FUNDAMENTALS OF PLANT PATHOLOGY

(see Chapter 15 of 2000 WA/OR Sustainable Gardening)

Plant pathology = the study of plant diseases (cause, development, control, etc.)
Plant disease = a change in the *normal* structure, function, or development of a plant.

What's **so important** about plant diseases?
Diseases affect our food supply, $$, landscape, health (mycotoxins) and even our culture

Basic plant pathology terminology:
Parasite - feeds on another living organism.
Saprophyte - feeds entirely on dead matter.
Pathogen – entity capable of causing disease.
Life cycle - successive stages in the growth and development of a pathogen.
Vector- assist in spread/movement of disease agent (inoculum)

Host plant - plant with the ability to develop a disease caused by a particular pathogen.
Nonhost plant - plant that cannot be infected by a particular pathogen.
Host range- all the plant species (cvs./var.) that can be infected by a particular pathogen.
Resistance - ability of a host plant to resist a pathogen, either partially or completely.
Susceptibility - inability of a host plant to resist a pathogen, either partially or completely.

Symptom - abnormal appearance of a plant.
Sign - physical presence of a pathogen.

What Causes Plant Diseases?
Living Causes: pathogens (called diseases, pathogenic diseases, biotic diseases)

*****Most microorganisms (except viruses) do not cause plant problems*****
types of plant pathogens:
fungi: multicellular heterotrophs- kill plants with toxins- like cool, wet , conditions
vegetative growth = hypha(e) or mycelium; often produce spores (fruiting bodies)
bacteria single celled heterotrophs- kill plants with toxins- like cool, wet , conditions
reproduce by division; can only enter plant passively (openings, wounds)
viruses submicroscopic genetic material in protein coat- hijack cells
nematodes (aquatic minute roundworms with plant piercing stylets)
parasitic higher plants (dodder, mistletoe) have haustoria (not true roots)

Know life cycle to determine pathogen's "Achilles' heel"- best places to direct management

Nonliving Causes: environmental, physiological, chemical, mechanical factors
(called disorders, nonpathogenic diseases, abiotic diseases)

nonliving stresses may predispose plant to infection by pathogens

MANAGEMENT OF PLANT DISEASES
(see Chapter 15 of 2000 WA/OR Sustainable Gardening)

Disease → Diagnosis → Management:

Use **Integrated Pest Management (IPM)**
Combining different management practices (cultural, chemical, physical, and biological) to reduce the amount of disease to a tolerable level (threshold) in a manner that is economical, efficient, and environmentally-safe.

The basic question: How can you manipulate a component(s) of the disease triangle to favor the host and 'disfavor' the pathogen:

pathogen

host environment

Know the life cycle of the pathogen/pest – exploit window(s) of opportunity

For Management Recommendations, check out:
HortSense - WA homeowner recommendations: http://pep.wsu.edu/hortsense/
PNW Plant Disease Management Handbook
yearly updates, local (PNW) problems
cultural & chemical management recommendations
registered homeowner [H] &. commercial pesticide listing

When using pesticides:
LABEL = LAW! READ & FOLLOW THE LABEL!
never use a pesticide on a plant that is not listed on the label
never use a pesticide above the recommended rates on the label
never use a pesticide within the restricted preharvest interval (PHI)

METHODS OF PLANT DISEASE MANAGEMENT
General strategies:
Exclude the pathogen - prevent inoculum from coming into an area where the pathogen does not occur (e.g., quarantines, inspections, certifications).
Eradicate the pathogen - remove or reduce inoculum (e.g., rotation, sanitation, eliminating alternate hosts, heat treatment, some pesticides).
Protect the healthy plant against infection - provide a "barrier" (chemical, biological, or physical) between the host plant and pathogen.
Genetic resistance of the plant against the pathogen - grow a less susceptible host plant.
Avoidance - avoid development of a disease on a plant(s) even though it does occur in the area.

MANAGEMENT PRACTICES:

Cultural Management

Sanitation - clean environment; remove or reduce sources of inoculum (weed and alternative hosts, insect vectors, debris).
Pruning - remove infected tissue, promote more vigorous growth, increase air circulation
Watering - avoid overwatering or underwatering; flooding soils.
Planting date - unfavorable conditions for pathogen, favorable for host.
Fertility - avoid overfertilization or underfertilization.
Rotation - nonhost plants and resistant varieties; reduce soilborne pathogen populations
Trap plants & antagonistic plants - e.g. marigolds.
Quarantines, restrictions on moving plant materials across county, state, or national borders.

Chemical Management

Chemical **barrier to protect** the host plant and/or eradicate an existing infection.
Pesticides typically cannot "cure" heavily diseased plants
Types of pesticides: *fungicides, bactericides*, nematicides, insecticides, biocides.

***Contact fungicide**:* effective only at the site of application (**protectant**)
must be applied BEFORE pathogen infects the plant; new growth emerging after application is not protected. examples: mancozeb, coppers, chlorothalonil, captan.

Systemic fungicide: absorbed & translocated (moved from application site) by the plant
locally systemic = moves short distances (towards leaf margin) within the plant from the site of application (e.g., benomyl, triforine)
systemic = moves further within the plant from the site of application (e.g., metalaxyl moves from roots up to shoots and foliage).

READ and FOLLOW THE LABEL!
pesticide timing can be crucial
pathogen/vector present (or potential) & susceptible: know life cycles, monitor diligently
repeat applications may be necessary: protectant vs. systemic, new growth, rain/irrigation
time dormant applications carefully, e.g., lime sulfur will burn young foliage of most plants
avoid conditions leading to phytotoxicity (climate influences, antagonistic tank mix)

AVOID Resistance to Pesticides:
Reduce the chance of resistant strains of a pathogen developing by 1) using integrated management strategy, 2) minimal applications of narrow-spectrum pesticides, & 3) alternating classes of pesticides

Pesticide names:
Common Name = name of the active ingredient (e.g., chlorothalonil)
Trade Name = name under which the pesticide is sold to the home market (e.g., Daconil 2787, Funginil, or Multi-Purpose Fungicide for the home market)
Commercial Trade Name = name under which the pesticide is sold to commercial markets (e.g., Bravo or Exotherm Termil)

Genetic Resistance
Most plants resist infection by the majority of microorganisms.
Degree of resistance/susceptibility varies among plant species and varieties
Resistance is dynamic (changes) - races or strains of a pathogen vary in pathogenicity (how severe a pathogen), and the environment affects host resistance.
HEALTHY PLANTS ARE MORE RESISTANT!

Physical Management
Heat treatment – steam sterilization of soil/materials; soil solarization, heat treatments
Cold treatment - refrigeration (postharvest).
Moisture management: reducing humidity; drying out of bulbs, tubers, etc. for winter storage

Biological Management = using a parasite to manage a pathogen
Limited options available at the moment.
Example: Crown gall caused by *Agrobacterium tumefaciens,* can be reduced by using a product containing the competitive bacteria *Agrobacterium radiobacter* strain 84 (Galltrol or K-84)

DEVELOPING A DISEASE CONTROL PROGRAM

Name of Disease:

Type of Pathogen:

Spread:
Overwinter:

Draw disease triangle:
How common in this area?
Control strategy: exclusion eradication protection

Control practices:

Cultural:

Chemical

Biological:

Genetic:

Physical: