



# Plant Disease Basics

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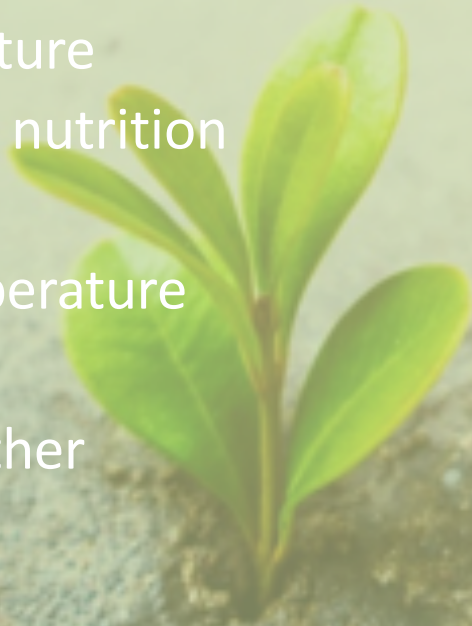
UAF CES

*With material adapted from Julie  
Riley*



# Plant Disease Diagnosis

- You must first assess the situation
- Need to rule out Abiotic Factors
  - Moisture
  - Plant nutrition
  - Light
  - Temperature
  - Wind
  - Weather



# Plant Disease Diagnosis



**You must first assess the situation**



**Need to also rule out Insect Pests**

Sometimes insect pests and disease go hand-in-hand

In this presentation, we will cover plant disease basics and guide you towards plant disease diagnosis and treatment



# What Causes Plant Diseases?

## Nonliving Factors

- Environmental/ Physical/ Mechanical/ Chemical
- (disorders, nonpathogenic, abiotic)

## Living Organisms

- Pathogens: Fungi/Bacteria/ Viruses, Nematodes, etc. (diseases, pathogenic diseases)
- Other biotic agents: Insects, Large Animals, Parasitic Plants

# Diseases Affect Functions



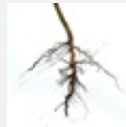
Leaves

Spots, blights, chlorosis, necrosis, and wilt



Stem

Damping-off, canker, wilt, gall, blight



Roots

Rot, galls, and nematodes



Flowers

Blight and wilt



Fruit

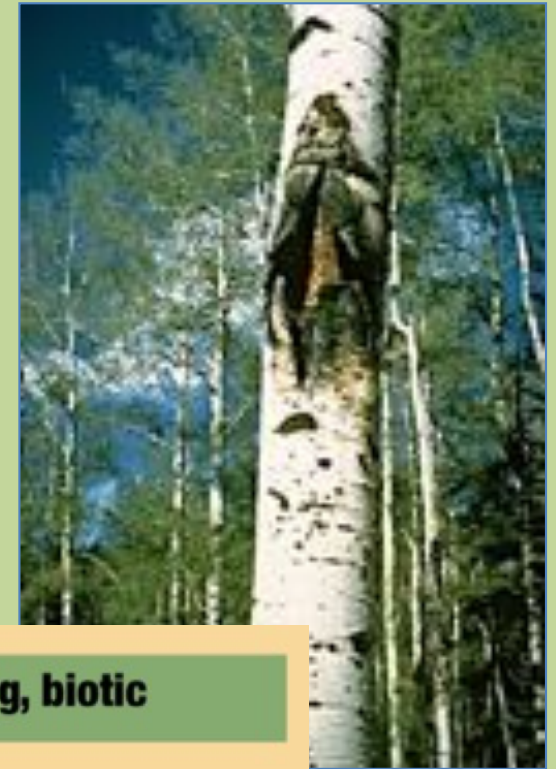
Soft rot and seed decay

# What is PLANT DISEASE?

Plant varies from healthy condition



- **Infectious agents**
  - living, transmittable
- **Non-infectious agents**
  - non-living, not transmittable



