

BASIC PLANT PATHOLOGY

for

EXTENSION MASTER GARDENER VOLUNTEERS

This 7 page summary is a companion to the more comprehensive materials provided through the core preparation session.

I. General Information.

Casual Agents of Disease:

Living = fungi, bacteria, nematodes, viruses, and phytoplasmas = microplasma-like-organisms.

Non-living (environmental) = nutrient deficiencies, mineral toxicities, lack/excess soil moisture, too low/too high temperature, lack/excess of oxygen, air pollution (ozone), soil acidity/alkalinity (pH).

Plant Disease: any alteration in the physiological processes of a plant, caused by living organisms or non-living agents, which negatively affects the plant.

Plant Pathogen: a pathogen is an organism that is capable of changing the physiological processes of a plant, thus causing disease.

Pathogenic: means disease causing.

Plant Pathology is the study of:

1. the living entities and the environmental conditions that cause disease in plants.
2. the mechanisms by which these factors produce disease in plants.
3. the interactions between disease causing agents and the diseased plant
4. the methods of preventing or controlling and alleviating the damage it causes.

History of Plant Pathology.

700 B.C.- The Romans celebrated the holiday “Robigalia” that involved sacrifices of reddish colored dogs and cattle in an attempt to appease the rust god Robigo.

470 B.C.- Pliny was the first to use a fungicide, amorce of olives, to control blight.

1844-1845- The Irish Potato Famine, caused by the Late Blight fungus *Phytophthora infestans*, struck Ireland and prompted the birth of modern plant pathology. The average adult male ate 15 lbs. of potatoes a day. The Famine killed 1.5 million people and forced another 1.5 million to immigrate between 1845-1850. The population of Ireland was 8.5 million in 1840, it decreased to 4 million by 1900.

1885- Bordeaux mixture. Downy Mildew of Grape was a great problem in the growing fields in France but there was no known ways of controlling it. The vineyards were also troubled with pilferers. They began applying a mixture of copper sulfate and lime to the plants along edges of the fields. The bluish-white mixture deterred people from helping

themselves to a snack. It was also observed that these plants held onto their leaves throughout the season.

1900- White Pine Blister Rust caused by *Cronartium ribicola*. The pathogen was introduced on seedlings from European nurseries. White pines, especially young trees, and plants belonging to the genus *Ribes* (currants and gooseberries) are susceptible to the disease. Although WPBR is occasionally a severe foliar disease on *Ribes* plants, on white pines it is lethal if allowed to spread from an infected branch into the trunk. This disease caused the first US quarantine in 1912.

**“Current” information: Within the blister rust hazard areas, all susceptible *Ribes* should be removed from the vicinity of valuable white pines. *Ribes* are not allowed to be planted in nine northern counties of New York and parts of 6 others. If you wish to plant *Ribes* in New York State, contact Robert Mungari (Phone 518-457-2087) at the NYS Dept of Agriculture & Markets before purchasing or planting to determine if you can plant in your area.

1904-1940- Chestnut Blight caused by *Cryphonectria (Endothia) parasitica*. Chestnut seedlings imported from the orient brought with them the pathogen that killed off all the mature chestnuts in eastern North America. The disease devastated the people who relied on the chestnut tree for their livelihood. There are still some sprouts left in the forests, put up by the living root systems, but they too eventually succumb to the blight.

1910- Citrus Canker caused by *Xanthomonas axonopodis pv. Citri*, was discovered near the Georgia border and was eradicated in 1931. The pathogen was found 400 miles away in Dade County in 1912. The pathogen spread throughout the Gulf States and as far north as South Carolina. It took more than 20 years to eradicate that outbreak of citrus canker and \$2.5 million in State and private funds (the equivalent of \$28 million in 2000 dollars). In 26 counties, over 250,000 grove trees and over 3 million nursery trees were destroyed by burning. Subsequent outbreaks occurred in 1986 and 1995.

1930-present- Dutch Elm Disease caused by *Ophiostoma ulmi*. This disease devastated mall and roadside planting of American elm trees throughout much of the United States.

