# Diagnosis of important Plant Diseases

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# Importance of proper diagnosis

- Control measures depend on proper identification of diseases and of the causal agents
- Without proper identification of the disease and the disease-causing agent, disease control measures can be a waste of time and money
- Proper disease diagnosis is therefore vital.

# Detection methods of plant pathogens

- Symptoms based
- Microscopy based
- Protein based
- Nucleic acid based

# These symptoms may be diagnostic or non-diagnostic

**Diagnostic**

**Non Diagnostic**

# Symptoms and Signs

**Symptoms :** The visible response of a plant to a causal agent over time.

- Dead spot in leaves or bark
- Unnatural colour or shape
- Swelling on root or branches

Dead Spot on Leaves

Swelling on Branches

# Symptoms and Signs

**Signs :** The pathogen or its parts that seen on a host plant

- Observable structure of agent that cause the disease
  - Fungal spores
  - Insects on plant



Fungal Spores

Aphids on Plant

# Categories of Symptoms

- Symptom changes of colour
- Symptom death of cell
- Hypertrophy & Hyperplasia
- Hypotrophy & Hypoplasia

# Example of Plant Disease Symptoms

- Symptom Changes of Colour
  - Chlorosis
  - Etiolation
  - Mosaic

# Chlorosis

**Yellowing** of leaves due to:

- Loss of chlorophyll pigment/lack of active chlorophyll
- Nutrient deficiencies
- Toxicity of material (pesticide)

# Etiolation

- Symptom of yellowing & **elongation of stems/leaves**
- Due to the lack of light (under dark condition)

# Mosaic

- Formation of light and dark green/yellow mosaic pattern on leaves

## Symptom Death of Cell Necrosis

- General necrosis
  - Soft rot
  - Dry rot
  - Vascular wilt
  - Blight
- Local necrosis
  - Leaf spots
  - Anthracnose
  - Downy mildew
  - Powdery mildew
  - Canker

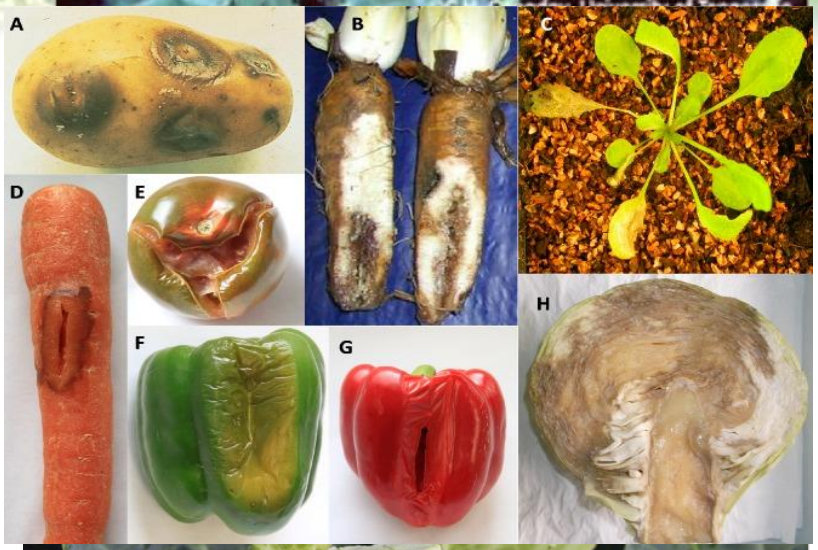
## General Necrosis

- Occur in the **whole plant** that causes rot of plant / tissue

## Local Necrosis

- The necrosis sites are limited
- Only involved a **part or few plant cells** / tissues

# General Necrosis – Soft Rot




- Occur to the fruit &vegetable that cause by the bacteria (***Erwinia carotovora*** )
- The infected part become **rot and watery**

# General Necrosis - Blight

- The fast and **overall death of plant tissue** such as shoot or leaves
- Pathogens kill the cells / tissues with which they are in close contact and become generally distributed.
- Example - Potato late blight (*Phytophthora infestans*)-fungus

