

# PLANT PATHOLOGY

## What is Plant pathology?

1. The living entities and the environmental conditions that cause disease in plants;
2. The mechanisms by which these agents produce disease in plants;
3. The mechanisms by which plants react to these agents;
4. The interactions between the disease causing agents and the diseased plant;
5. The cellular and sub-cellular interactions between plant and agents; and
6. The methods of preventing or controlling disease and alleviating the damage it causes.

### 1. What is a pathogen?

A pathogen is an organism that can cause disease, *e.g.* fungus, bacterium, nematode, virus, or an abiotic agent, such as air pollution.

### 2. What is a disease?

A disease is a harmful disruption of the normal physiology, growth and development of an organism by a causal agent.

### 3. What is a symptom?

A symptom is the reaction of a host to infection by a pathogen. Wilt, yellowing, leaf spots, and brown dead tissue (necrosis) are all examples of symptoms that may indicate disease in plants.

Fever, sneezing, and a runny nose are symptoms of the common cold, a disease of humans.

### 4. What is a sign?

A sign is the physical presence of a pathogen or part of a pathogen on or in a diseased organism. For example, fungal hyphae and spores present on a rotting plum are signs of brown rot of stone fruit. The large numbers of bacilli present in the blood of an animal that has died from anthrax are a sign of anthrax.



## What is disease?

Plant disease can be defined in many ways but one of the simplest definitions describes:

1. Disease is any condition in a plant caused by living and nonliving agents that **interferes** with its normal growth and development.

Diseases or plant health problems can impact plants in many ways since all parts of a plant can be affected including flowers, leaves, fruits, seeds, stems, branches, growing tips, and roots.

2. A disease is a harmful disruption of the normal physiology, growth and development of an organism by a causal agent.

1. Disease is a malfunctioning induced by continues irritation.

**Vital processes are disrupted by pathogens.**

2. Disease is injurious alteration of ordered processes of energy utilization in a living system. **Energy sources:** Carbohydrates, Organic acids, lipids, Amino acids.

3. Disease is a phenomenon exclusive to life form.

4. Disease diminishes the efficiency of energy capture and use by plants.

**Energy is drained by the invading agent for its own use**

5. Disease result when plants are disrupted continuously.

6. Injury results when plants are disrupted momentarily. **Disease vs injury**

7. Disease causes damage when host, pathogen and environment remain in conjunction long enough.

8. Pathogen-host interaction represents a dynamic state of disequilibrium.

9. Parasitism and disease are distinct biological phenomena that should not be confused. **Symbiosis:** Root-nodule bacteria, Mycorrhizae

## CONDITIONS NECESSARY FOR DISEASE

In order for a biotic plant disease to occur, three conditions must be met:

1. The host plant must be susceptible.

a. The genetics of the plant determine its susceptibility or resistance to a particular disease.

- b. Specific pathogens vary in their ability to infect different plant species.  
For example, the late blight fungus can infect certain solanaceous plants such as tomato, potato, and eggplant.

- c. Cucumbers, beans, and other types of plants are not susceptible to **late blight**.

## 2. A pathogen must be present/Virulent

- a. Various physical and biochemical factors of a given plant species influence susceptibility.
- b. These factors include plant defense mechanisms, carbohydrates and protein types, cuticle thickness, and stomatal shape.
- c. The developmental stage of the plant also can influence disease development. **For example**, damping-off diseases occur in younger plants, but not in older plants.
- d. Pathogens differ in their ability to survive, spread, and reproduce. **For instance**, a certain viral disease may occur only when a **specific insect vector** transports virus particles to the susceptible plant.
- e. A fungus that cannot survive cold winters may be problematic only in the growing season following the shipment of the infected plant material from a warmer region.