1941-present- Golden Nematode, *Globodera rostochiensis*, was discovered in 1941. It entered the country on the tracks of WWI equipment returning from Europe. It caused a slow decline in potato plants that eventually lead to death. As of 1955, the distribution

was believed to be located only in Nassau and Suffolk counties in NYS. After decades of building their population levels, the GN was capable of reducing the potato yield up to 70%. For over 60 years, an effective Federal and State quarantine program has confined the pest to nine counties in New York.

1970- Southern Corn Leaf Blight caused by *Helminthosporium maydis*. Originally considered a minor disease, a change in the genetics of seed corn caused an epidemic. In 1970, the disease was reported in every state east of the Mississippi River, also in several states west of the Mississippi River. The epidemic received enormous press coverage with over 37 articles printed in the Chicago Tribune alone. Losses due to the epidemic were officially estimated at nearly \$1 billion nationally. Reduction in yield was greater in

the South versus the min-west corn belt states. In some areas damage caused losses of 50-100%. Nationally losses averaged 20-30%.

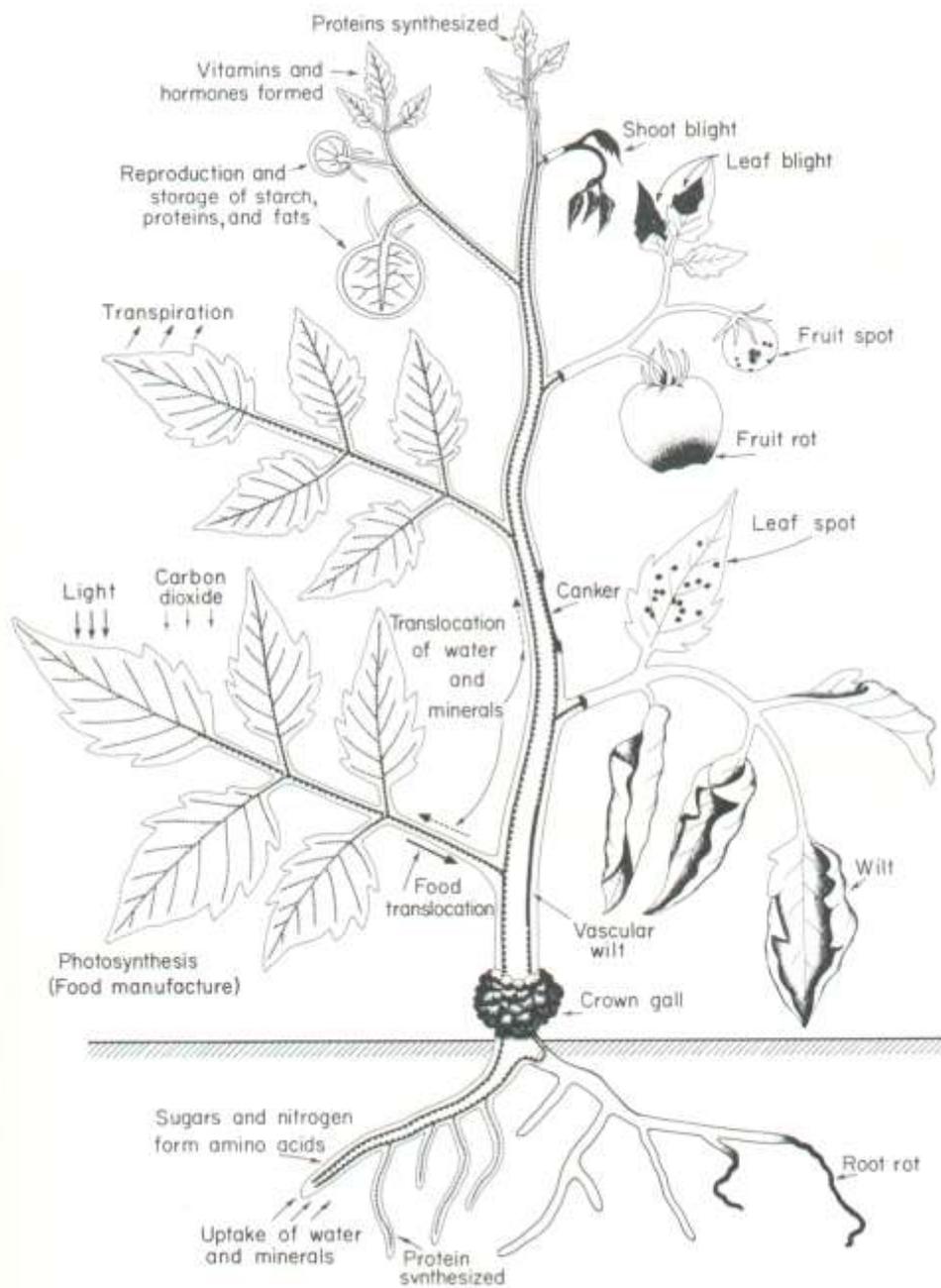
1995- Sudden Oak Death, caused by *Phytophthora ramorum*, was discovered in California. A large number of tanoaks were found to be declining with no known cause. It took five years to isolate and identify the causal agent. Also called ramorum blight and ramorum dieback. Although the disease was first observed in the United States in tanoaks, it is also found to infect **many, many** other plant species.