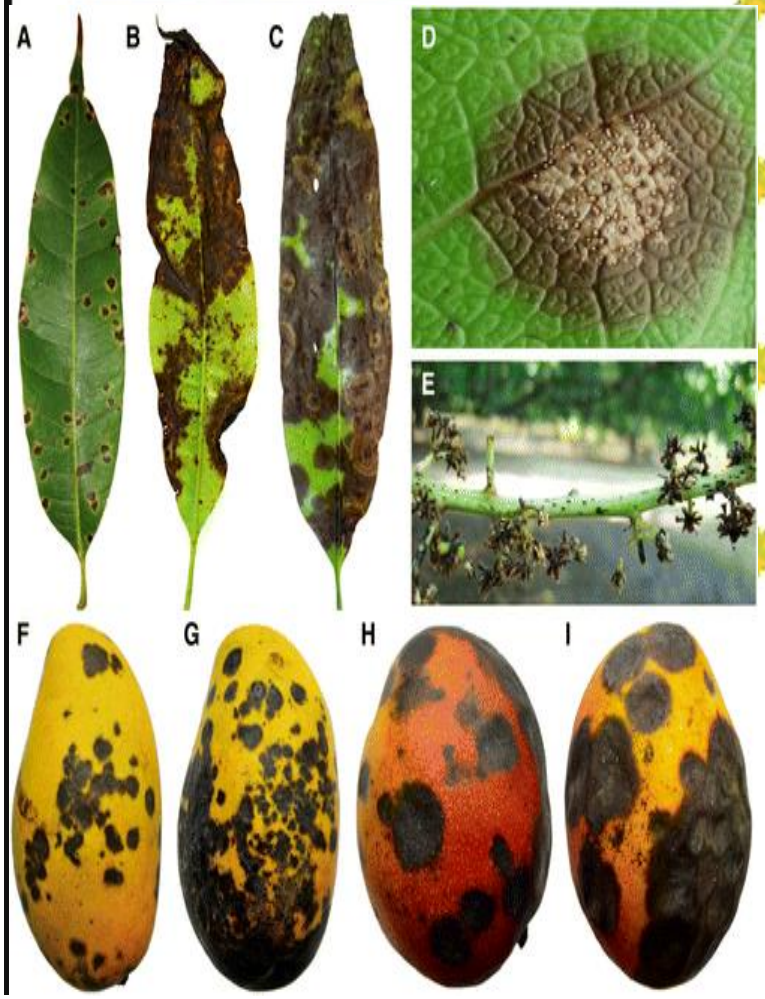
# Local Necrosis – Leaf Spots

- **Spot of death cell** or the presence of small necrotic areas on leaves
- Might caused by virus, fungal, bacteria, insect bites, etc.
- Example :
  - Bacteria leaf spot – *Xanthomonas* campestris pv. *vesicatoria*
  - Septoria leaf spots - fungus

Bacteria Leaf Spot on Pepper

Septoria Leaf Spot

# Local Necrosis - Anthracnose




- Normally infected by imperfect fungi or Ascomycetes
- Produces **blackish lesions** on fruits, stem & leaf
- Blackness being due to the presence of dark spores, mycelium or both
- Example -
  - Mango : *Colletotrichum gloeosporioides*
  - Cucurbit : *Colletotrichum lagenarium*

# Necrosis – Cankers

- Sunken areas in wood
- Death of plant parts
- Most are caused by fungi (Ascomycetes), but - a few bacterial cankers
- Example - Durian cankers = *Phytophthora palmivora* (fungus)

# Necrosis- Powdery Mildew

- The appearance of **powdery spots** on the leaves
- Example - Powdery mildew on cucurbit =*Erysiphe cichoracearum* (fungus)

# Local Necrosis – Downey Mildew

- The occurrence of **yellowish rectangular spot** on the leaves
- Example - Downey mildew on cucurbit - *Pseudoperonospora cubensis*, (fungus)

# Symptom of Hyperplastic Deformation

- Hypertrophy
- Hyperplasia

Gall

**Hyperplastic Deformation** : Abnormal outgrowths of the plant host

**Hypertrophy** : Overgrowth of plant organ or plant size because the increasing of **cell sizes**

**Hyperplasia** : Overgrowth of plant organ or plant size because the increasing of **cell numbers** or cell multiply rapidly.

