

"What's your problem?" Diagnosing plant disease for nursery growers

Luisa Santamaria, Ph.D.
luisa.santamaria@oregonstate.edu



Oregon State University
North Willamette Research
and Extension Center



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What is the main goal in plant production?



Healthy Plants

Every activity and practices at the nursery are connected.



Plant disease

Any change or alteration in the development of a plant.

Sick plants (**biotic causes**) vs. injured plants.



Plant disease diagnosis

Where do you start?



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Why is important an early diagnostic?



Plant diseases spread as quickly as human diseases.



Infected plants cannot be saved.

Early detection and correct diagnosis will cut losses.



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A correct diagnosis is useful information



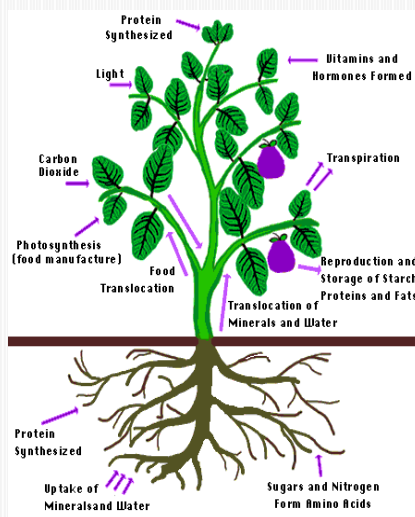
Look closely for clues



- ✓ You are able to make better decisions
- ✓ Allows you to plan for the future
- ✓ Don't guess; have the problem diagnosed

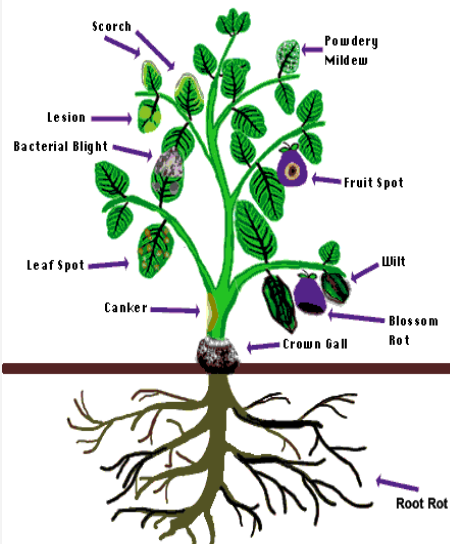
Consider possible causes/agents
Observations are key

Healthy plant



versus

Sick plant



(Source: Department of Plant Pathology, The Ohio State University.)

Abiotic Problems - (non-living causes)

Environmental factors/chemical factors

- ✓ Low or high temperature,
- ✓ Acidity/alkalinity (soil pH),
- ✓ Nutrient deficiencies
- ✓ Air pollution
- ✓ Water stress or excess
- ✓ Cold or heat injury
- ✓ Pesticide/ herbicide injury



Copyright 2006 Melodie Putnam, Oregon State University Plant Clinic

Pluot (*Prunus* sp. hybrid) foliar distortion caused by cold damage.

Characteristics of abiotic damage

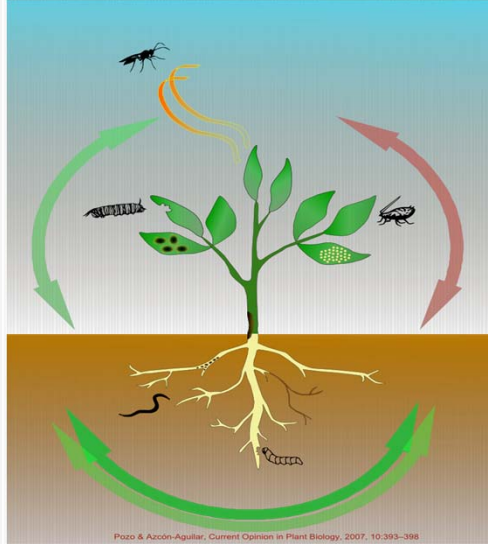
- ✓ There is no organism to reproduce or spread from plant to plant.
- ✓ Plant symptoms show up over a period time.
- ✓ Lesion do not grow.



Biotic causes (living organisms)



Insects
Nematodes



Characteristics of biotic diseases

- ✓ Move from sick plants to healthy plants.
- ✓ Nonuniform damage pattern: scattered damage on one or only a few plants species.



Observation of Patterns



Scattered symptom
distribution

Random pattern of damage

<http://www.forestryimages.org>

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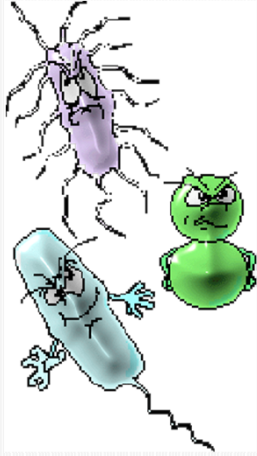

Weeds



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
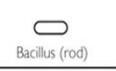







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Pathogens

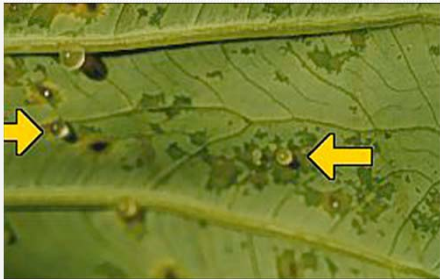


- ✓ Disease-causing organism: It is a living organism that can cause plant disease. Also known as: “biological agents”.
- ✓ They are microscopic.

