

Vivekanand College, Kolhapur
(Autonomous)

Department of Botany

B.Sc. II

Plant Protection

Topic : Plant Diseases

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M.Sc., Ph.D.

Classification of Plant Diseases and Plant Pathogens

Classification of Plant Diseases

- Based on plant part affected.
- Based on perpetuation and spread
- Based on the signs and symptoms produced by the pathogens
- Based on the host plants affected
- Based on major Causes
- Based on Infection Process
- Based on pathogen generation

Based on plant part affected

- **Localized:** if they affect only specific organs or parts of the plants.
- **Systemic,** if entire plant is affected. or
They can be classified as root diseases, stem diseases, foliage/fo liar diseases, etc.

Based on perpetuation and spread

- **Soil borne** *-when the pathogen perpetuates through the agency of soil.*
- **Seed borne** -when the pathogen perpetuates through seed (or any propagation material).
- **Air borne** -when they are disseminated by wind e.g. rusts and powdery mildews.

Based on the signs and symptoms produced by the pathogens

- Diseases are classified as **rusts, smuts, powdery mildews, downy mildews, root rots, wilts, blights, cankers, fruit rots, leaf spots, etc.**
- In all these examples, the disease are named after the most conspicuous symptom of the disease appearing on the host surface.

Based on the host plants affected

- They can be classified as: **cereal crop diseases, forage crop diseases, flax diseases, millet diseases, plantation crop diseases, fruit crop diseases, vegetable crop diseases, flowering plant diseases**, etc.
- Cereal
- Vegetable
- Fruit
- Forest
- ornamental

Based on major Causes

They can be classified as

- **fungus diseases,**
- **bacterial diseases,**
- **viral diseases,**
- **Mycoplasmal diseases, etc.**

Based on Infection Process

- **Infectious** -All the diseases caused by animate causes, viruses and viroids can be transmitted from infected host plants to the healthy plants and are called infectious.
- **Non-infectious-** Non-infectious diseases can not be transmitted to a healthy plant.
Also referred as non-parasitic disorders or simply physiological disorders, and are incited by abiotic or inanimate causes like nutrient deficiency or excess or unfavorable weather conditions of soil and air or injurious mechanical influences.

Classification of Animate Diseases in Relation to Their Occurrence

- **Endemic diseases** -which are more or less constantly present from year to year in an moderate to severe form in a particular geographical region, i.e. country, district or location.
- **Epidemic or epiphytotic diseases** -which occur widely but periodically particularly in a severe form. They might be occurring in the locality every year but assume severe form only on occasions due to the favourable environmental conditions occurring in some years.

- **Sporadic diseases** occur at irregular intervals and locations and in relatively few instances.
- **Pandemic diseases:** A disease may be endemic in one region and epidemic in another.
- When epiphytotics become prevalent through out a country, continent or the world, the disease may be termed as pandemic.

Based on pathogen generation

- **Simple interest/monocyclic disease**

The increase of these disease is analogous of increase in money due to simple interest i. e. those disease which complete only one life cycle in one cropping season. e.g. loose smut of wheat, wilt of tomato.

- **Compound interest disease/polycyclic disease**

diseases which have more than one generation in one cropping season. e.g. late blight of potato

- **Polyetic disease**

these are also polycyclic diseases but they complete their disease cycle in more than one year over years e.g. cedar rust of apple

Plant Pathogens

WHAT IS PATHOGEN?

Pathogen:

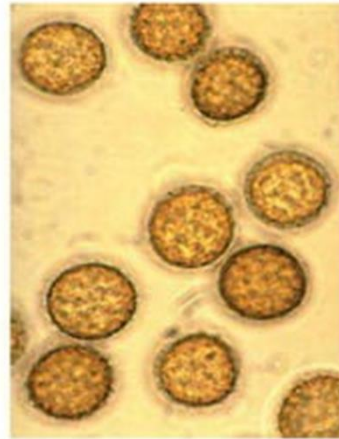
- Any entity that can cause disease in a host
eg. **Fungus, Bacteria, virus, Phytoplasma, Viroids, RLO's, Parasitic Plants, Nematodes**

Parasite

- An organism that lives on or in another organism and obtains food from the second organism