**Non-living, abiotic**

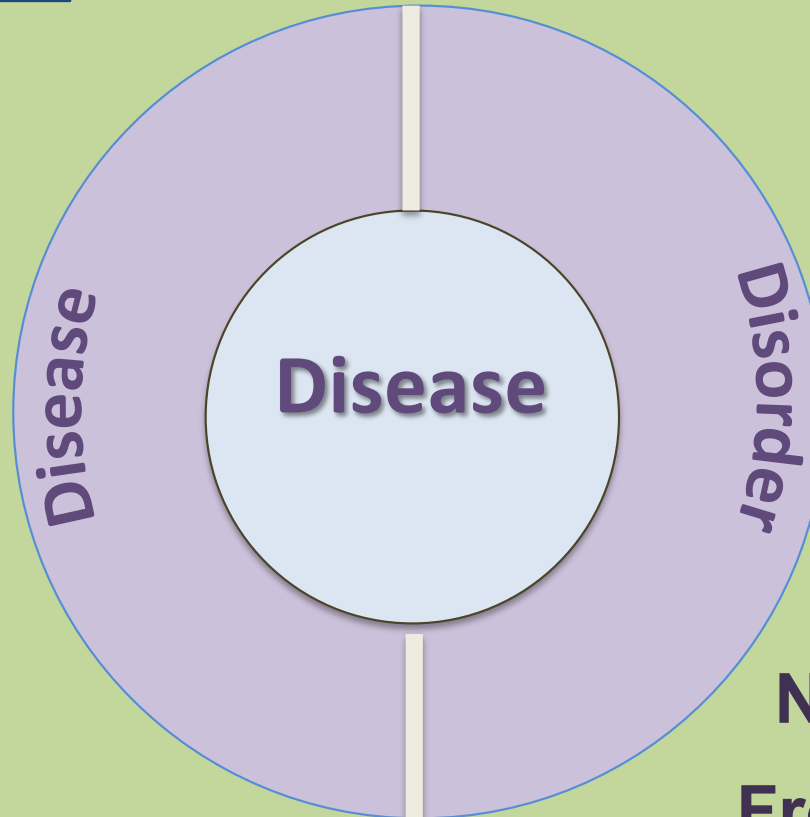


**Living, biotic**

**BIOTIC**  
(living)

**ABIOTIC**  
(non-living)

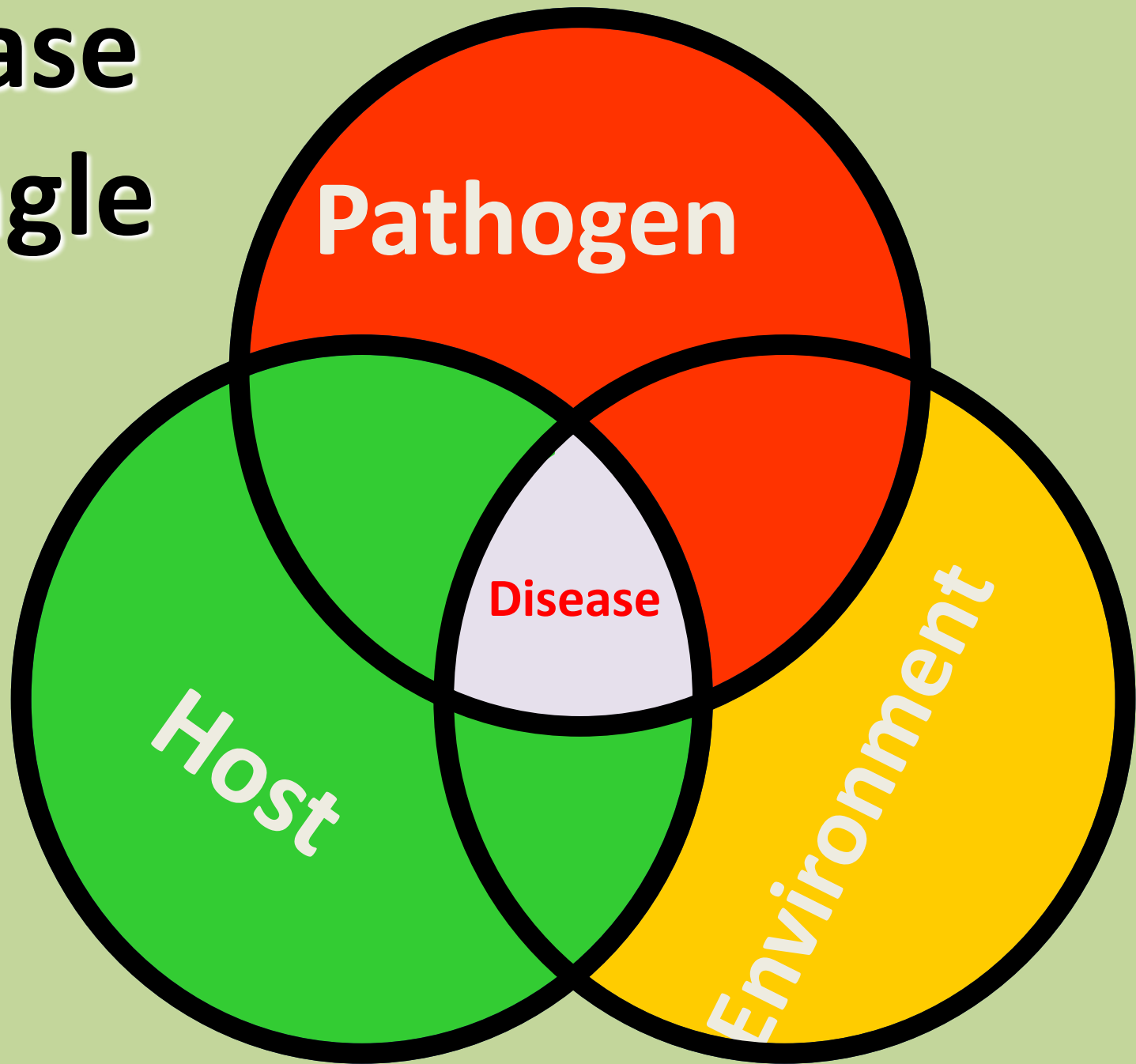
**Fungi**  
**Water molds**  
**Bacteria**  
**Virus**  
**Nematodes**



**Pesticide injury**  
**Nutrient deficiency**  
**Drought**  
**Hail**  
**Nutrient toxicity**  
**Frost injury**

**PATHOGENS**

# Disease Triangle





# PATHOGENS

\* Organisms capable of causing disease

**Fungi**

**Bacteria**

**Viruses**

**Mycoplasmas**

**Nematodes**



# **Causal Agent Terminology**

**Pathogen- causes disease (harms plant)**

**Parasite- lives in or on, and obtains nutrients from, another living organism (host); harms its host**

**Saprophyte- obtains nutrients from non-living organic material**

# Terminology

**Host plant-** plant on which a particular disease may develop

**Nonhost-** a particular disease is unable to infect or become established on the plant

**Alternate host:** another species of plant required for pathogen to complete its lifecycle.

**Host Range-** all plant & cultivars or varieties that can be infected by a particular pathogen

# Terminology

**Symptom- abnormal appearance of the plant**



WSU Hortsense Images: R. Byther

**Sign- physical presence of pathogen, pest or problem causing entity**

# Signs: physical presence of problem causing entity

*Pucciniastrum* rust of fuchsia

Rust  
sporulation



WSU Hortsense: R. Byther

# Symptoms Often Require Further Investigation



WSU Hortsense: R. Byther

*Phytophthora root rot: pathogen thrives in saturated soils*

# Fungi

- largest group of plant pathogens >7000 species
- reproduce by spores or spore bearing structures
- germinate to produce threadlike hyphae (mycelium)
- causes damage by direct penetration of plant cells and tissues
- enter plants via enzymes, mechanically or openings



# Fungi

- Cause nearly all of the economically important diseases.
- Characterized by filamentous mycelium.
- Non-photosynthesizing, exudes enzymes to absorb food.
- Reproduces by spores and fragmentation.

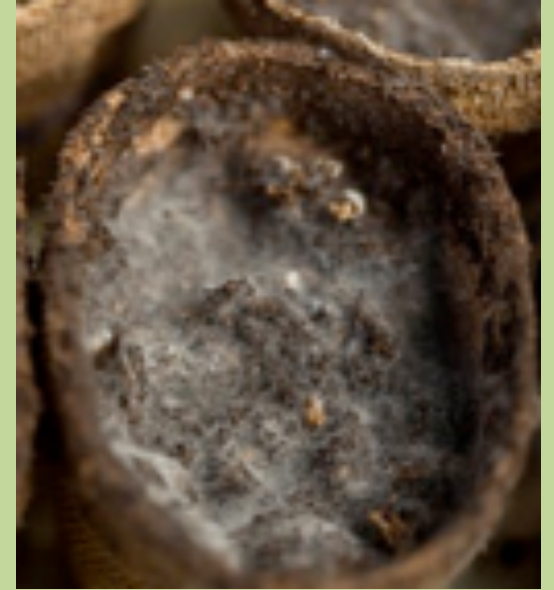


Photo by G. Gordon Pyle

Fruiti



# Fungal diseases

- Powdery mildew
- Black knot
- Dry rot

**Wood Decays and Stains.....**

Pini Conk or Red Ring Rot.....

Pinicola Conk or Red Belt Fungus.....

Chicken of the Woods or Sulfur Fungus.....

Velvet Top Fungus.....

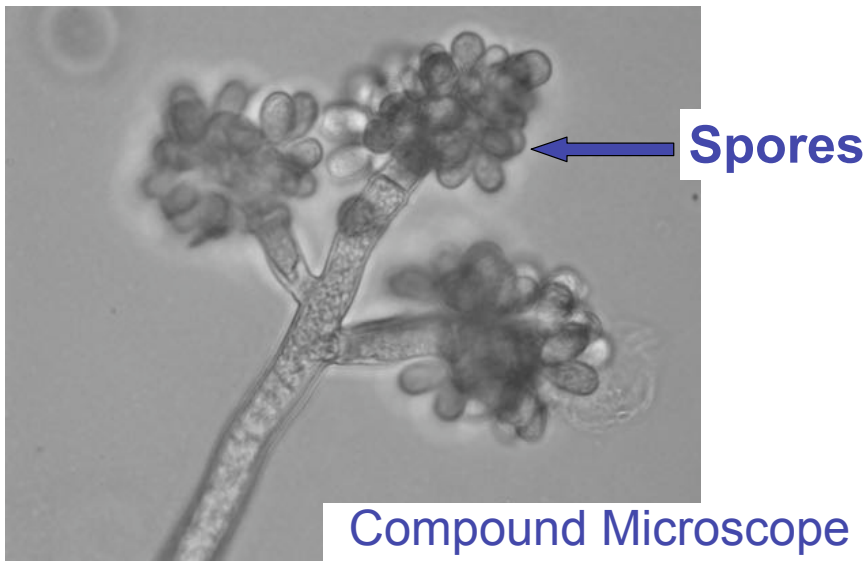
Artist's Conk.....