Bacteria

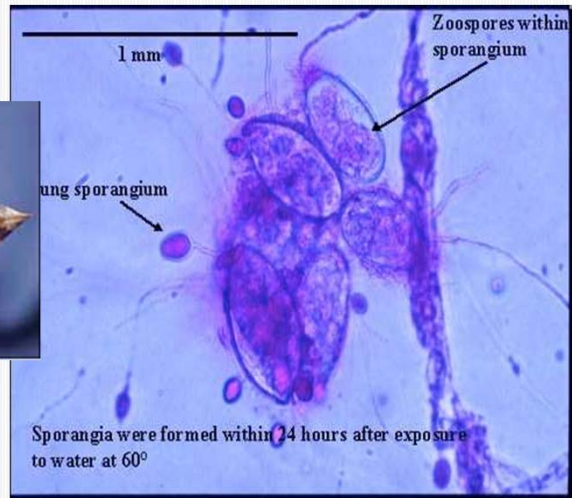
Coccus sphere	Bacillus (rod)	Spirochete
 Pairs and singles	 Pairs and singles	 Borrelia
 Chains	 Chains	 Treponema
 Clusters	 Flagellated bacilli	 Spirilla

- ✓ Their cell walls are covered with a slimy matrix.
- ✓ Bacteria can build up to such high numbers in a plant that they ooze out of its tissue.

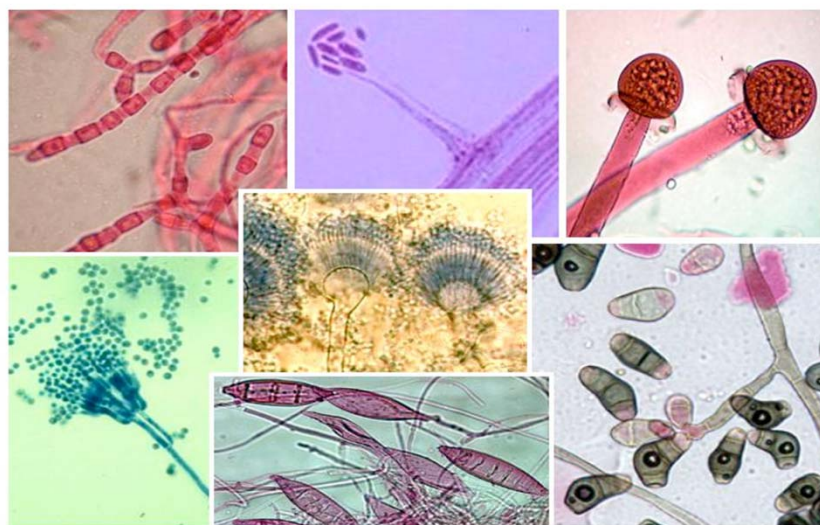


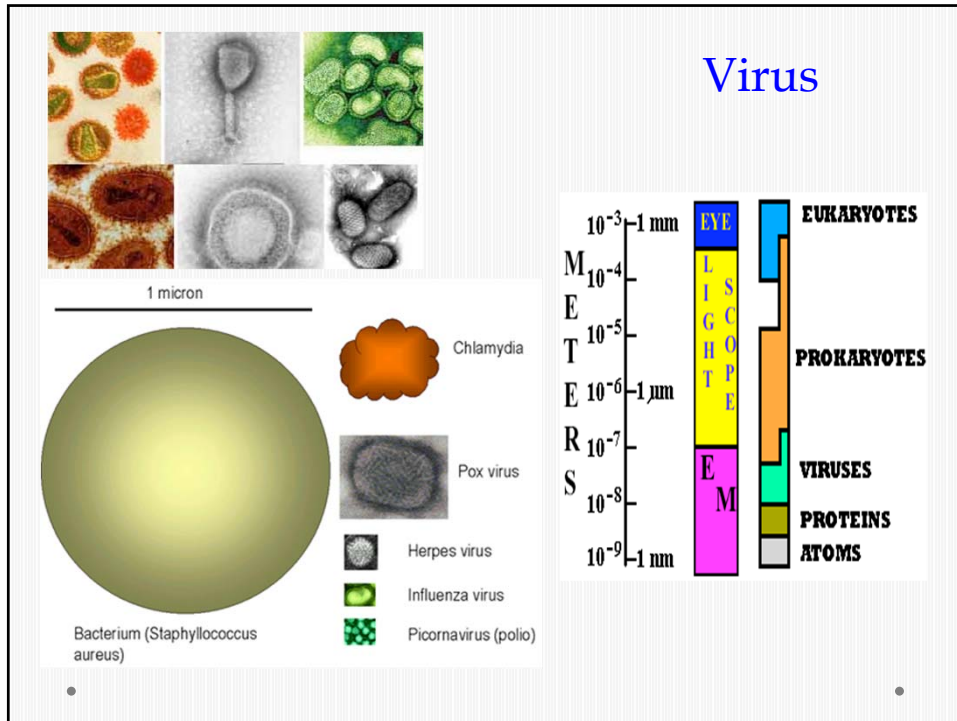
http://erec.ifas.ufl.edu/plant_pathology_gui/delines