1999- Southern Wilt/Brown Rot, caused by *Ralstonia solanacearum* R3 B2. Southern Wilt is a disease of Geranium and Brown Rot is a disease of Potato. *Ralstonia solanacearum* Race 3 Biovar 2 has appeared on Geranium a few times in recent years but it appears to be confined to greenhouse crops and there is no evidence of spread to potato, tomato, or eggplant.

1999- Plum Pox, caused by *Plum Pox Virus*, is a disease of stone fruits caused by a viral pathogen called the Plum Pox Virus, also known as “Sharka”. It was first discovered in an Adams County, Pennsylvania Orchard in 1999. It is a member of the Agricultural Bioterrorism Select Agent Listing of 2002. It was removed from the listing in April 2005 due to its limited ability to spread easily.

2004-Soybean Rust, is caused by two fungi named *Phakopsora pachyrhizi* and *Phakopsora meibomiaae*. It is a member of the Agricultural Bioterrorism Select Agent Listing of 2002. It was removed from the listing in April 2005 due to its established presence in the US. *P. pachyrhizi* appeared in the US in November 2004, apparently entering on winds of Hurricane Ivan. It was found in 9 States shortly thereafter. Detected by a NPDN exercise participant. It was found in Florida early in 2005 on Kudzu and volunteer Soybean and new detections for this season remained in the South.

Plant Disease Symptoms:



Examples = root rot, leaf spot, gall, fruit rot, blossom blight, canker, shoot blight, leaf blight

Points to keep in mind=

- 1) No single plant pathogen can cause many different symptoms on a plant
- 2) More than one pathogen or disease can occur on a plant at one time
- 3) There are some symptoms that may appear identical for two different diseases

Pay particular attention to the roots of a plant when evaluating it for disease. Anything that affects the roots will have some effect on the growth and function of all parts of the plant above ground.

Symptoms produced by plant pathogens include:

Wilts: Verticillium Wilt on Watermelon.
Fusarium Wilt on Cyclamen corm. Notice the red/brown discoloration of the vascular tissue.

Blights: Diplodia (Sphaeropsis) Tip Blight on Pine.
Late Blight on Tomato caused by *Phytophthora infestans*.

Leaf Spots: Leaf spot on Fiddle leaf Fig caused by the fungus *Glomerella*.
Leaf spot on Ivy caused by a bacterium.

Fruit Rots: Black Rot of Pumpkin caused by the *Didymella* sp.
Late Blight of Tomato caused by *Phytophthora infestans*.

Cankers: Cytospora Canker on Spruce, overall branch dieback.
Cytospora Canker on Hemlock, a close-up of a canker.

