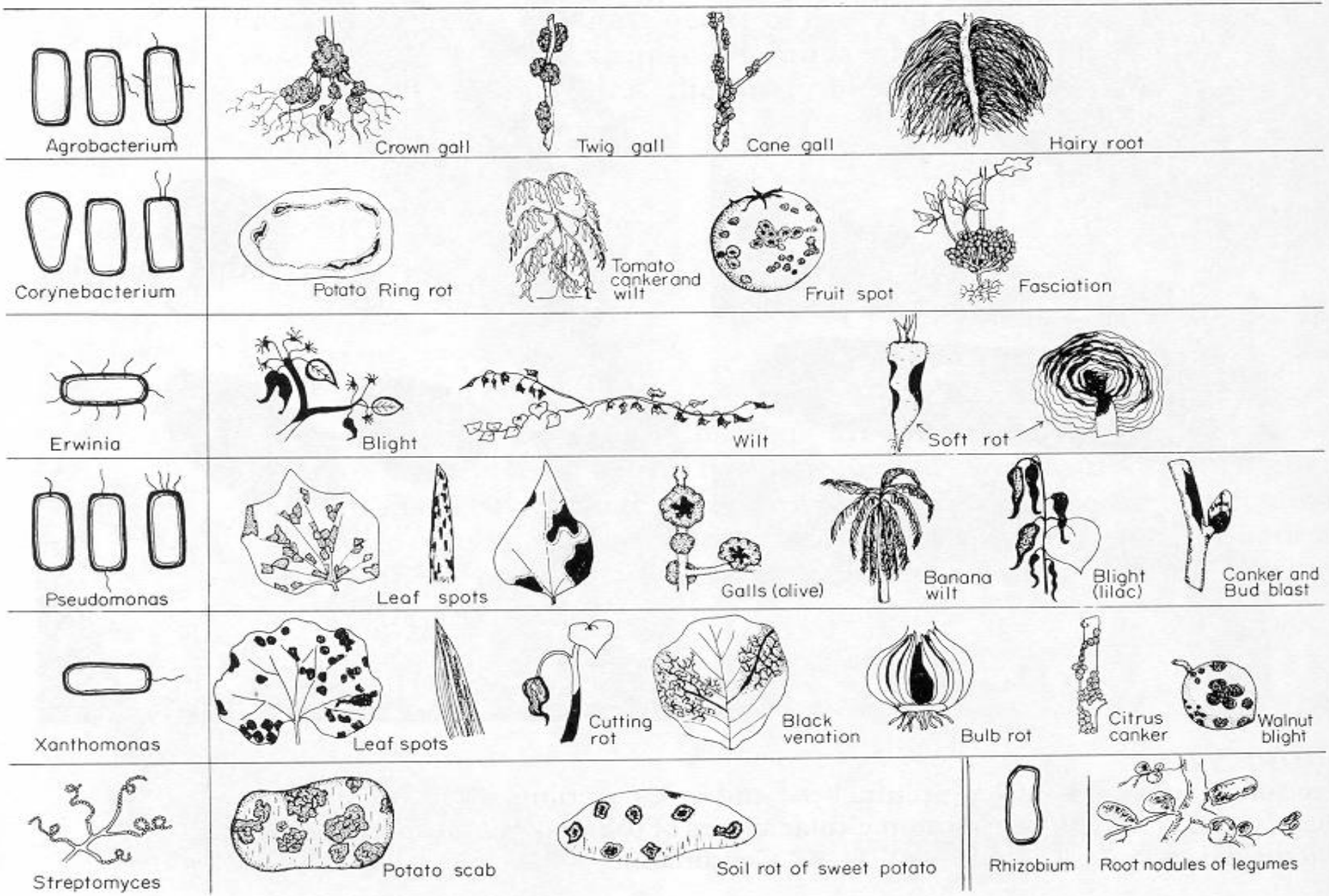
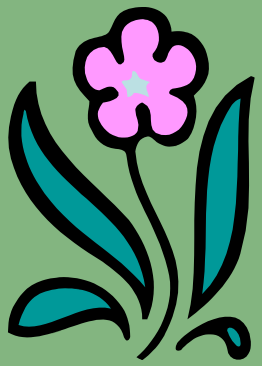


FIGURE 148.
Genera of bacteria and kinds of symptoms they cause.