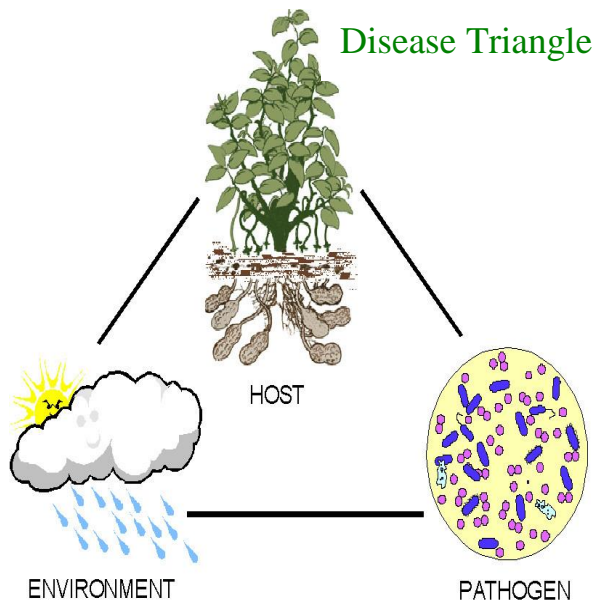
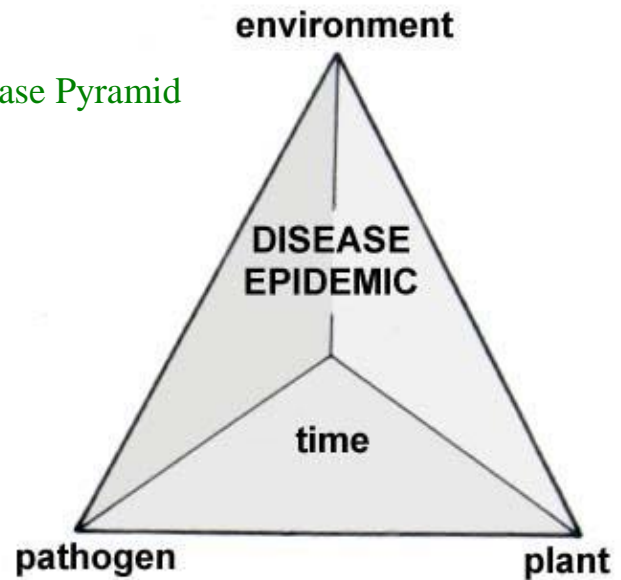
## 3. The environment must be favorable for infection by the pathogen.

- a. Environmental factors such as temperature, light, or moisture conditions generally are necessary for a disease to occur.
- b. Cool, moist conditions are ideal for many fungal and bacterial pathogens.  
For example, the bacterial disease fire blight and the fungal disease peach leaf curl both are more severe following wet springs.

## Development of Infectious Disease

There are **four elements** necessary for the development of a plant disease.

Called- **Disease Pyramid**.

**Disease Pyramid**

**Susceptible Host:** All plants are not susceptible to all pathogens. In order for disease to occur in a given plant, that plant must be able to be **entered and infected** by a particular pathogen.

**Plant Pathogen:** A microorganism capable of causing disease is a vital component of disease. Most plant pathogens are **host specific**, and will cause disease in only a few host plants.

**Favorable Environment:** Plant pathogens have certain temperature and moisture requirements for growth and entry into plants. For example, environmental factors may influence the **production of spores in fungi** or the **movement of fungi** or bacteria from plant to plant. **Without a favorable growing environment, a plant pathogen will not be able to cause disease even when present on a susceptible host.**

**Time:** The interaction of host, pathogen and environment occurs over the course of some period of time (usually hours) before infection takes place.

Time also influences the **growth stage of the host**, and the **development of symptoms** on an infected plant. Symptoms often change considerably over the course of weeks or months.

When all four of these elements are present, plant disease is the result.

## CAUSES OF PLANT DISEASES

### 1. LIVING (BIOTIC) ORGANISMS

Pertaining to life and therefore living organisms. For example, plant diseases of a biotic origin are caused by living organisms such as fungi and nematodes, etc

### 2. Non-LIVING (ABIOTIC)

#### ORGANISMS

Pertaining to physical and inorganic components.

For example, diseases/disorders in plants can be caused by abiotic factors such as extremes of heat, light, moisture, lack of nutrients etc.