Both gave the same results to the plant where the size of plant tissue or plant organs increased than usual (abnormal size)

# Gall

- Localized **swellings** of plant organ
- May caused by various pathogens such as bacteria, fungi, nematodes and insects.
- Examples -
  - Crown gall = *Agrobacterium tumefaciens* (bacteria)
  - Root knot = *Meloidogyne spp* (nematodes)

Bacteria Crown Gall-
affect root & stem

Root Knot - attack root

# Witches' Broom

- Appear as a cluster of small shoots

# Curls

- The leaves become twisted and curled

# Symptom of Hypoplasia

**Retardation**

**Dwarfing**
One or more members of a plant are significantly **smaller** than standard members of their species

# Hypoplasia

- The underdevelopment of **plant tissue** and **organs** due to the smaller production than normal cells

# Major plant pathogens

- Fungi
- Bacteria
- Nematodes
- viruses

# Laboratory Tests

- Incubation of plant material.
- Isolation and identification of biotic plant disease causal agents.

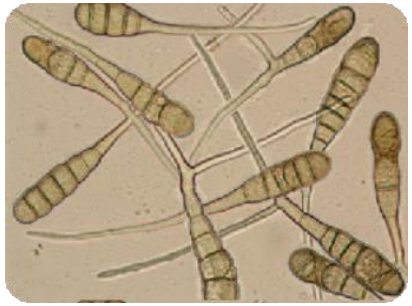
Nutrient Agar

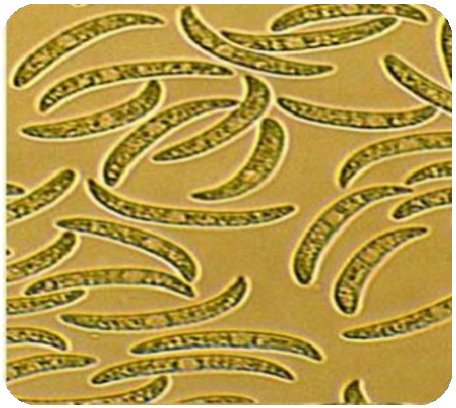

Nutrient Agar

# MICROSCOPY

- To detect the pathogen on the basis of morphology.
- In case of fungi: reproductive structures, vegetative structures, spores can be seen under microscope. From which we can identify the fungus up to genera level.
- We can detect the nematodes after preparing slide from suspension, and visualized it under microscope.

# MICROSCOPY





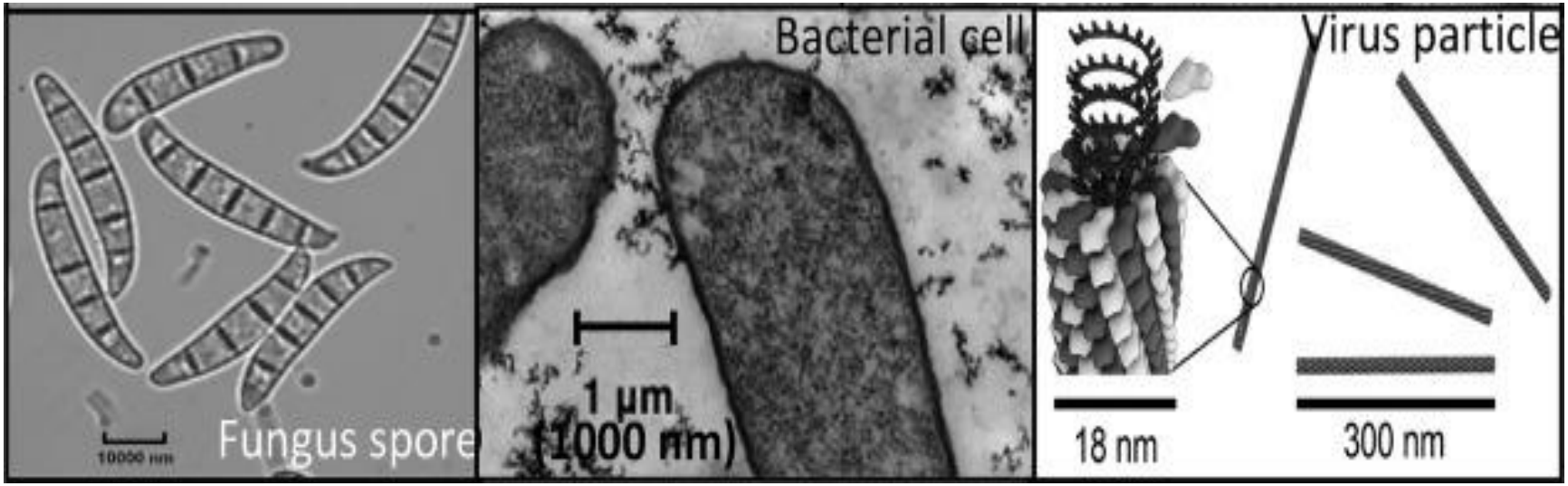

Fungus spore
10000 nm
Bacterial cell
1 µm
(1000 nm)
Virus particle
18 nm
300 nm

**Figure 3.** Bacterial ooze from cut tomato stem infected with *Ralstonia solanacearum*. (Used by permission of M. Williamson)

Bacteria : spots are often angular due to limitation by leaf veins. Color is usually uniform and no signs of plant pathogen are evident. Tissue may appear initially as being water soaked but may become papery as it dries.