Some Examples: Bacteria

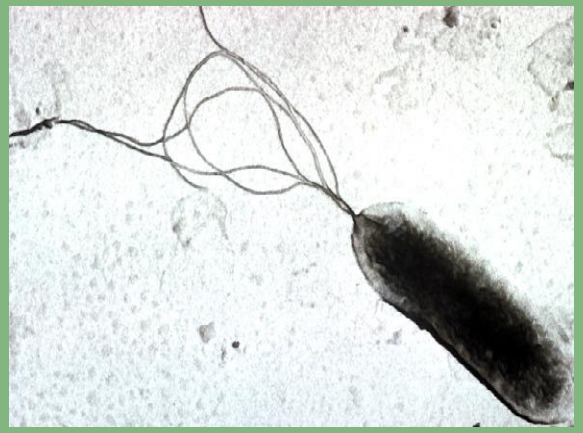
- Bacterial Gall
- Bacterial Canker
- Fire Blight
  - ooze, wet, slimy, smelly
  - without defined border
  - spread by insects, tools, animals, people

Bacteria



FIRE BLIGHT

Erwinia amylovora



Single cell, one colony

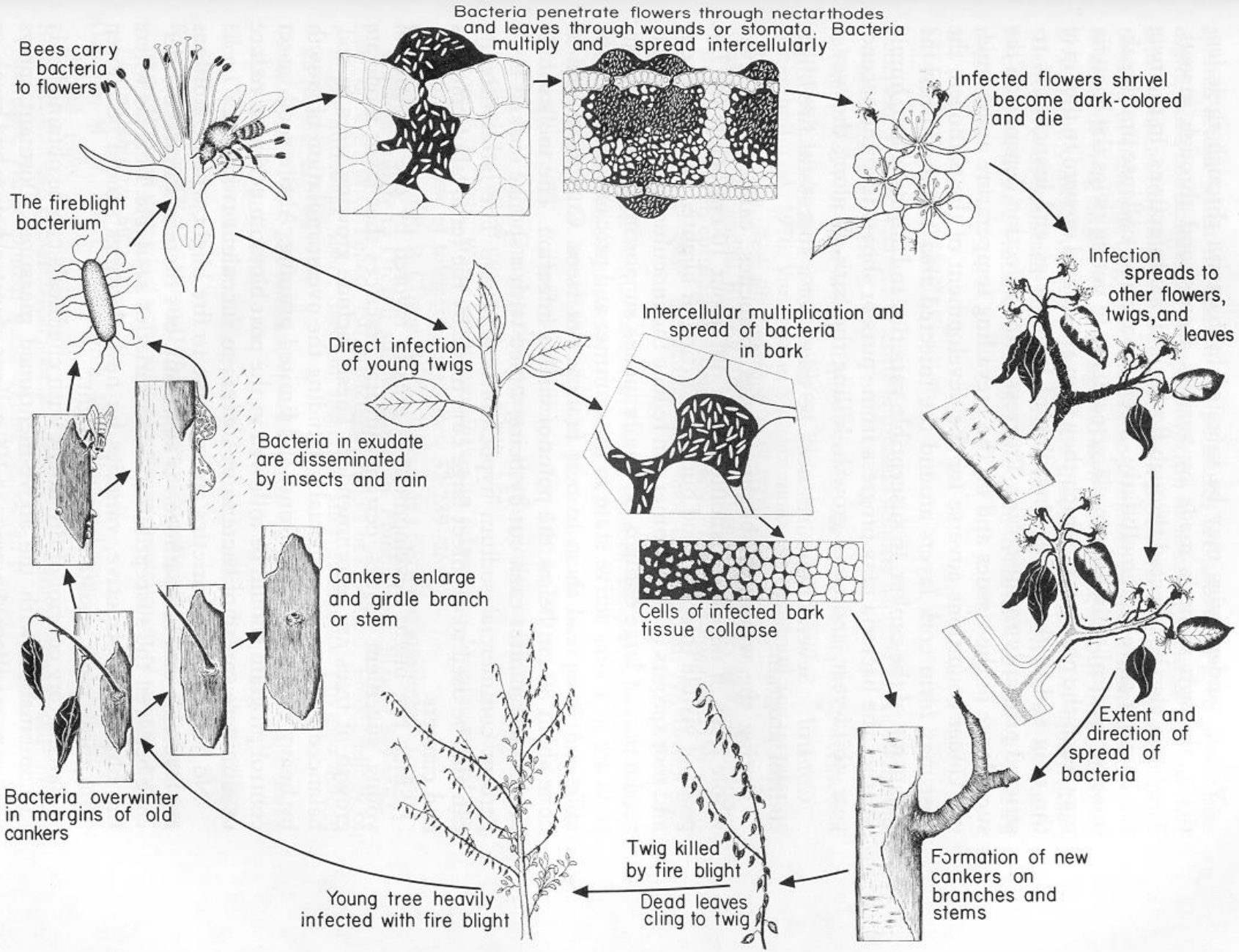
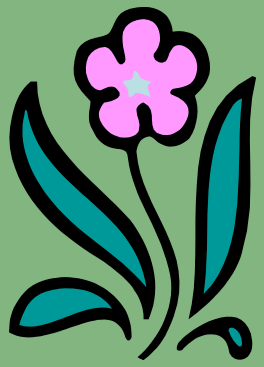