Fungus

- Fungus is nucleated spore bearing, achlorophyllous organisms which generally reproduce sexually or asexually and whose usually filamentous branched somatic structures are typically surrounded by cell wall containing cellulose or chitin or both.
- e.g. *Phytophthora infestans*

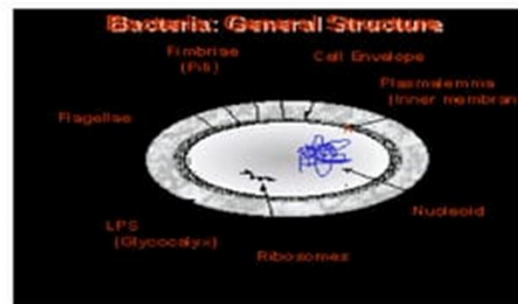


BACTERIA

- Microscopic prokaryotic one-celled organisms that reproduce by binary fission.



FIGURE 1-20 (A) The fire blight bacterium *Erwinia amylovora*. (B) Fire blight on apple trees. (C) Erwin K. Smith. (D) Crown gall, caused by the bacterium *Agrobacterium tumefaciens*. [Photographs courtesy of (A) Oregon State University, and (B) K. Nelson and (D) R. L. Foster, University of Idaho.]



VIRUSES

Matthews (1982; 2005) A virus can be defined as a set of one or more nucleic acid molecules (either RNA or DNA) encased with in a coat or coats of protein or lipo-proteins, replicate within a suitable host cell and with in such cells the virus production is dependent on:

- host protein synthesizing machinery
 - Composed from a pool of components rather by binary fission
 - And are located at sites with in host cells that are not separated from host cell components.
- Continually giving rise to variants through various changes in the viral nucleic acid.

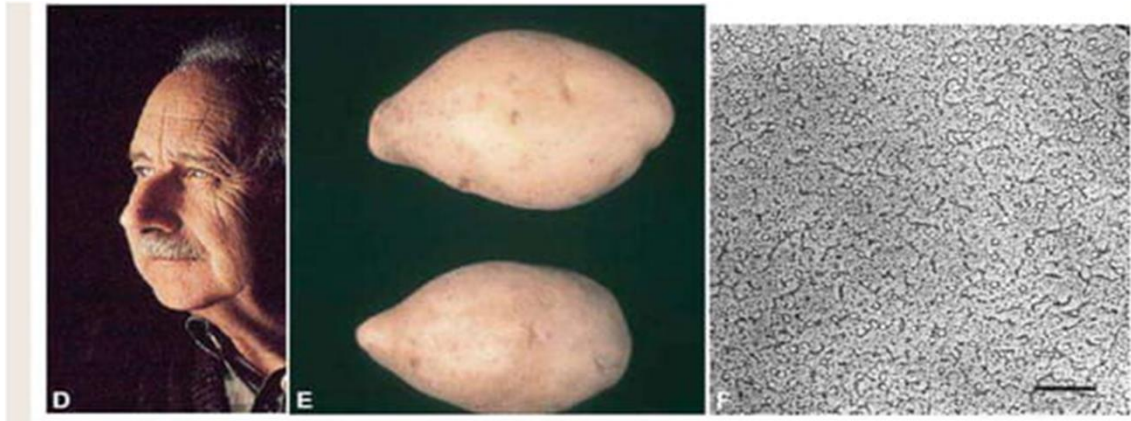


FIGURE 1-21 (A) Adolph Mayer. (B) Tobacco leaf showing symptoms of tobacco mosaic. (C) Particles of tobacco mosaic virus.

Viroids

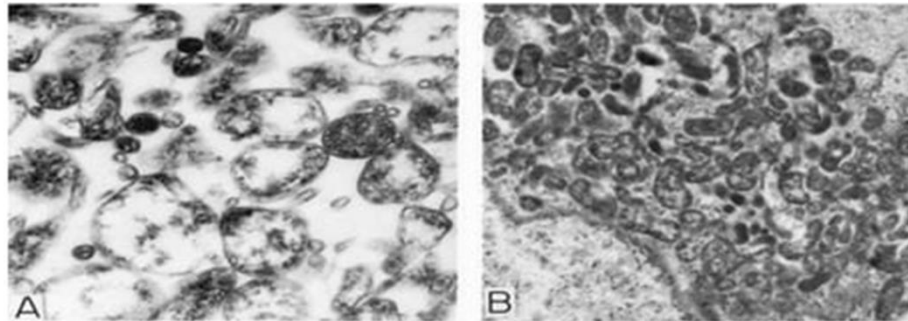
Viroids are small, low mol wt. RNA units (250-370 bp.), lack protein coat, replicate themselves and cause disease (TO Diener, 1971).