Fungi: the largest group of plant pathogens



Fungal structures - fruiting bodies, thousands of spores





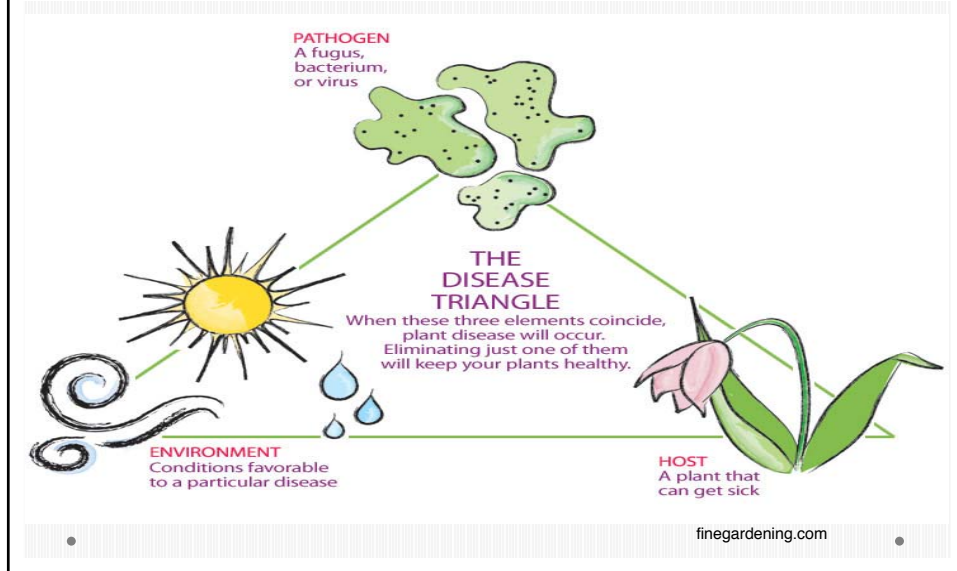
Host plant

This is the plant that allows the penetration and establishment of the pathogen.

There are **susceptible, resistant, and tolerant plants**; this is related to its genetics.



How do the plants get sick? DISEASE TRIANGLE



Pathogen Spore

Pathogen Attacked Infiltrated and Infected

- ✓ Wet weather is favorable for downy mildews, leaf spot, rusts, and root rot diseases.
- ✓ Cool, humid weather is favorable for gray mold (*Botrytis*)
- ✓ Hot, humid weather favors *Rhizoctonia* diseases

October 11, 2012

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Oct 15, 2012 8:08 PM (7/11)

USCC_NASDAQ

Look for Signs and Symptoms of Disease.

Do you know the difference?

Do not jump to conclusions when a plant problem is first noticed and disease may be the cause.



Observe carefully affected plants, the surrounding plants, and the general environment.

Symptoms and **signs** are used to diagnose the condition of a plant.

Symptoms can include leaf spots and leaf blight, **wilt**, galls, cankers, **rots**, necrosis, **chlorosis**, and **general decline**.

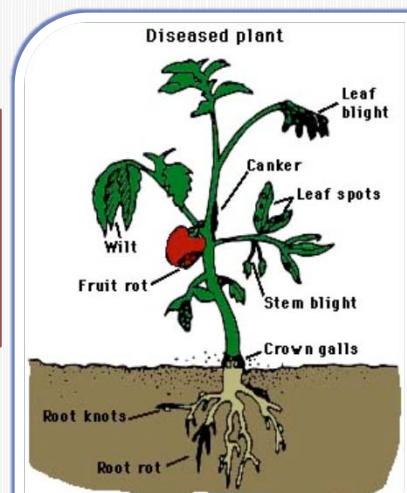


Fig. 1. Possible disease symptoms on plant

Examine all part plants for Symptoms and Signs

Leaves

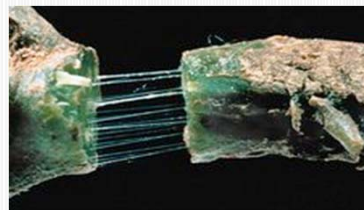


Leaf spots could provide some clues to identify the pathogen.

Symptoms of **bacterial infection** in plants are much like the symptoms of fungal plant disease.



Angular bacterial spot



Bacterial ooze



Chlorotic halo



Streaked bacterial spots in monocotyledonous plants.

Leaf spots caused by **fungi**



Necrotic leaf spots



Chlorotic leaf spot

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Leaf spots caused by **virus**



Mosaics: chlorotic areas alternate with green areas



Tomato spotted wilt virus (TSWV)

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Stems

If affected branches are cut, a ring of discolored wood can be seen.



• Stem cankers



Roots

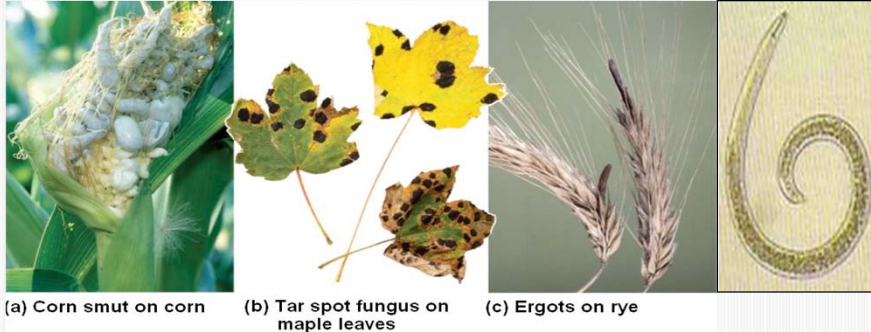


Nematode damage



Root rot damage

Signs: Physical evidence of the pathogen, including fungal fruiting bodies (such as mushrooms or pycnidia), mycelia, bacterial slime, presence of nematodes.



Mycelium (plural mycelia) is the vegetative part of a fungus, consisting of a mass of branching, thread-like hyphae.