FIGURE 159.
Disease cycle of the fire blight of pear and apple caused by *Erwinia amylovora*.


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



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

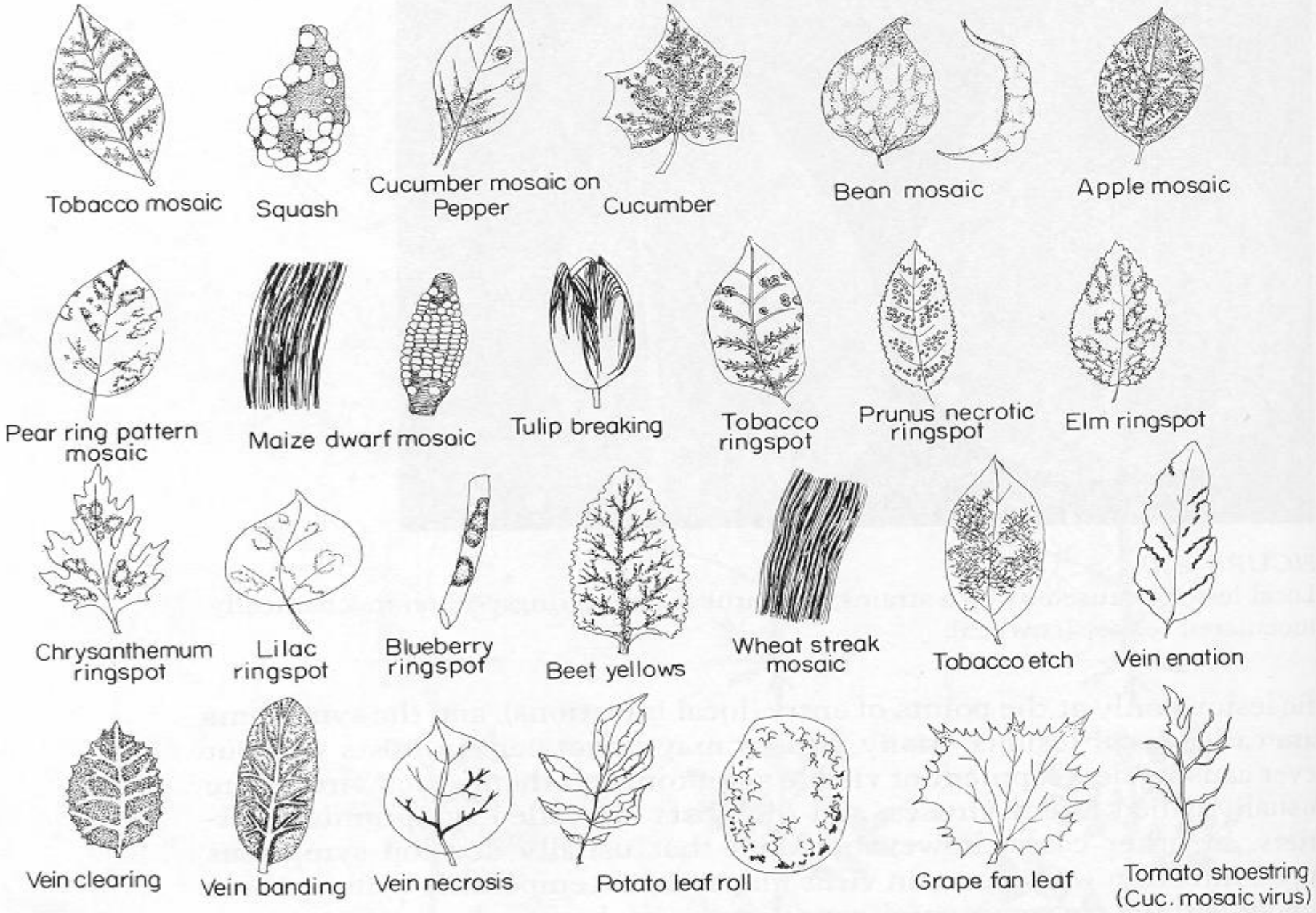


FIGURE 211.
Kinds of symptoms caused by viruses in plants.

Phytoplasma Diseases