- e.g. Potato spindle tuber viroid (PSTVd), coconut cadang-cadang viroid (CCVd).



MYCOPLASMA (PHYTOPLASMA): (DOI ET AL., 1970)

- are submicroscopic, measuring 150-300 nm in diameter having ribosomes and DNA strands enclosed by a bilayer membrane but not the cell wall, replicate by binary fission, can not be cultured artificially *in vitro on medium and are sensitive to certain antibiotics (tetracycline not to penicillin)*.
- E.g. Little leaf of brinjal, Peach yellow Spiroplasm citri (Fudt Allh et al. 1571) Citrus stubborn.



Virusoids: (Keese & Simon 1986)

- A circular, single stranded virusoid like satellite RNA measuring 300-400 base long, encapsidated with single stranded linear RNA (450 bp) of velvet tobacco mottle virus.

RICKETTSIAE: (WINDSOR AND BLACK, 1972) FASTIDIOUS VASCULAR BACTERIA

- rickettsiae are non-motile bacteria measuring about 200 -300 nm in diameter, have cell wall, plasma membrane and cytoplasm containing ribosomes and DNA strands and are obligate:
 1. Multiply by binary fission
 2. Contain enzyme for ATP productione.g. Club leaf of clover, citrus greening



Nematodes

- Nematode are small, multicellular wormlike creatures. Many live freely in the soil, some species parasitize plants. E.g. Ear cockle of wheat caused by *Anguina tritici* & Potato cyst nematodes (*Globerodera pallida*)



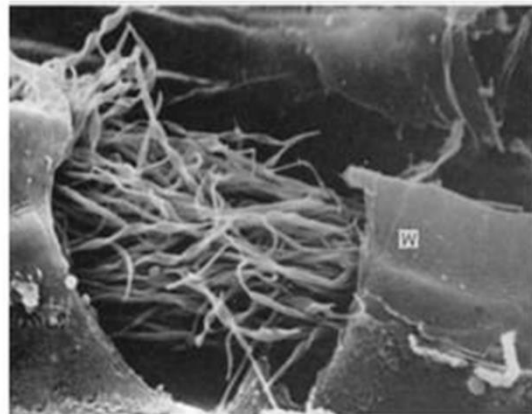
ALGAE

- Green algae are single-celled or multicellular organisms that form colonies, free-living organisms, all of which have chlorophyll b.
- Some of the green algae are parasitic on higher plants.
- e.g. *Cephaleuros green algae*, attack tea, coffee, cacao, black pepper