Lacquer Conk or Varnish Conk.....



# Signs versus symptoms

## Botrytis spores & mycelium are signs

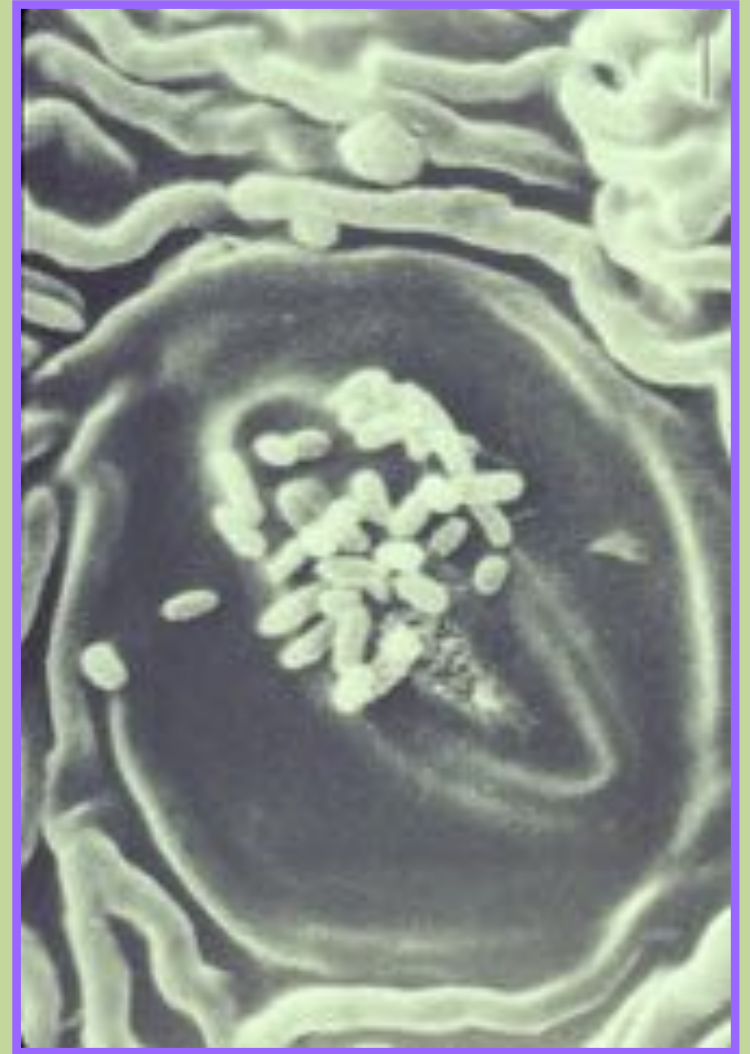


# Botrytis



# Bacteria

- **small, microscopic one-celled organisms**
- **reproduce by fission**
- **water important in spread of bacterial disease**
- **enter plants through wounds and natural plant openings**





**Fireblight on apple**

*Erwinia amylovora*

# Bacterial Diseases

One celled organisms

Wikipedia



North Carolina State University

**Bacterial leaf spot on begonia**

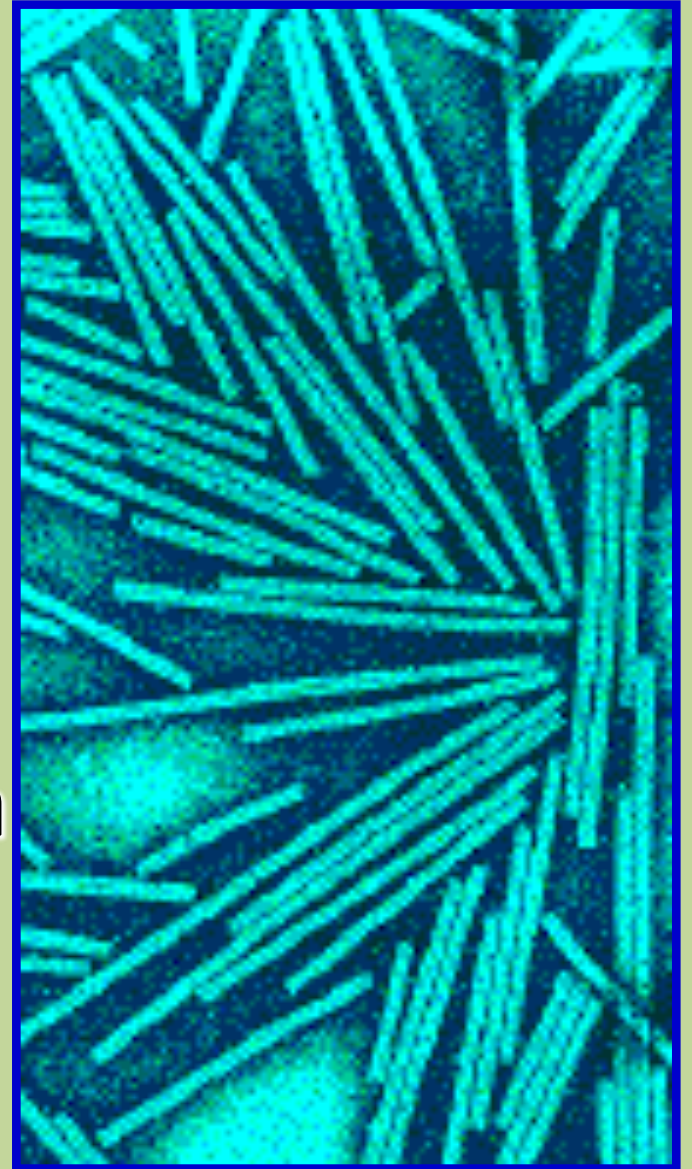
*Xanthomonas begoniae*

# Xanthomonas



# Viruses

- submicroscopic particles
- central core of nucleic acid and an outer coating of protein
- reproduce only in living cells
- transmitted by insects (vectors), mechanically or via plant tissue (pollen, seed, vegetative reproduction)