UGA1525631


Impatiens necrotic spot virus
(INSV) on *Lisianthus*

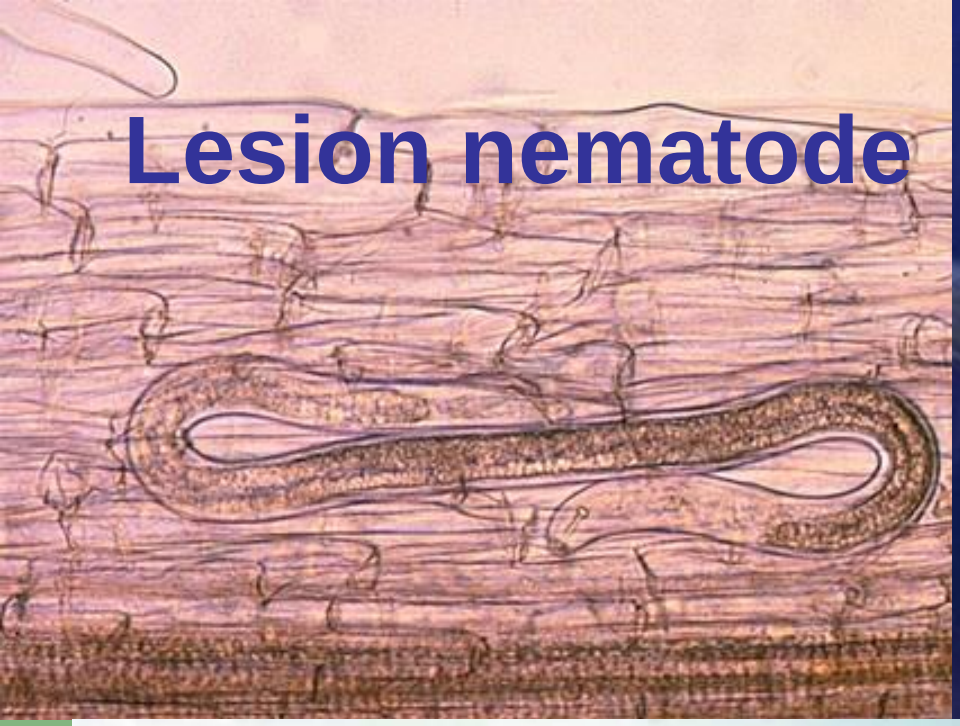
Some Examples: Virus

- 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

Soil Borne Nematode Management

- Fumigation
- Solarization
- Fallowing
- Resistant varieties (VFN)
- Incorporation of lots of organic matter