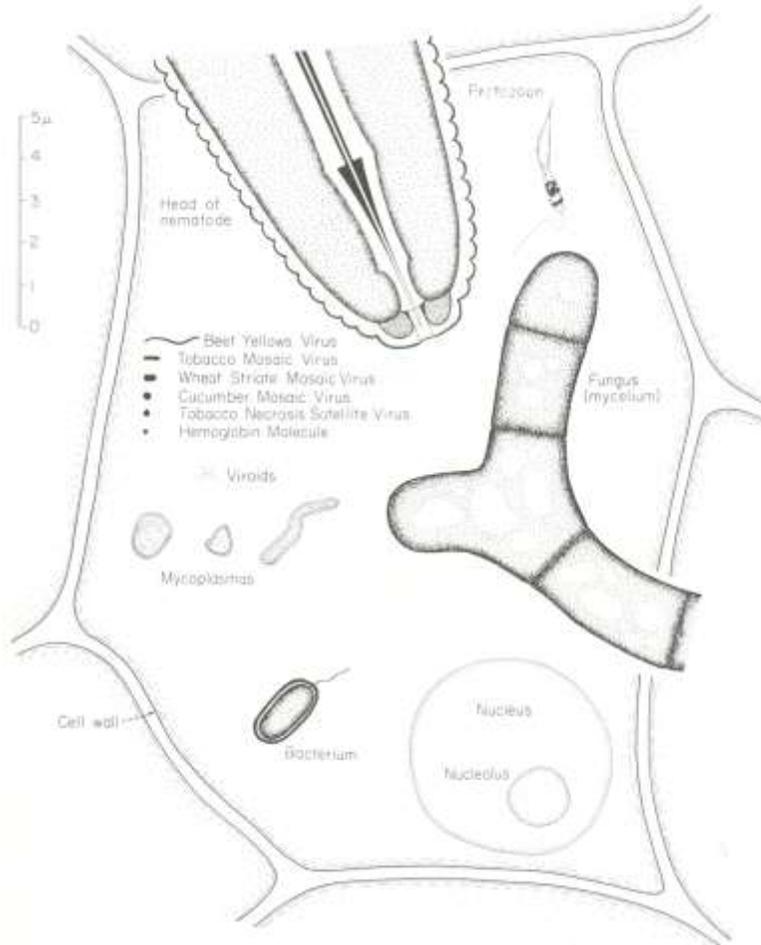
Root Rots: Root Rot on Spinach caused by the fungus *Fusarium*.

Damping Off: Damping Off of Pepper caused by the fungus *Fusarium*. Note the narrowing of the stem right at the crown area.

Reduced Growth, Development, and Yield: Ranunculus plants with and without Impatiens Necrotic Spot Virus.

<u>Symptoms:</u>	<u>Bacteria</u>	<u>Fungi</u>	<u>Viruses</u>	<u>Nematodes</u>	<u>Phytoplasmas</u>
Wilts	√	√		√	√
Leaf Spots & Blights	√	√	√		
Fruit Rots	√	√			
Root Rots	√	√		√	
Damping Off		√			
Distorted Growth	√	√	√	√	√

Plant Cell with various plant pathogens present:



Parasite: an organism that invades and consumes another living organism; a plant pathogen is a parasite.

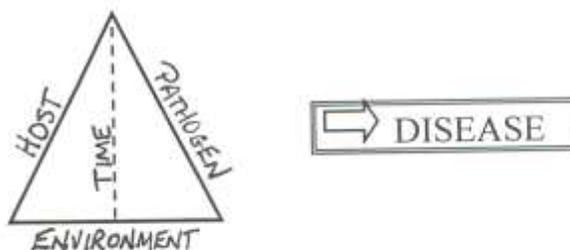
Saprophyte: an organism that derives its food from dead, organic matter. Ex: Birds Nest Fungus growing on a dead log.

Some plant pathogens may be able to live as both a saprophyte and a parasite. A parasite and saprophyte can often coexist together (part of tree branch is alive and part is dead).