# Viral Diseases



Photo by Julie Riley

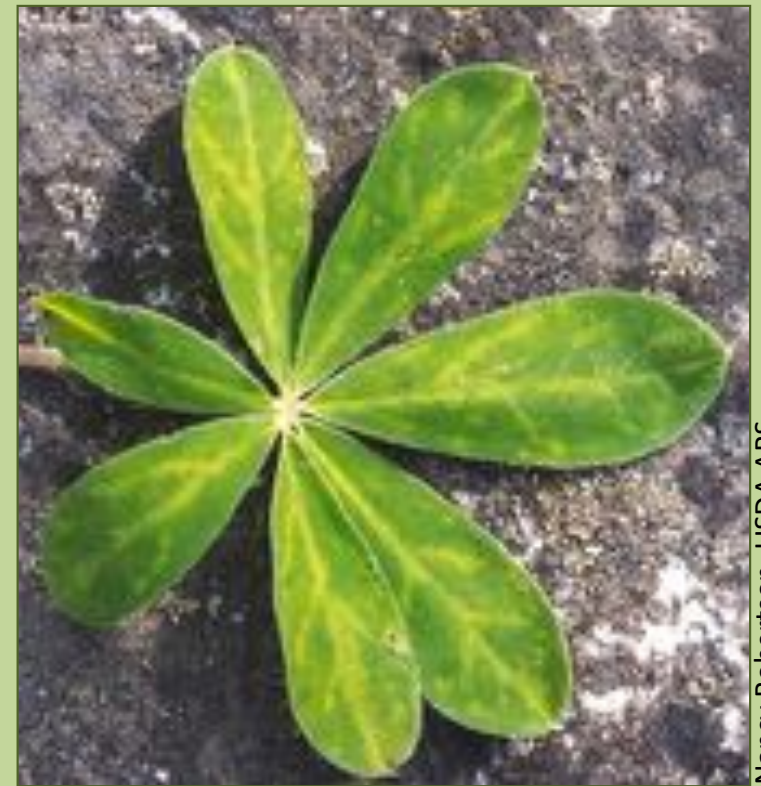
Virus on peony





Tobacco rattle virus on peony  
*Tobravirus*

# Viral symptoms



Vein clearing on Alaska  
lupine

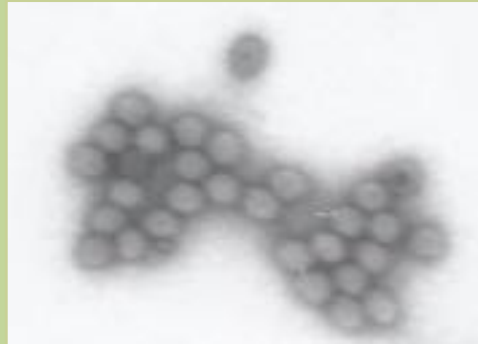
# Mosaic Virus



# Identification of viral diseases

Characterization of 'Lupine virus'

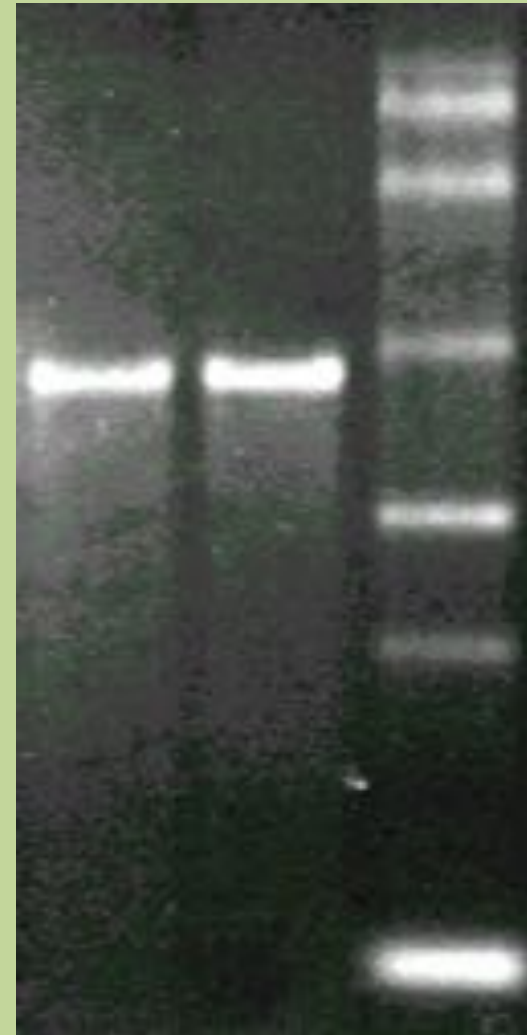
**Virions**



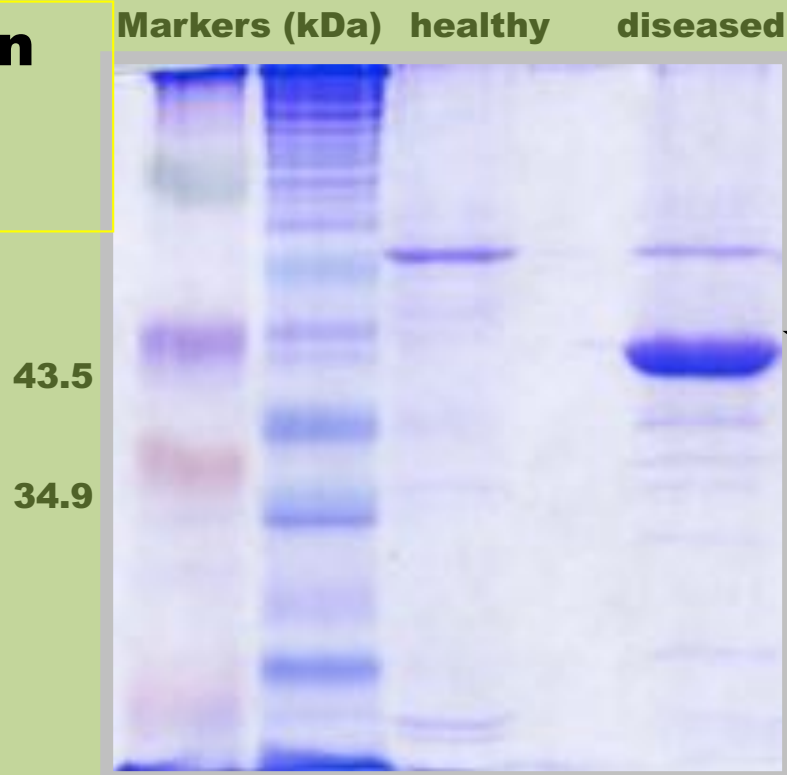
**RNA Gel**

Virion RNA

Marker (Kb)



**Protein  
SDS-  
PAGE**



Original slide by Nancy Robertson, USDA ARS

# Nematodes

- Roundworms, nonsegmented
- Some are animal parasites (horses). Many are free-living
- plant parasitic nematodes puncture plant cells with a stylet
- they feed on cell contents and inject a toxin
- reproduce by laying eggs