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

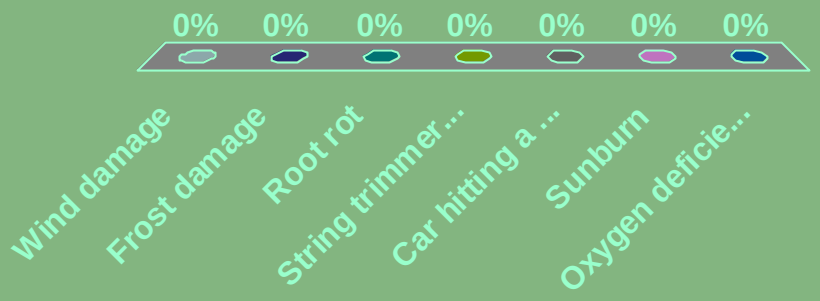

Ozone damage


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

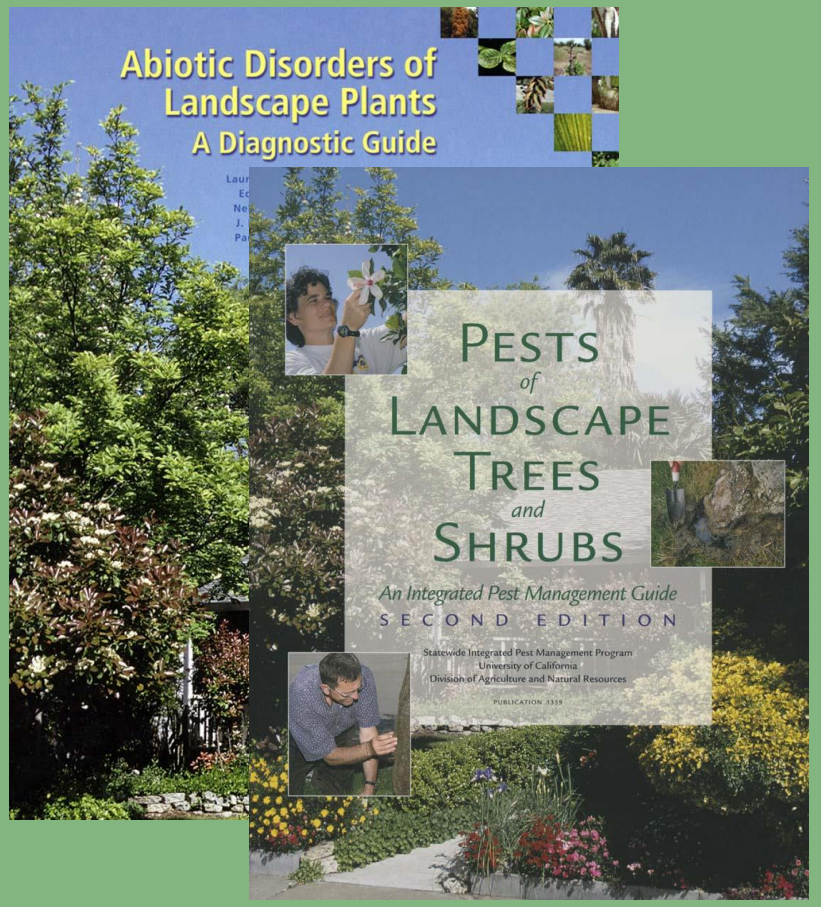
- **The methodical act or process of determining the nature or cause of a diseased or disordered condition**

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

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- Identify the symptoms
- Inspect entire plant
- Inspect the site for factors that may contribute to injury
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- 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

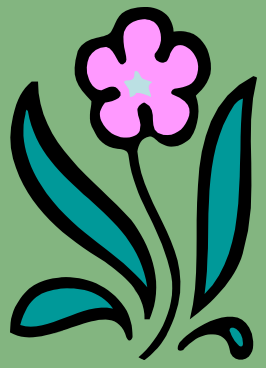
Disease	Dormant	Bloom			Spring[a]		Summer	
		Pink bud	Full bloom	Petal fall	2W	5W	May	June
Alternaria	----	----	----	----	----	+++	+++	+++
Anthracnose	----	+++	+++	+++	+++	+++	+++	+++
Brown rot	----	++	+++	+	----	----	----	----
Green fruit rot	----	----	+++	----	----	----	----	----
Leaf blight	----	----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