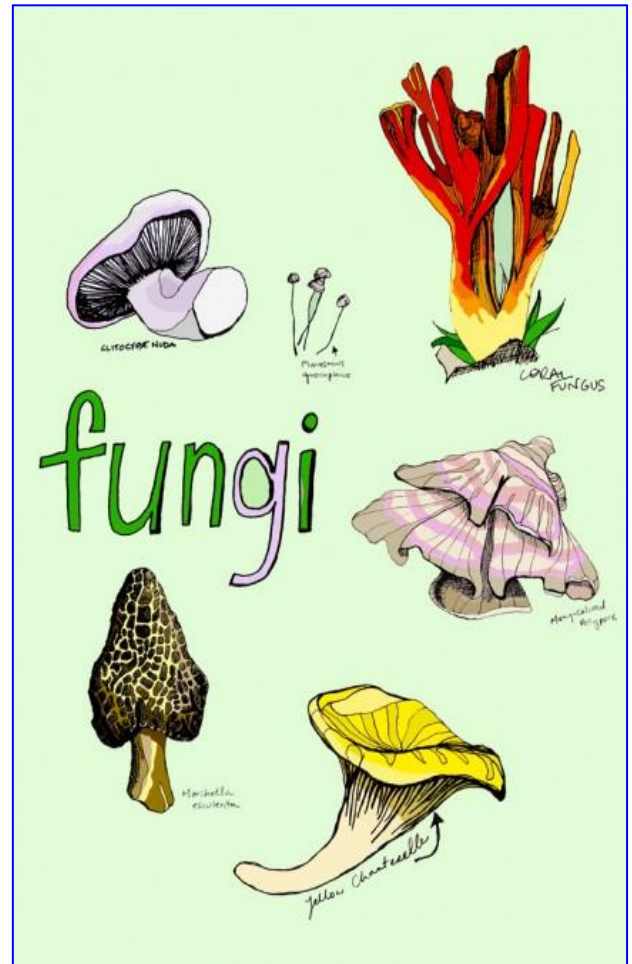
### 3. MESOBIOTIC

## Fungi

These are eukaryotic, spore-producing, achlorophyllous organisms with absorptive nutrition that generally reproduce both sexually and asexually and whose usually filamentous [cells arranged in long threads], branched somatic structures, known as hyphae, typically are surrounded by cell-walls.

**Saprophytic**, meaning that they consume dead organic matter such as fallen leaves and grass cuttings. Saprophytes do not attack living plants. **Many mushrooms** fall into this group as well as many fungi that live "invisibly" in the soil. Saprophytes are extremely important ecologically. Imagine what our world would look like if dead plants and animals and their waste did not decompose.

10,000 fungi cause diseases in plants. All plants are attacked by some kinds of fungi. In turn, each of the pathogenic fungi can attack one to many different kinds of plants.



Plant pathogenic fungi have developed specialized ways to take nutrients directly from living plants.

**Parasite:** An organism that obtains its food from living plants.

**Obligate parasite:** If a fungus or other living organism obtains nutrients only from *living* tissues, it is called an. Rusts, powdery mildews, and downy mildews are fungi that are obligate parasites.

**Non-obligate parasites** live mostly as parasites, but under certain conditions they may feed on dead organic matter. Examples of non-obligate parasites are the fungi that cause potato late blight, *Fusarium* wilt, and damping-off.

**Hyphae:** The "body" of the typical fungus is made up of individual thread-like structures called.

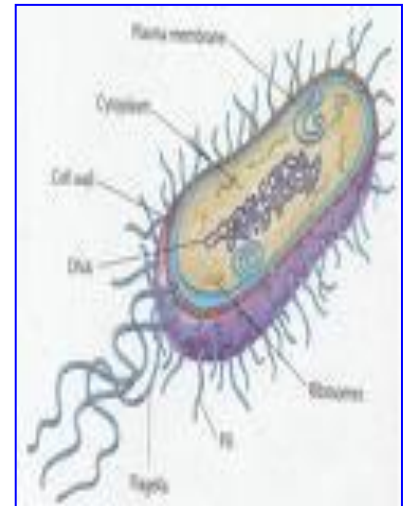
**Mycelium:** A mass of hyphae branches out in all directions.

**Spores:** Fungi reproduce through propagules.

## BACTERIA

Bacteria are extremely minute, rigid, unicellular micro-organisms without definite nucleus i.e. the nuclear material is not bounded by nuclear membrane wall [member] but have a single circular chromosome. And have no chloroplasts and mitochondria.

11% of the diseases are caused by bacteria.