# Nematodes

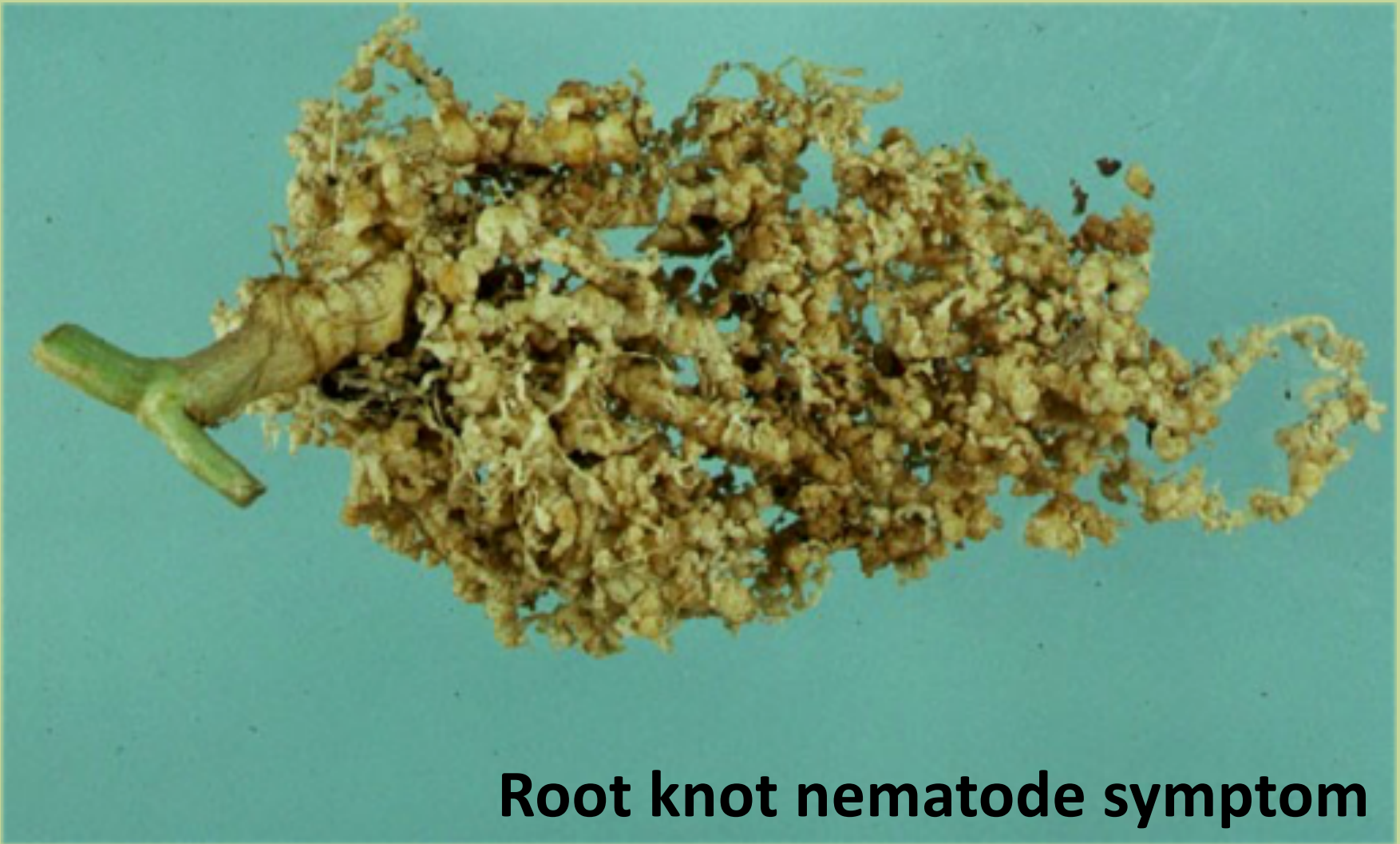
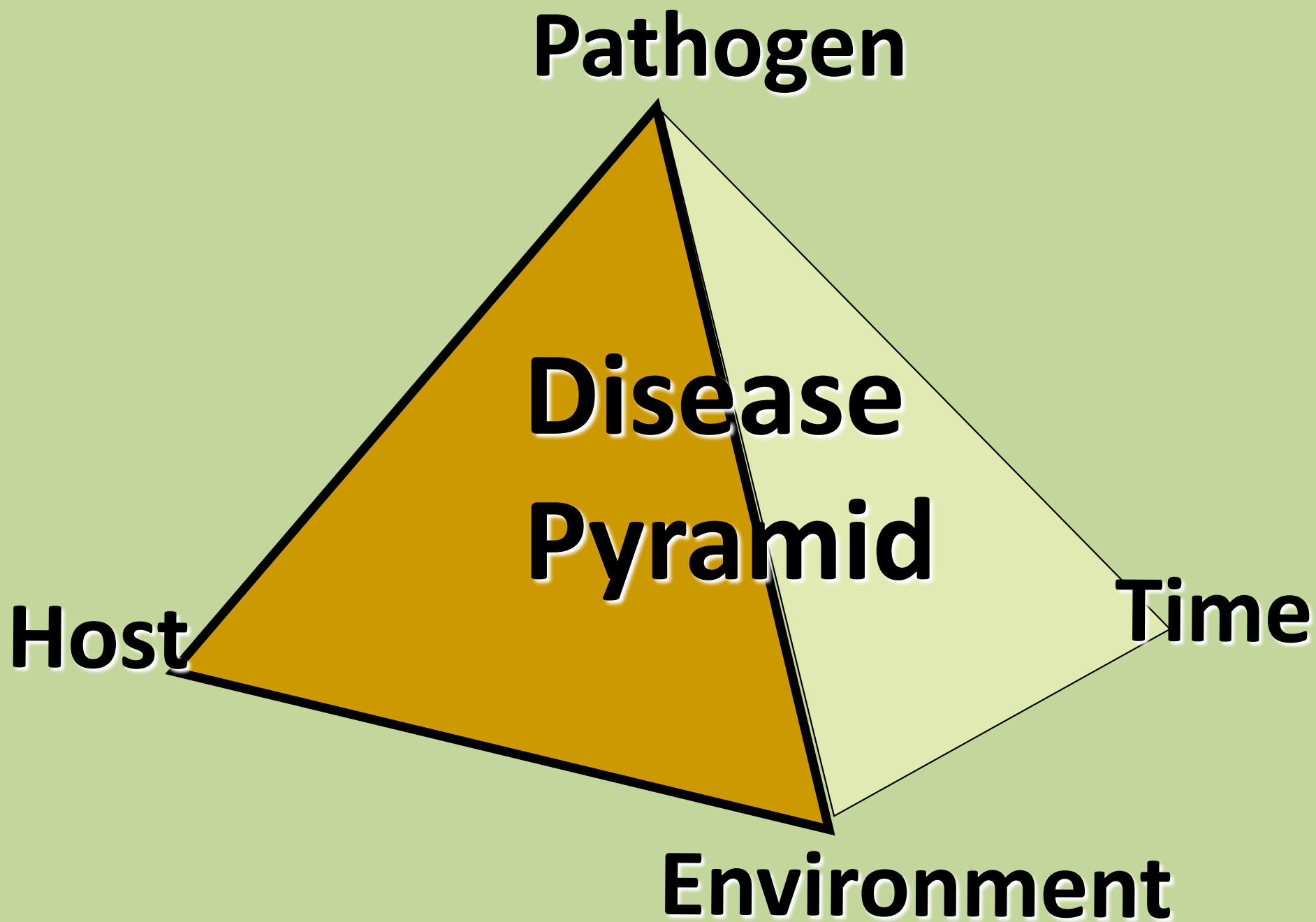