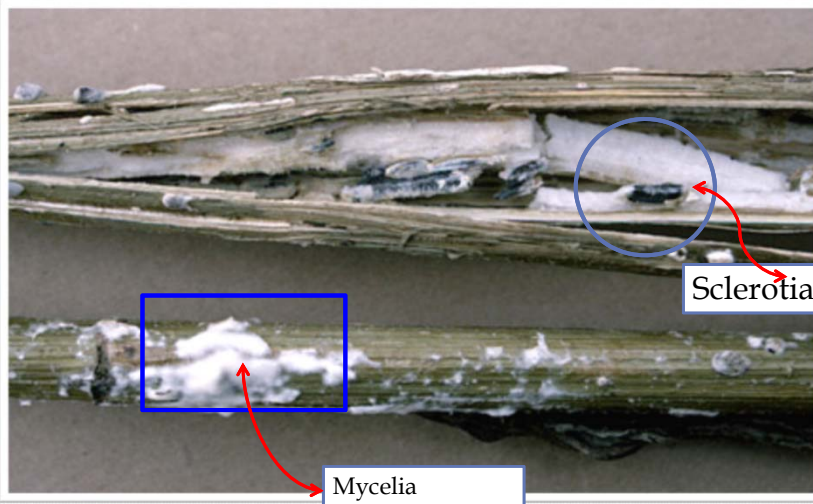
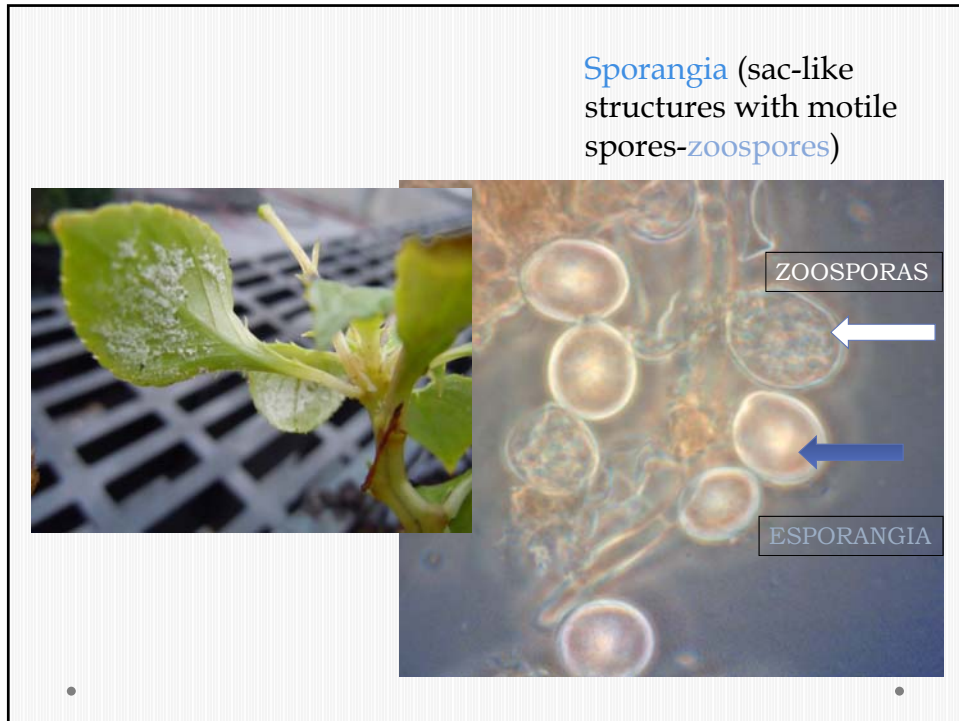
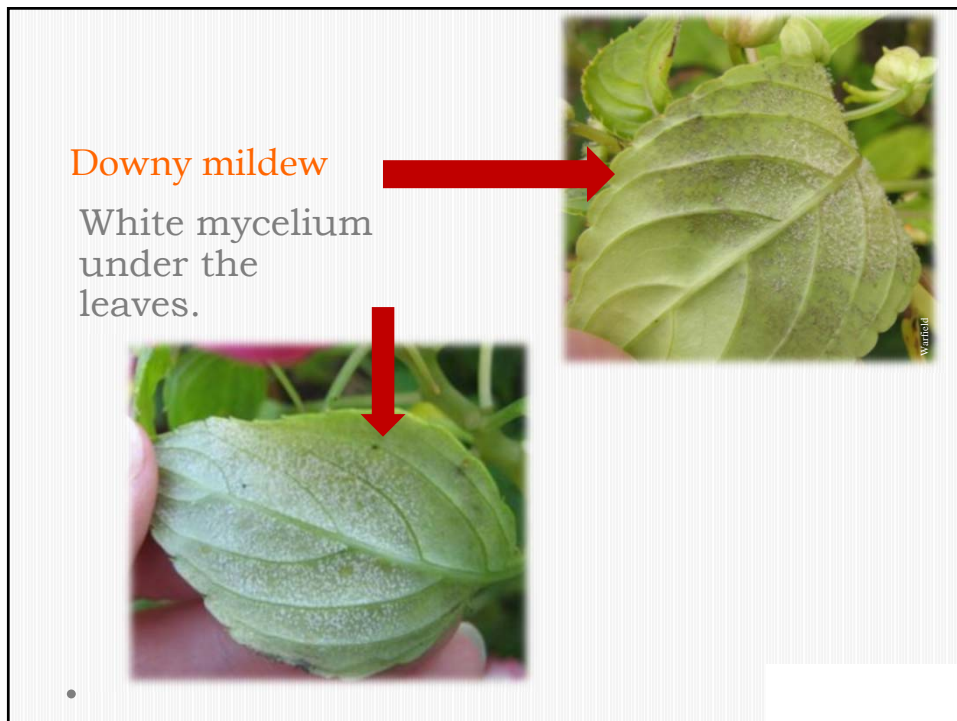


Photo: Royal Horticultural Society.