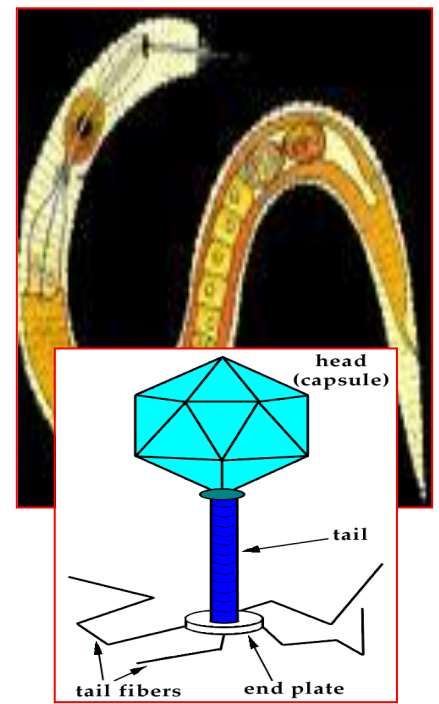


## NEMATODES

Nematodes are generally multicellular, microscopic, worm-like, non-segmented, ell-shaped, tapering at both ends micro-organism that live saprophytically in water or soil and as parasites of plants and animals. They possess all the physiological systems like animals except respiratory and circulatory systems.

## VIRUSES

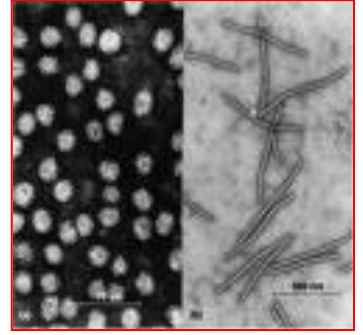
A virus is a super molecular complex that can replicate within appropriate host cells. It is a sub-microscopic,





obligate, infective and filterable entity which is **nucleo-proteinic** in nature. It placed in mesobiotic group of plant pathogens. They consist of DNA or RNA surrounded by a protein capsid or membranous envelope.

An average virus is 100,000 to 1,000,000 times smaller than a plant cell. Due to their size and biology, plant viruses traditionally have been difficult to identify. Symptoms give important clues, but yield no real proof of the exact pathogen involved.



## VIROIDS

A viroid is a piece of genetic material that, unlike a virus, has **no protein coat**. Viroids divert plant metabolism to produce more viroids. They spread by vegetative propagation.

## PHYTOPLASMAS

Phytoplasmas (formerly called mycoplasma-like organisms) are similar to bacteria, but they have **no cell wall**. They reproduce like bacteria and usually **reside in the phloem** (food-conducting vessels) of an infected plant.

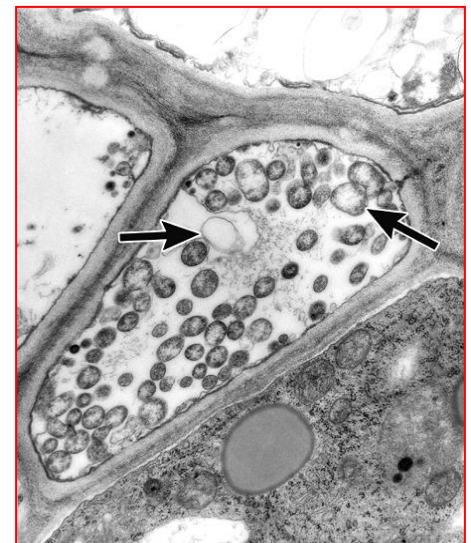
Leafhopper insects transmit phytoplasmas.

**Symptoms** of phytoplasma diseases include dwarfed leaves, yellowing or reddening of leaves, excessive proliferation of shoots (witches' brooms), green or sterile flowers, and very short internodes.

## PARASITIC PLANTS

Dodder, mistletoe, witchweed, Indian pipes, and beech drops are seed-bearing plants that lack chlorophyll. They gain all or some of their nutrients by parasitizing other seed-bearing plants.

Dodder forms a pale green, viney growth on garden plants and on crops such as alfalfa. Mistletoe causes witches' broom.



Phytoplasmas (arrows) in a phloem cell of an infected plant. Note that the phytoplasmas are pleomorphic (variably shaped).