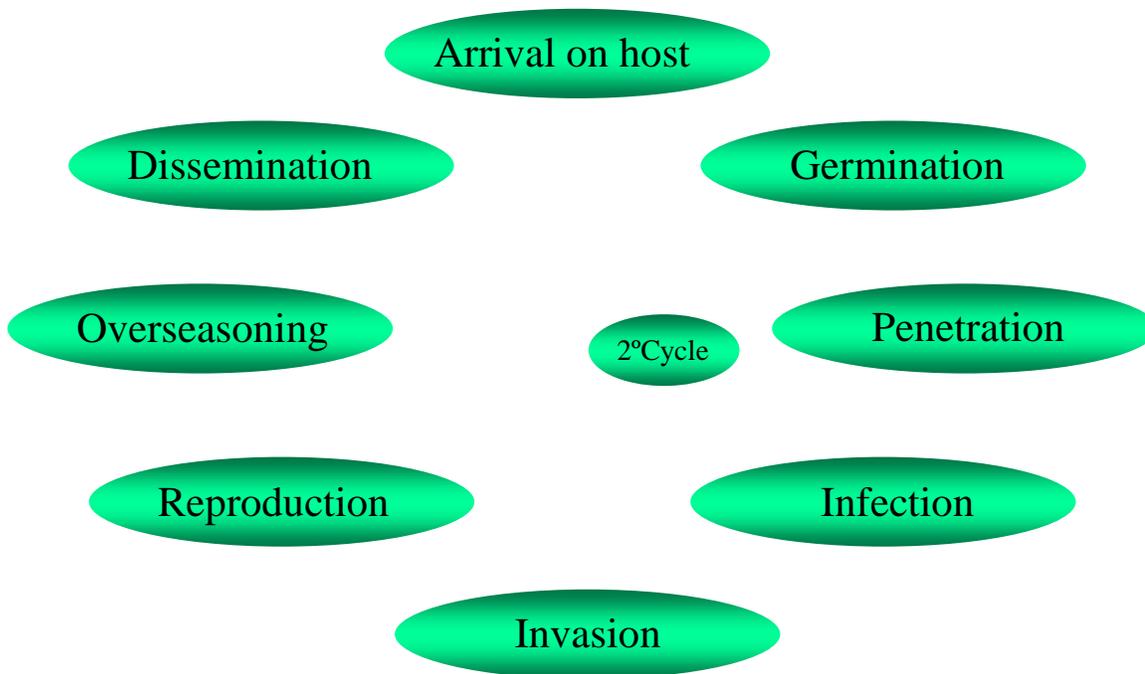
Often saprophytes overgrow parasites so the real cause of the symptom cannot be determined.

Disease Pyramid: 1) susceptible host plant, 2) virulent pathogen, 3) favorable environment (moisture, temperature) 4) time for the interaction to occur.

All these factors must be present for disease to occur.



Disease Cycle:



Spread of Plant Pathogens: rain, dew irrigation, drainage water, wind, soil; insects, crop debris, seeds & propagating materials, man, animals, machinery.

Generally microorganisms cannot move themselves from one plant to another due to their extremely small size. Thus they rely on elements in the environment for movement (rain, dew, wind, etc.). Microorganisms also must produce very large numbers of reproductive bodies so that at least a few will happen to land in the right place and survive.

A Broader Description of the Disease Cycle based on Calendar Year:

The disease cycle usually occurs during the growing season of the plant (April to September). For a fungus, the first spores produced during the spring are called **primary spores** (or primary inoculum); those produced in successive lifecycles of the fungus are called **secondary spores** (or secondary inoculum). These secondary spores are generated throughout much of the growing season and allow the fungus population to really build up.

A pathogen must **survive (overwinter)** during plant dormancy (October to March).

A pathogen must also survive other unfavorable environmental conditions (i.e. drought, heat, lack of food). Examples of overwintering structures for fungi are tarspots on maple leaves. These allow **Rhytisma** sp., the cause of tarspot, to overwinter. “Shoe strings” on tree trunks allow **Armillaria** sp., a fungus that causes root rots of woody plants, to survive unfavorable conditions. A virus can survive the winter in the affected plant itself (if perennial) or in nearby perennial weeds.

Learn More: Cornell University Plant Disease Diagnostic Clinic: <http://plantclinic.cornell.edu/>
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