Rusts must pass from living plants to other living plants or they die within weeks.



Plants kept in the greenhouse/field all year act as **reservoirs of pathogens and insects**, and should be under strict disease control.

Diagnosis of diseases in selected nursery crops



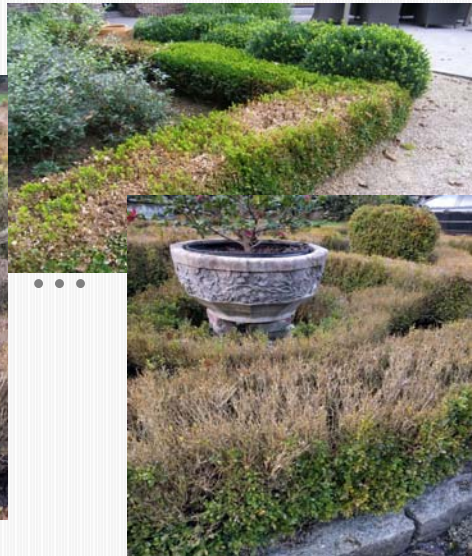
Boxwood blight - leaf spots



Boxwood blight- stem lesions



Advanced symptoms in the landscape



Advanced symptoms in nursery production



Defoliation - occurs very fast after the first observations of leaf spots



- ✓ Highly infected plants lost most of their leaves.
- ✓ Some can recover, but become infected again and finally die.



Liners of
Buxus suffruticosa



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*Cylindrocladium
pseudonaviculatum*
infects only the aerial
parts of the plant, not
the roots.



Boxwood blight

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Japanese Pachysandra
Pachysandra terminalis

<http://www.forestryimages.org/browse/detail.cfm?imgnum=0581032>

Japanese pachysandra, native to temperate Asia, has been planted in the U.S. as an ornamental.





Pachysandra terminalis

Volutella - Volutella buxi



Larrelli Lacey & Kelly Ivors, NCSU, 2015. Photo: Kelly Ivors

Photo credit: Kelly Ivors



Photo credit: Melodie Putnam

Root rot caused by *Phytophthora* spp.

P. citrophthora and *P. cinnamomi*



Photo credit: Robin Rosetta



Photo credit: Robin Rosetta



Photo credit: J. Parke



Photo credit: Melodie Putnam

Chemical damage



Diagnosis of diseases in some nursery crops



Physalis alkekengi
Common name:
Chinese lantern, Japanese
lantern, strawberry
groundcherry, or winter
cherry





Diagnosis of diseases in some nursery crops

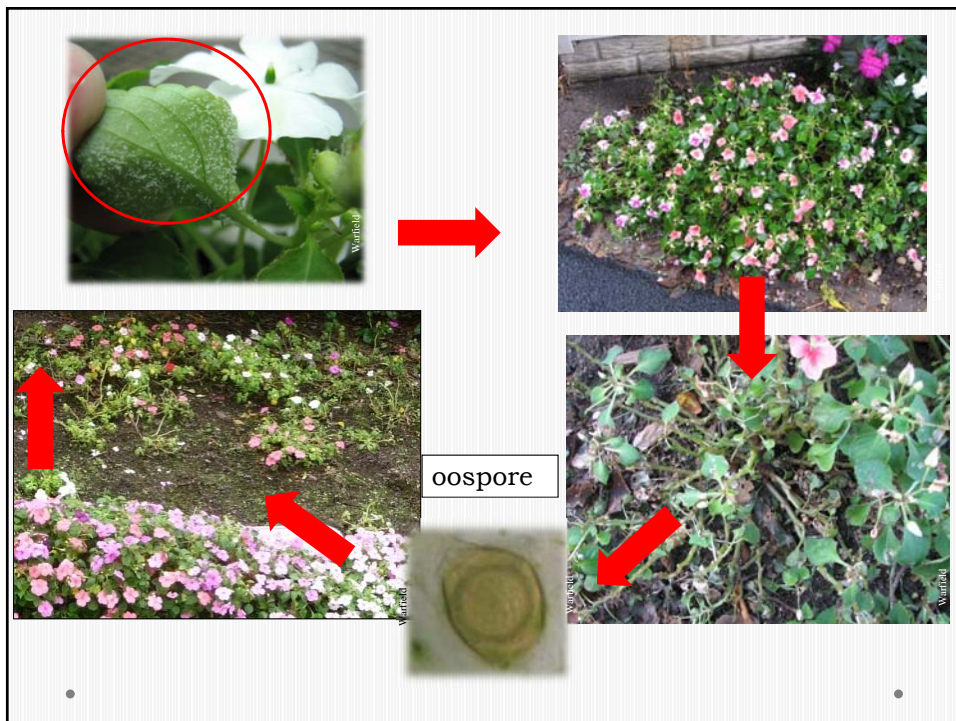


Downy Mildew-garden impatiens

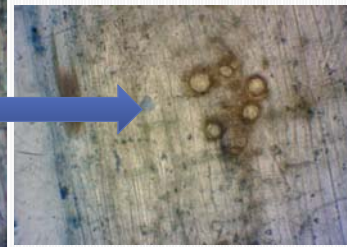
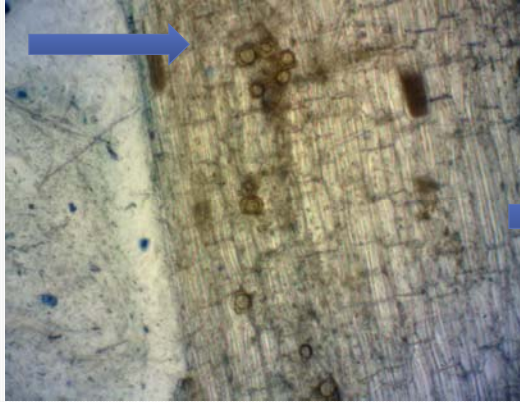


Symptoms

- Leaf drop
- Lack of flowers



Survival/overwinter structures
-OOSPORES
✓They are form in the stems
and leaves of infected plants,
and can survive for several
years in the soil.