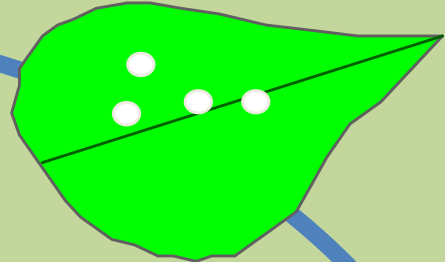
Photo: NC State Cooperative Extension

**Root knot nematode symptom**



# PATHOGEN LIFE CYCLE

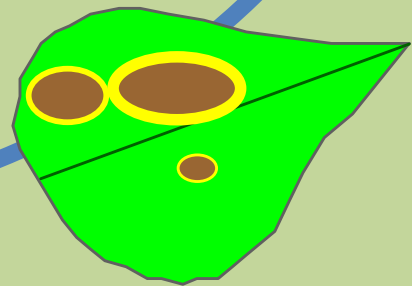
inoculation



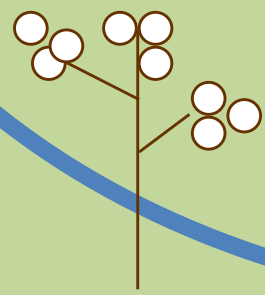
penetration

incubation

infection & colonization

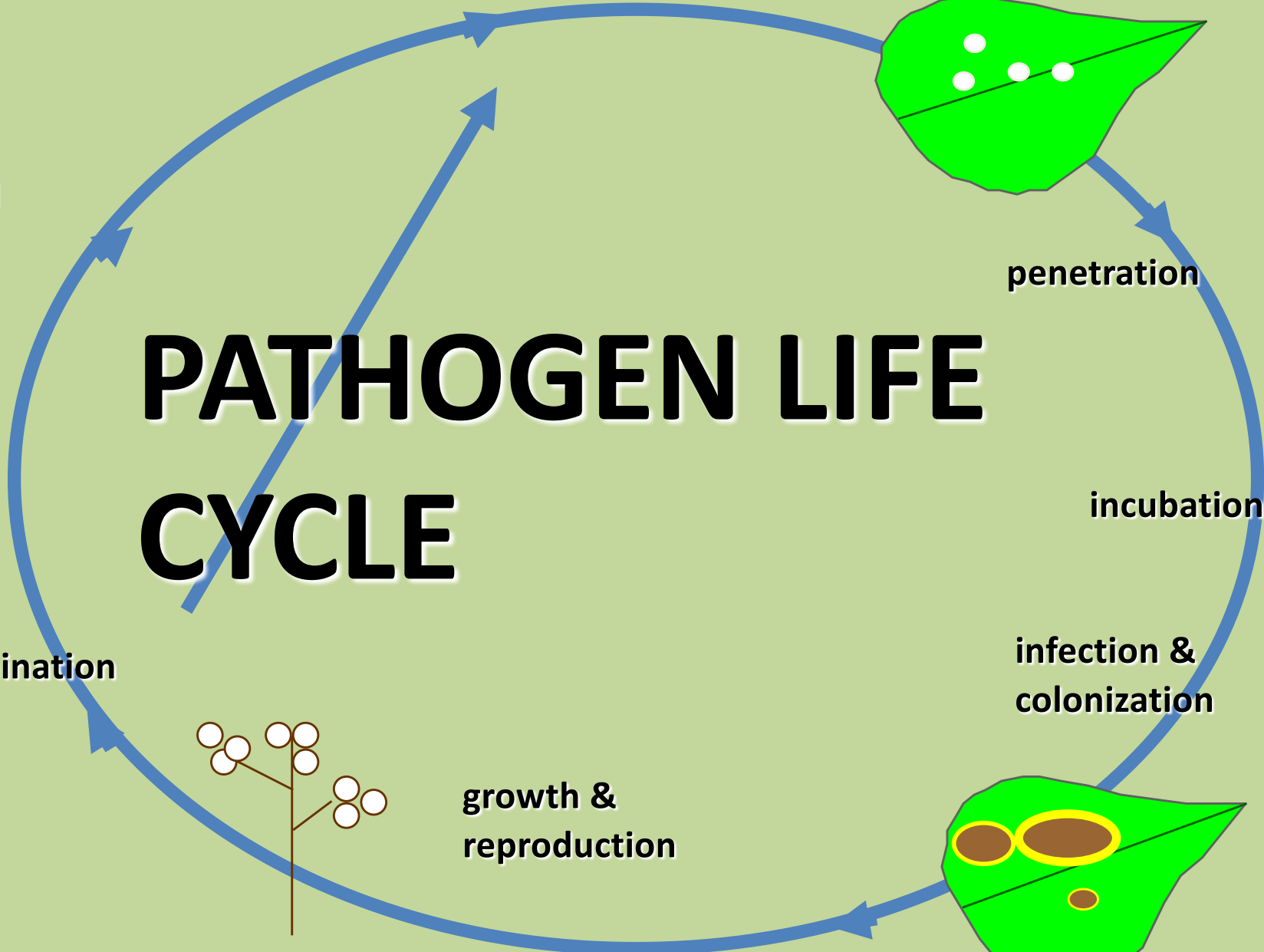


growth & reproduction



dissemination

survival



# **Disease Management Strategies**

**exclusion**

**eradication**

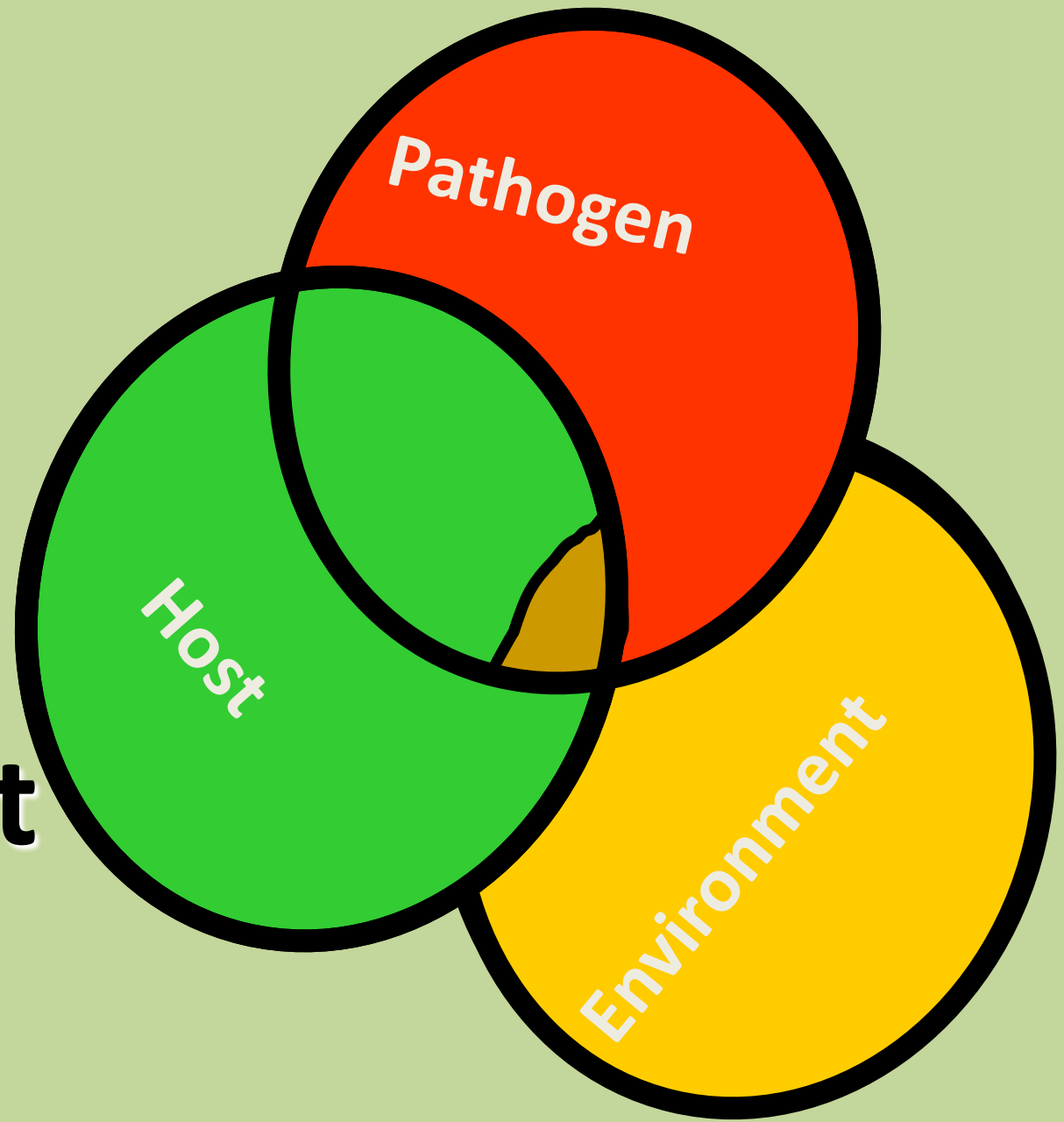
**sanitation**

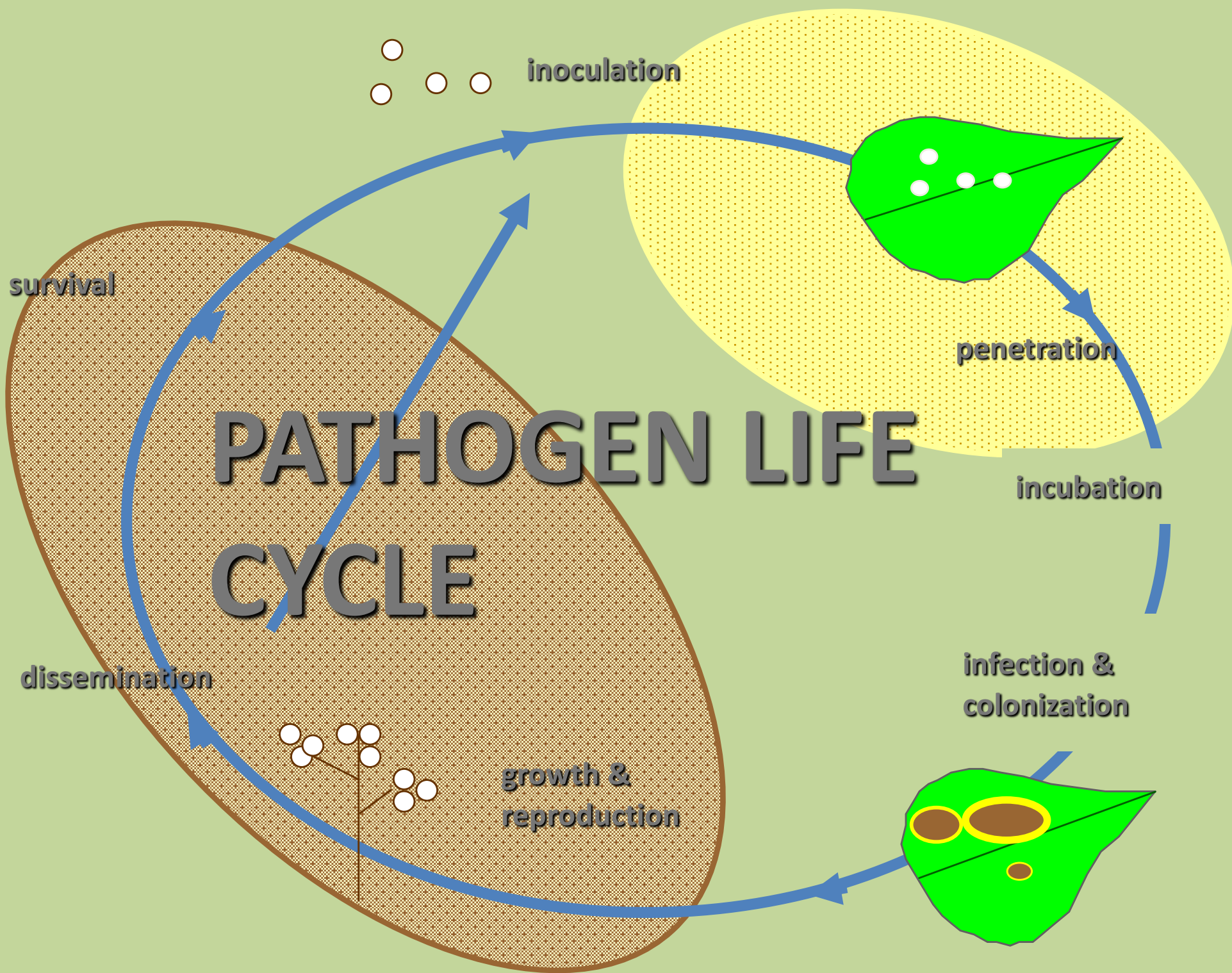
**protection**

**resistance**



**Impacting  
Disease  
Triangle to  
Achieve  
Management**





# PATHOGEN LIFE CYCLE

inoculation

penetration

incubation

infection & colonization

growth & reproduction

survival

dissemination

# Integrated Disease Management

- ✓ Cultural Methods
