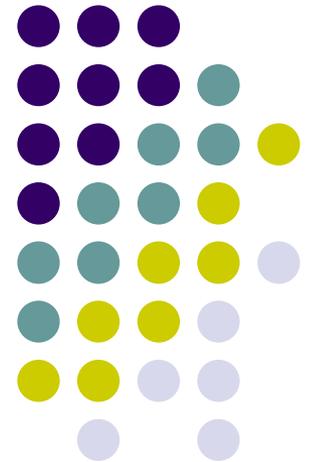
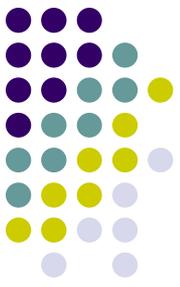


Detection of plant pathogens





Identify Plant Part Affected

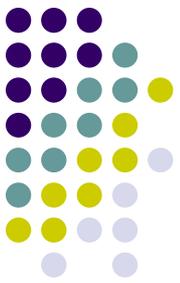
- It is important to note if the symptoms observed are associated with specific plant parts.
- Is a wilt observed correlated with a disruption of the vascular system which may be indicated by browning of the vascular system or are the roots of the plants abnormal including knots or are necrotic lesions observed strictly on younger leaves?



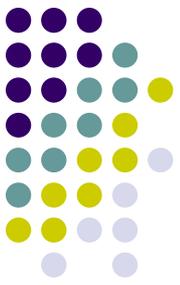
Check distribution of symptom



- Observe how the diseased plants are distributed over the affected area
 - Whether distributed uniformly across an area or localized
 - Any definite pattern to the distribution
 - Only along the edges of a greenhouse near open windows, in low spots of a field, in a planted row, or affecting plants at random
 - Non-infectious problems *viz.*, improper herbicide use or soil factors
 - Uniform pattern on an individual plant and over a large area are usually due to abiotic agents.



- How prevalent is the problem? Are all plants affected?
- Infectious problems occur over time and symptoms progress over time. Rarely all plants are affected.
- Generally, disease problems caused by biotic agents is observed on a low percentage of plants at the start of the disease, unless infected seeds were used. Even then, rarely will 100% infection be observed.
- When a problem appears in 100% of the plants, it more commonly results from factors: soil conditions (deficiencies or toxicities), adverse climatic factors (cold temperatures, hail, drought, etc.), or toxic chemicals (improper pesticide use, air pollutants, etc.)



- What has been the progression of symptoms on plants?
- If the symptoms all appeared at the same time and there has been no further development of symptoms, this would indicate a possible episodic event such as a change in temperature or improper chemical usage.
- If symptoms started in one area and slowly spread to other areas and the severity of symptoms changed over time, this would be most likely due to a biotic agent.

Check for host specificity



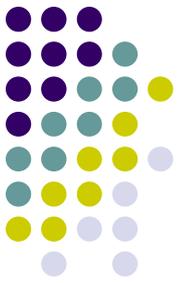
- Is the problem occurring in only one plant species or are different plant species affected? If different plant species are affected, this suggests the possibility of a non-infectious problem which could be related to cultural or environmental problems.
- However, *Phytophthora* and *Pythium* root rots can cause problems on many different plant species; therefore, the fact that more than one plant species is affected does not completely eliminate infectious agents.
- If there is more than one species of plant involved, are these plants closely related and can they be infected by a common pathogen?

Review the cultural practices and growing environment



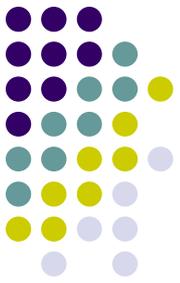
- Activities conducted around the affected plants are important, *viz.*, activities of neighbour. Information pertaining to the growing environment to which plants have been exposed is vital *viz.*, changes in the environment such as extreme temperatures (freezing and heat), rainfall, prolonged drought, etc. Site factors such as soil type, drainage problems, and soil pH should also be evaluated.
- Cultural and maintenance activities such as application rate of pesticides or other chemicals, equipment used, any unusual occurrences or weather patterns, etc.
- Careful investigation by the diagnostician is required as someone may have done something improperly and may be unwilling to admit their error.

Final Diagnosis

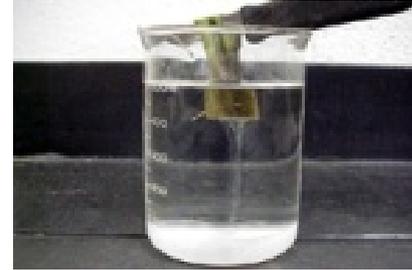


- Diagnosis is hypothesis testing. The hypotheses are generated through observations of the plant, environment, and information from the grower.
- When all information is successfully collected, literature sources be consulted to determine already known causes of the diseases and disease-causing agents.
- Diagnosis of plant problems is like a detective investigating an assault. All clues should be investigated and compilation of the clues ultimately lead to the most accurate diagnosis.
- Some of the common symptoms may be produced by different types of problems. Detail symptoms and signs need to be studied during the diagnostic process for proper diagnosis.

Initial steps: Look for signs of biotic causal agents



White mycelia of *Armillaria* growing under bark of peach tree



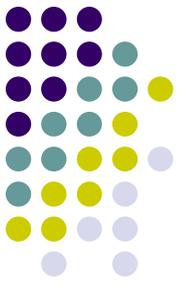
Bacterial ooze from cut tomato stem infected with *Ralstonia solanacearum*



Stem rust on barley caused by *Puccinia graminis*



Powdery mildew on apple blossom cluster caused by *Podosphaera leucotricha*



Laboratory Tests

- Incubation of plant material
- Isolation and identification of biotic plant disease causal agents
- Diagnostic tests for identification of biotic causal agents (traditional and modern)
- Diagnostic tests for identification of abiotic plant disease causal agents

Modern Disease Diagnosis methods



Direct Method

- **Serological methods**
 - Enzyme Linked Immunosorbent Assay (ELISA)
 - Immunofluorescence (IF)
 - Flow Cytometry
- **Molecular methods**
 - Fluorescent In Situ Hybridization (FISH)
 - Polymerase Chain Reaction (PCR)
 - DNA Arrays

Indirect Method

- **Bio-marker based methods**
 - Gaseous metabolite profiling
 - Plant metabolite profiling
- **Plant properties/ Stress based**
 - Imaging techniques
 - Spectroscopic techniques