Botrytis spp. (gray mold) on geranium



Cool, wet = Botrytis Blight



Verticillium wilt: *Verticillium* spp.

- ✓ Infects the host through the roots.
- ✓ The fungus grows in the vascular tissue and gradually become systemic in the host.



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- ✓ If affected branches are cut, a ring of discolored wood can be seen.



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- ✓ Leaves suddenly wilt and dry up.
- ✓ This may occur on the whole tree.

Frequently only one side or just a few branches are damaged.



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Confirmation of *Verticillium* can only be obtained by culturing the pathogen in a laboratory.



There are several strains of *Verticillium*, some are more virulent than others.



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Powdery mildew

Some pathogens must have living plant tissues in order to grow, reproduce, and survive.



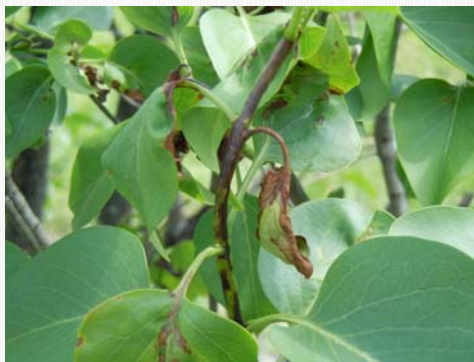
Powdery mildew on barley,
Erysiphe graminis.



Powdery mildew on oak.
Microsphaera alphitoides Griffon &
Maubl.

Some bacterial diseases

Lilac (*Syringa vulgaris*)
with bacterial blight
(*Pseudomonas syringae*)