- ✓ Biological Methods
- ✓ Chemical Methods



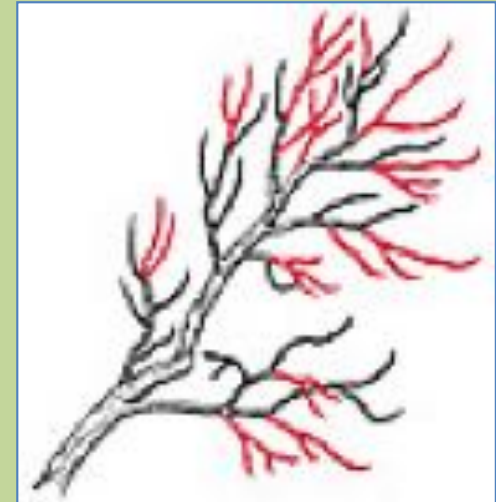
# Cultural Methods

Sanitation

Improvement of growing conditions of plants

Creating conditions unfavorable for the pathogen

Crop rotation, planting date



Pruning for good air circulation....

# How Do Pathogens Spread?

- Wind
- Water
- Animals, especially insects (Vectors)
- Within infected plants & infested soils

**Crucial Step:**

**Investigate the specific disease problem to determine HOW spread occurs & what YOU can do to prevent further spread**

# How Do Pathogens Survive From Year to Year?

- Understanding pathogen survival is important for developing **MANAGEMENT** strategies
- Overwintering stage is often the weakest link
- Common sites: plant debris, in cankers, in the vascular tissue, in buds, in vectors, exposed in water/soil, etc.