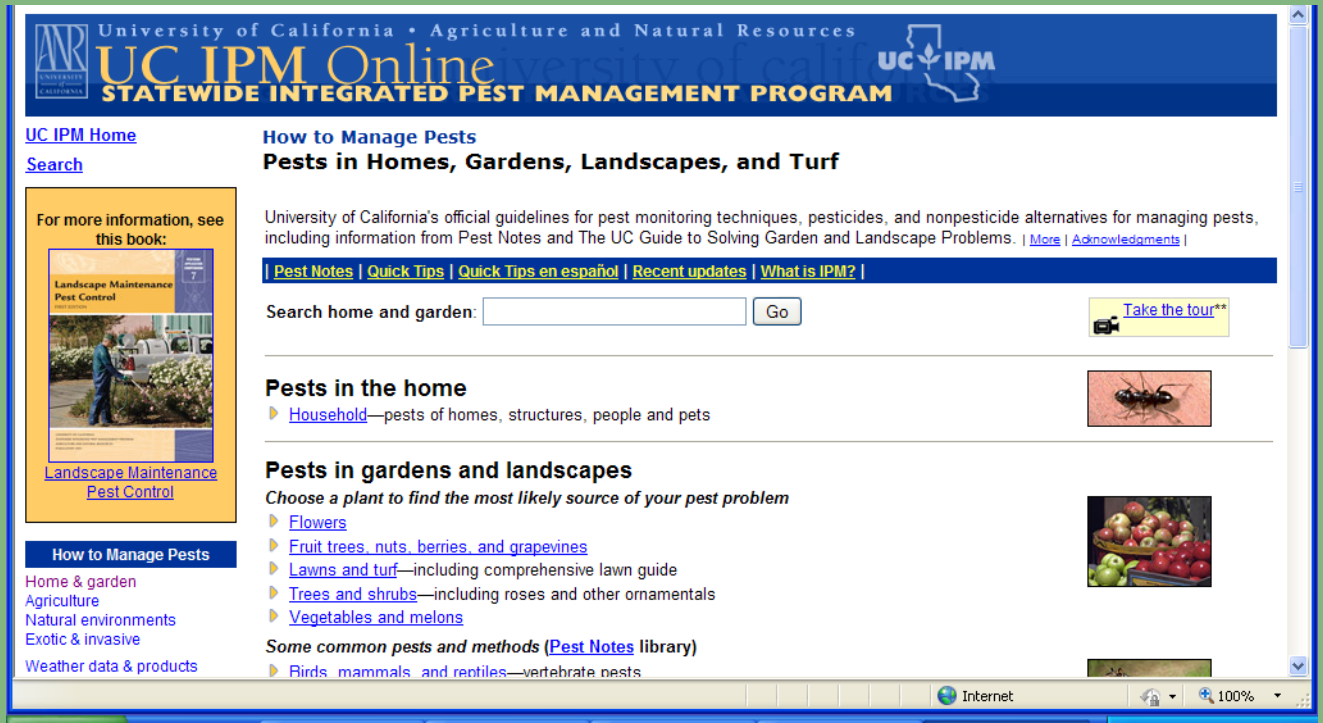
Control measures are preventive

By the time you see it -- too late

Plan for next year

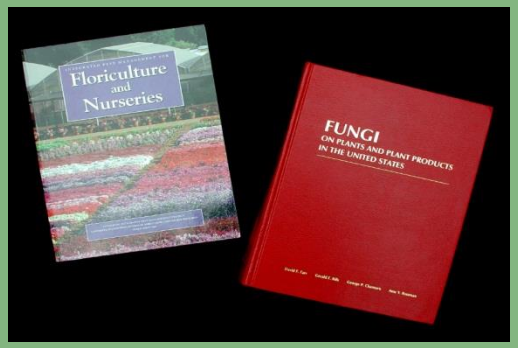
Resources for Plant Pathology Information

- 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



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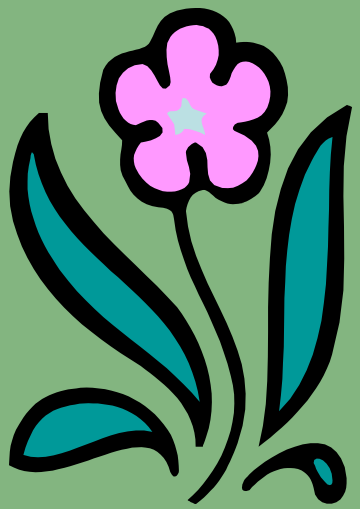
- Yvonne Rasmussen, Napa County MG Coordinator
- UCIPM
- California Master Gardener Handbook

Thank You



Any Questions?

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)