Flower spots on
impatiens caused by
Pseudomonas syringae



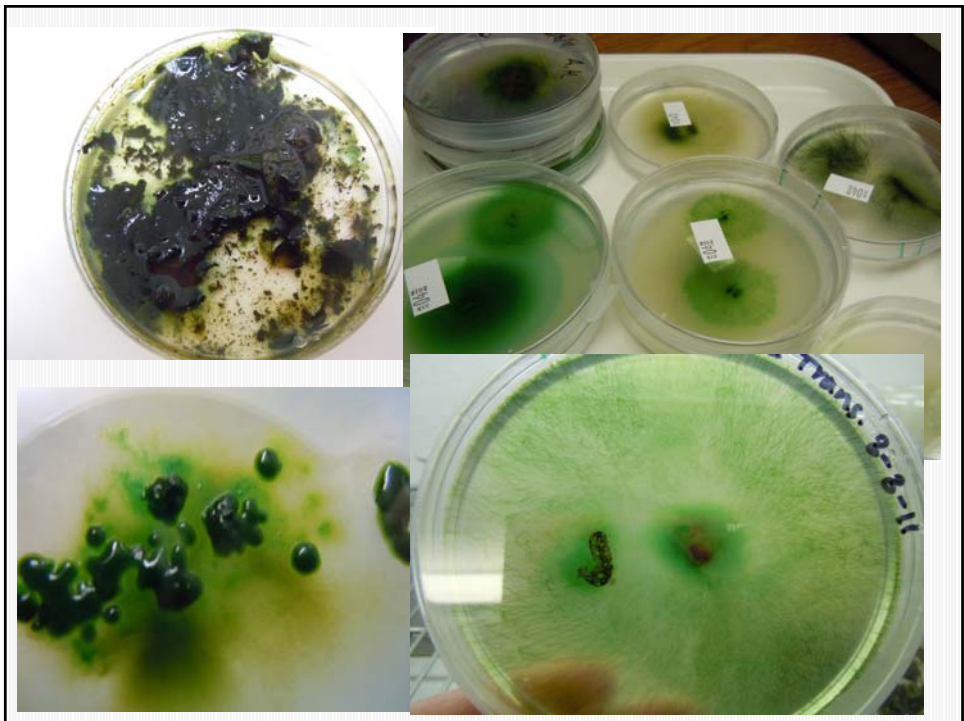
Bacterial rot on
chrysanthemum

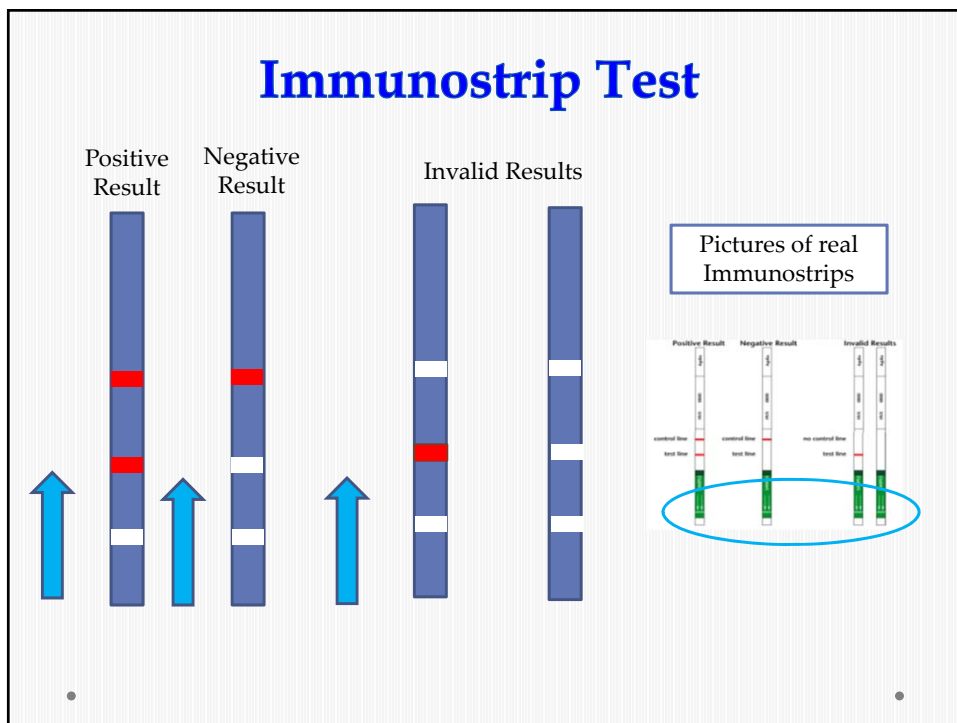
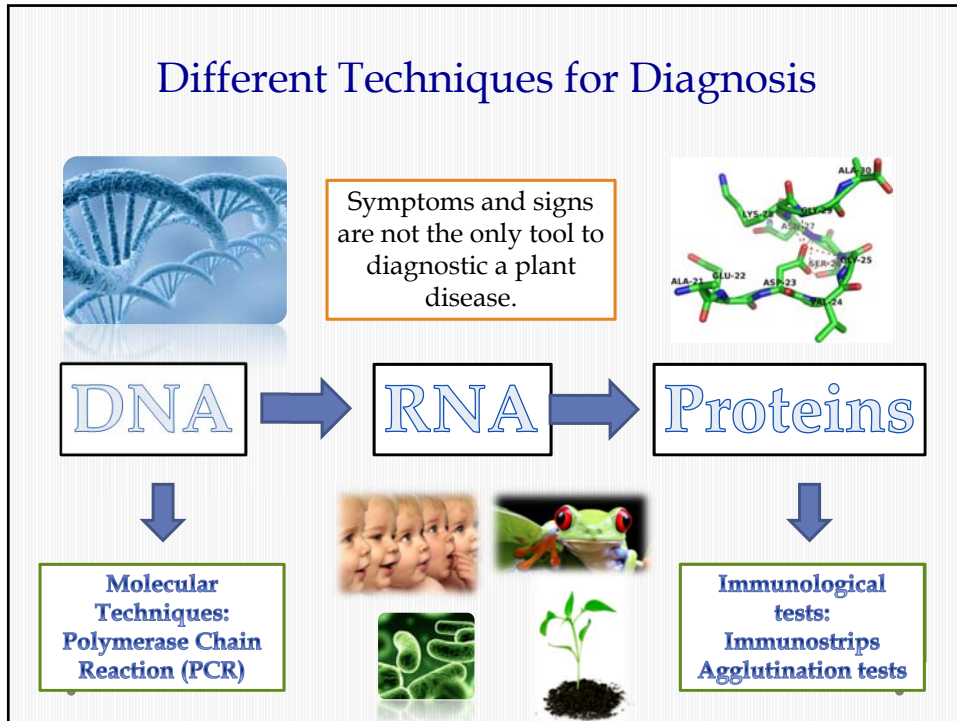
Bacterial leaf spot on
geranium caused by
Pseudomonas syringae



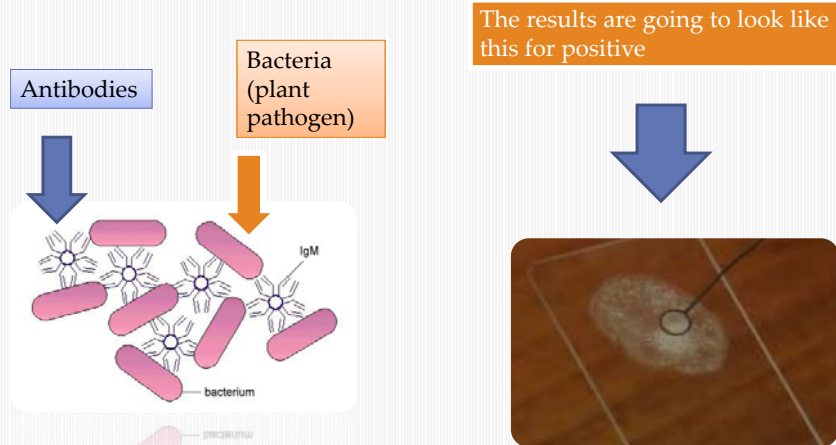
Geranium -- Bacterial Blight
Angular, dead areas occur when
sectors of leaves bounded by the veins
die.