# Methods of Disease Control

- **Cultural practices**
  - site selection
  - proper planting time & methods
  - good nutrition
  - crop rotation    -- sanitation
- **Resistant or tolerant varieties**
  - Dutch Elm, Chestnut blight, apple scab









# Chemical Methods

**Correct diagnosis**

**Understand the biology of the  
pathogen**

***CAREFULLY* read, understand, and  
follow all label instructions**

# Pesticide damage



[Home.comcast.net](http://Home.comcast.net)

**Fungicides are  
usually applied as**

**Protectants**

# How Do Pathogens Penetrate Plants?

Direct Penetration Methods (fungi, nematode)

Natural Openings

- Stomata
- Lenticels
- Hydathodes
- Nectaries

Wounds

Vectors



# **General Principles for Healthy Plants:**

**monitor often**

**sanitation**

**careful watering**

**healthy planting stock**

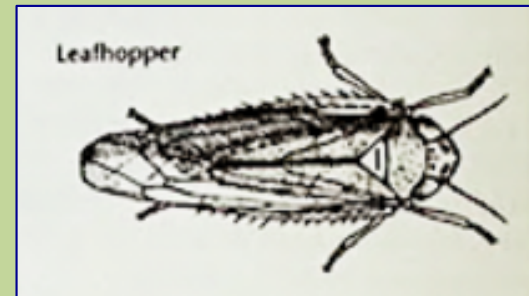
**resistance & diversity**

**right environment for species!**



# Disease Control continued

- **Disease free seeds/plants**
  - seed potatoes
- **Control of **vectors****
  - especially important to prevent spread of viruses
  - **leafhoppers,**  
aphids, mites





# Disease Control continued

- **Chemical Control\***:

**Fungicides**

**Bactericides**

**Nematicides**



Photo by Julie Riley

\* In disease management, pesticides are most effective against **fungi** pathogens.

# CHEMICAL CONTROL

- Best used with cultural controls
- Spray before first infection or at first sign of infection
- Fungicide coverage of the lower leaf surface important



- Alternate or tank-mix products with different modes of action



## Fungicide Groups

Group Code	Target Site of Action	Product names (examples)
1	Mitosis	Mertect, Topsin
2	Cytochrome reductase in lipid peroxidation	Rovral
4	RNS polymerase	Ridomil, Ridomil Gold
7	Complex II of fungal respiration	boscalid/Endura, Moncut
11	Complex III of fungal respiration: QoI site	Strobilurins/Quadris, Headline
M	Multi-site contact	Copper hydroxide/Kocide, Champ

From presentation by Ronda Hirnyck, University of Idaho Extension

## Cucumbers

### Diseases:

Bacterial wilt (*Erwinia tracheiphila*) - Remove and discard or destroy infested plants. Control cucumber beetles that spread the bacteria. (See striped or spotted cucumber beetles.) Control as soon as they appear. Some varieties are less susceptible to bacterial wilt but may not be readily available.

Powdery mildew - Avoid crowding plants. Space apart to allow air circulation. Eliminate weeds around plants and garden area to improve air circulation. In autumn, rake and dispose of all fallen or diseased leaves and fruit. Plant resistant varieties such as Marketmore 76, Slicemaster and Raider.

Scab - Avoid wetting foliage if possible. Water early in the day so aboveground plant parts will dry as quickly as possible. Avoid crowding plants.

Space apart to allow air circulation.



## Cucumbers

Cucumber mosaic virus - Remove and discard or destroy infested plants. Plant resistant varieties such as Pacer, Marketmore 76, Dasher II, Slicemaster, Spacemaster and Sweet Success. Manage aphids that spread virus. Eliminate perennial weeds such as milkweed, marshcress and yellow rocket; and avoid planting next to susceptible ornamentals.

Other diseases:

Anthracnose

Leaf spot

Downy mildew



## Summer Squash

### Diseases:

Bacterial wilt (*Erwinia tracheiphila*) -

Remove and destroy infested plants. If striped or spotted cucumber beetles appear control as soon as possible.

Powdery mildew - Avoid wetting foliage if possible. Water early in the day so that aboveground parts will dry as quickly as possible. Avoid crowding plants and eliminate weeds around plants and garden area to improve air circulation.



## Summer Squash

Scab - Avoid wetting foliage if possible. Water early in the day so that aboveground parts will dry as quickly as possible. Avoid crowding plants and eliminate weeds around plants and garden area to improve air circulation.

Viral disease - Remove and destroy entire infested plant along with immediately surrounding soil and soil clinging to roots. Eliminate wild cucumber and milkweed nearby. Plant variety Multipik to mask symptoms on fruit. Control aphids early in the season by washing off with water as needed early in the day. A hard stream of water can be used to remove many aphids.

Other diseases:

Downy mildew



## Winter Squash

### Diseases:

Bacterial wilt (*Erwinia tracheiphila*) - Remove and destroy infested plants. Control cucumber beetles if they appear.

Powdery mildew - Avoid wetting foliage if possible. Water early in the day so aboveground plant parts will dry as quickly as possible. Avoid crowding plants. Space apart and eliminate weeds around plants and garden area to improve air circulation.





## Winter Squash

Scab - Avoid wetting foliage if possible. Water early in the day so aboveground parts can dry as quickly as possible. Avoid crowding plants, Space apart and eliminate weeds around plants and garden area to improve air circulation. In autumn, rake and dispose of all diseased leaves and fruit. Do not save your own seed.

Viral disease -Remove and destroy entire infested plant along with immediately surrounding soil and soil clinging to roots. Eliminate wild cucumber and milkweed nearby. Control aphids early in the season.

Other diseases:

Downy mildew



## Tomatoes

### Diseases:

Blossom end rot - Water during drought or mulch to keep moisture level constant. Grow on soil high in organic matter. Fertilize properly. Avoid cultivating close to plants.

Catface - Grow locally recommended varieties and provide adequate fertilizer and water for vigorous growth.

Early blight, Septoria leaf spot - Locate new plants in a part of the garden different from previous year's location. Avoid wetting foliage if possible. Water early in the day so aboveground plant parts will dry as quickly as possible. Avoid crowding plants. Space apart to allow air circulation. Eliminate weeds around plants and garden area to improve air circulation. Practice plant sanitation. When plants are not wet, carefully remove and destroy affected plant parts. In autumn, rake and dispose of all diseased leaves and stalks. Septoria occurs early in the season, preferring cool, wet weather. Use clean transplants and remove lower infected leaves.



## Tomatoes

Late blight - Use same cultural control strategies as above. The fungus that causes late blight has recently become a major threat to home gardens and commercial growers because of migration of new more aggressive strains (genotypes) into the United States. Verification of late blight diagnosis and implementation of prompt control measures are highly recommended. Cultural controls mentioned above may not adequately control these new strains.



## Tomatoes

Fusarium wilt - Use same cultural control strategies as above. Plant resistant varieties such as Pik-Red, Better Boy, Duke, Freedom, Supersonic, Jet Star, Springset and Floramerica.

Verticillium wilt - Use same cultural control strategies as above. Plant resistant varieties such as Supersonic, Jackpot, Basketvee, Sunny, Jet Star and Springset.



## Turnip

### Diseases:

Black leg

Black rot

Turnip mosaic virus

While susceptible to the diseases that plague other cole crops, turnip diseases usually aren't a problem if grown in well-drained soil and harvested young.



## OTHER PROBLEMS

**Tip burn** on lettuce looks like brown and rotted areas on the edges of inside leaves. Tip burn happens when the lettuce plant loses more water from leaves than it can take up from the roots. This is more common during hot weather when plants do not get water often enough and do not take up enough calcium. It is more common on soils that have a lot of nitrogen.



## OTHER PROBLEMS

**Diseases** also affect leafy greens and are worse when it is wet. Choose disease resistant varieties, plant in well drained soil or on raised beds, and space plants so air flows between them. Water plants early in the day so they can dry. Rotate crops in a field to keep the spores from building up in the soil. Sprays of compost tea may work to prevent and control fungal infections.





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