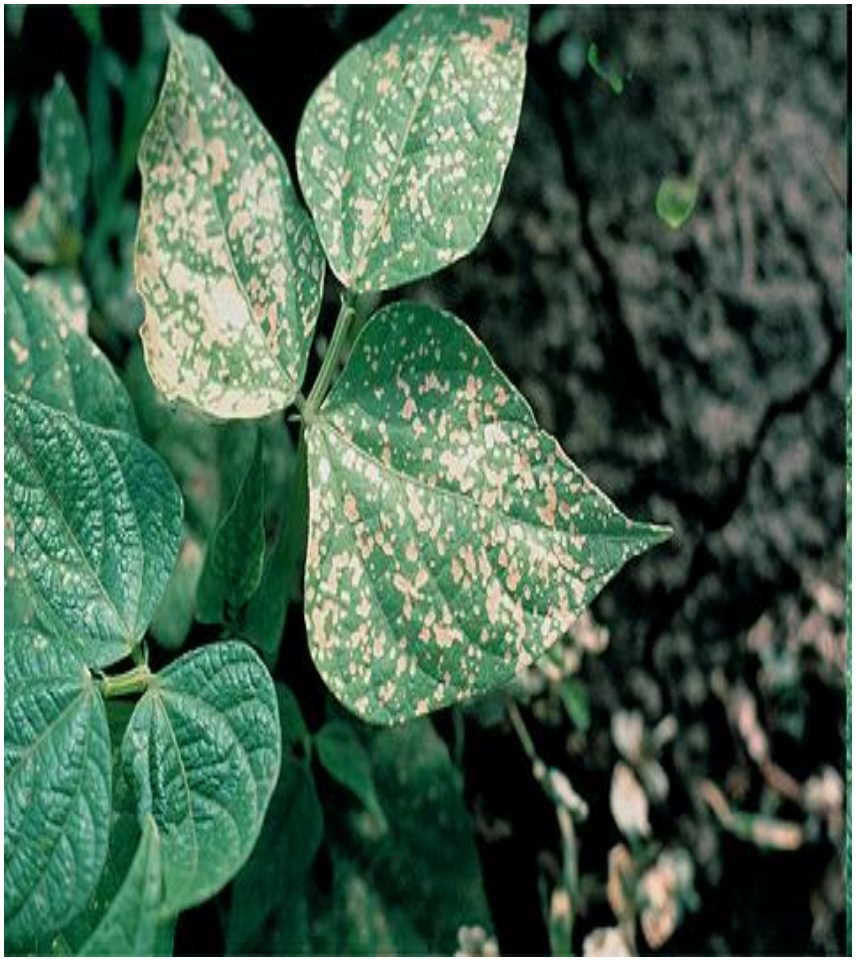
# Abiotic diseases

**N deficiency**

**Sulphur deficiency**

# Chemical spray or air pollutant injury -

- Spots associated with injury are relatively uniform in color and the interface between the affected and healthy area is usually sharp. Distribution on plant may be associated with where spray or pollutant comes in contact with the plant.
- Injury of beans caused by drift of the herbicide, paraquat.



Drift from imidazolinone herbicides like imazethapyr and imazamox can cause stunting and plants to exhibit more purple color than  normal

Glufosinate injury on non-Liberty LInk soybeans will progress fairly rapidly from chlorosis to necrotic areas throughout.

Glufosinate injury to non-Liberty Link corn hybrids will appear as chlorosis of new growth, whereas older leaves and leaf tips will become necrotic first. Glufosinate injury on corn is somewhat similar in appearance to frost damage.

Glyphosate injury on non-Roundup Ready corn hybrids is perhaps most often characterized by the distinctive chlorotic bands that form on the leaves around the plant. These injured leaves developed after the exposure, which indicates when the glyphosate drift or contamination occurred.