Cause: *Xanthomonas hortorum* pv.
pelargonii (formerly *X. campestris* pv.
pelargonii)





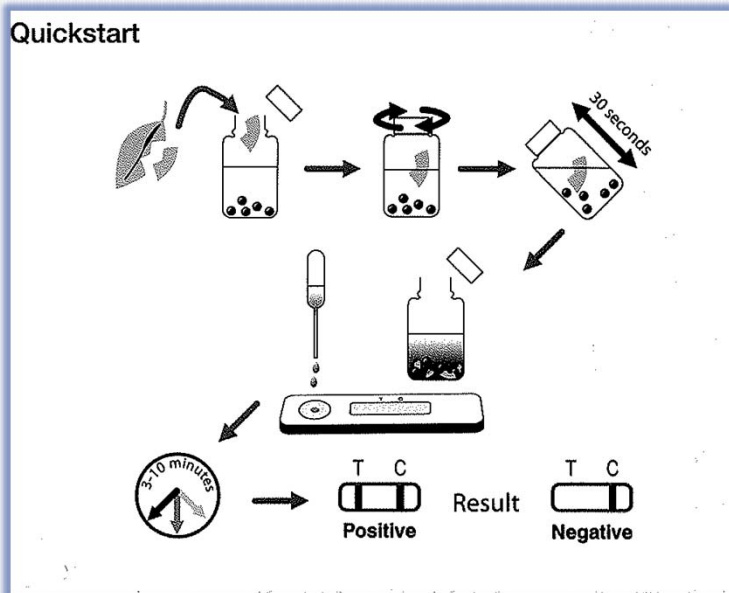
Agglutination



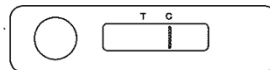
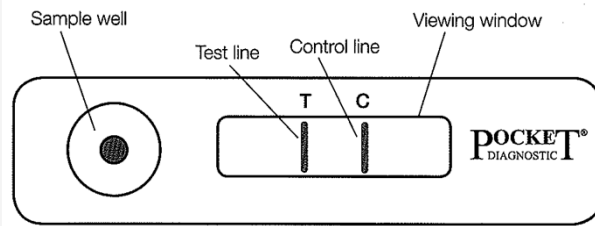
Diagnosis



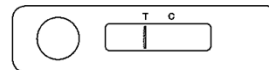
Pocket diagnostic test kit for detection of *Phytophthora*



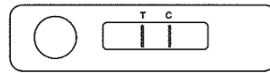
How to read the results



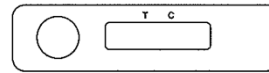
'C' line only: negative result, test valid



'T' line only: test is invalid



'C' and 'T' lines: positive result, test valid



No lines: test is invalid

If the test is performing well, a clear 'C' line will appear. The intensity of the 'T' line will vary with the amount of the pathogen present.

How do you feel about doing a plant diagnosis now?

Observe and learn to look for clues that help with diagnosis.

Can you summarize the steps that should be followed in a diagnostic process?

Summary of Plant Problem Diagnosis Steps

1. Consider the possible causal agents:
 - a. Biotic disease – symptoms progress and nearby plants become infected.
 - b. Abiotic disease – generally a lack of symptom progression. Does not spread.
2. Ask questions
 - a. When was the problem noticed?
 - b. Was the damage sudden or gradual?
 - c. How old are affected plants?
 - d. Percentage of plants affected?
 - e. What is the degree of injury?
3. Observe patterns: Determine prevalence of problem
 - a. Large area/all plants – generally abiotic
 - b. Scattered, localized – generally biotic
4. Check for distribution of symptoms
 - a. Uniform – generally abiotic
 - b. Random – generally biotic

5. Review cultural practices.

Proper planting technique
Fertilizer and pesticide application
Irrigation frequency

6. Review environmental conditions.

Temperature extremes
Drought or excess rain
Soil type and conditions

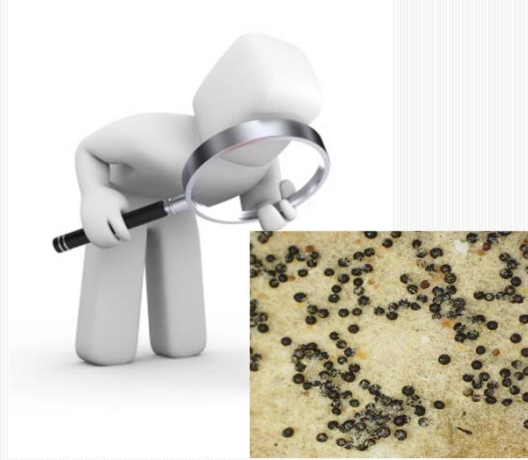
7. Check for symptoms and signs

8. Consult literature resources for possible diseases and disorders

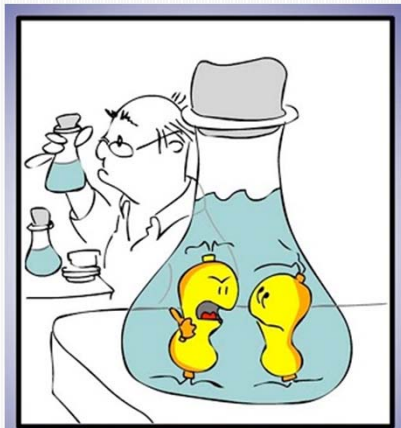
Indices listing hosts and their pathogens
Websites providing information
Books with background info and host/pathogen lists



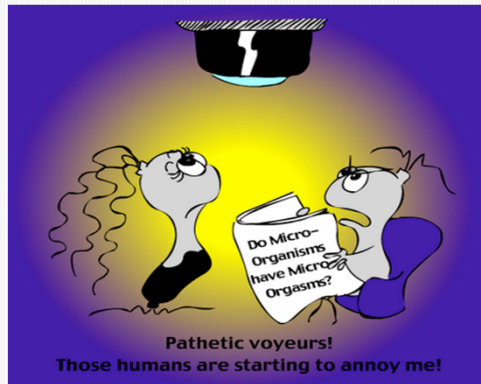
QUESTIONS ?



THANK YOU!



I'M FED UP WITH THIS GUY -
LET'S BECOME PATHOGENIC



Pathetic voyeurs!
Those humans are starting to annoy me!