PROTOZOA

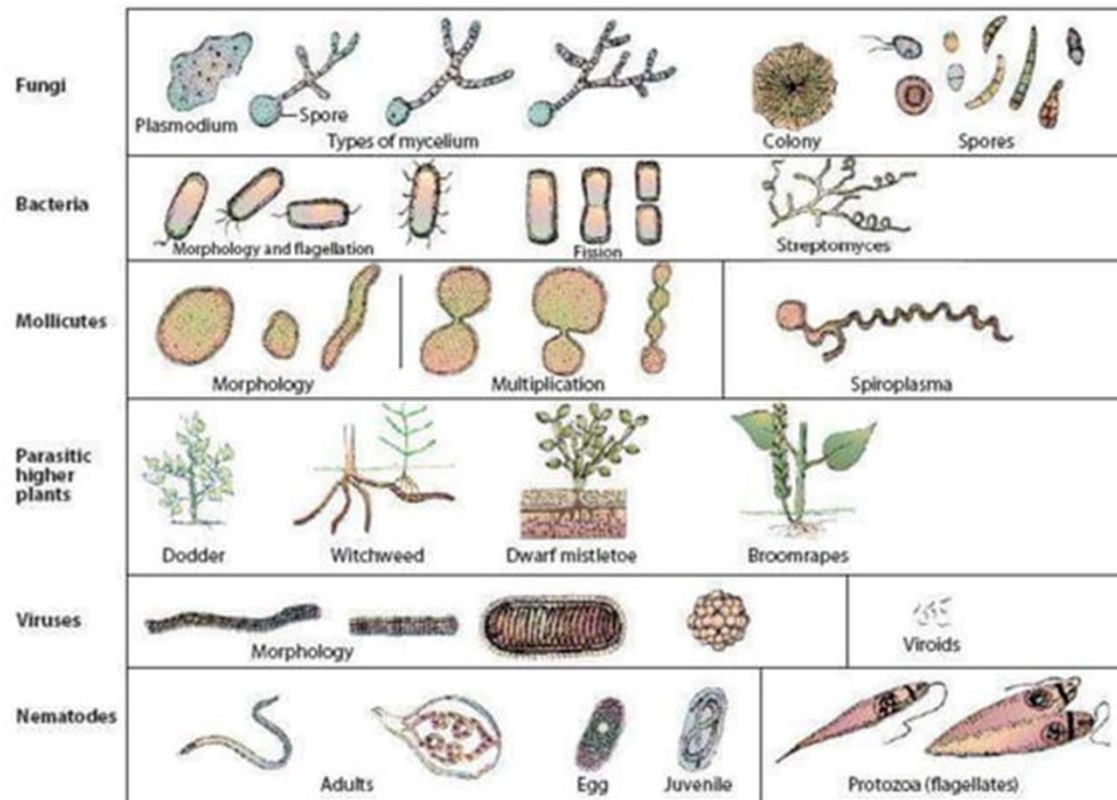
- The protozoa are mostly one-celled, microscopic organisms, generally motile, and have typical nuclei.
- Protozoa move by flagella, by pseudopodia, or by movements of the cell itself.



HIGHER PARASITIC PLANTS

- More than 2500 species of higher plants are known to live parasitically on other plants.
- these parasites are vascular plants that have developed specialized organs which penetrate the tissues of other (host) vascular plants, establish connections to the host plant vascular elements, and absorb nutrients from them.





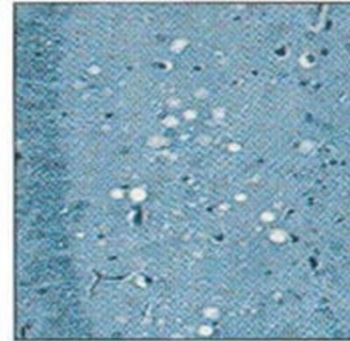
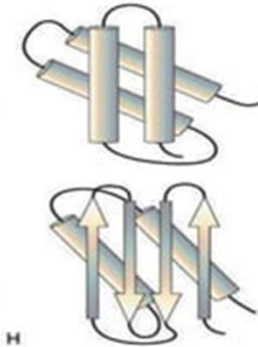
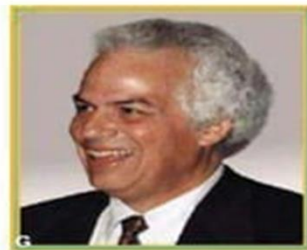
**Infectious disease agents are called pathogens.
Pathogens can be classified as :**

- ? Obligate parasites**
- ? Biotrophs,**
- ? Facultative Parasites**
- ? Facultative Saprophytes**
- ? Necrotrophs**

PRIONS: PRUSINER (1982)

Prion is an infectious agent composed of protein in a misfolded form.

- This is in contrast to all other known infectious agents, which must contain nucleic acid (either DNA, RNA, or both) along with protein components.
- Stanley Prusiner.
- Schematic presentation of a normal protein and of a deformed inactive one, i.e., a prion.
- Prions causes encephalopathies in mammals, including "mad cow disease"



PROOF OF PATHOGENECITY

KOCH'S POSTULATES

- Pathogen must ALWAYS be associated with disease in ALL diseased plants.
- Pathogen must be isolated and established in PURE culture.
- Inoculation of a healthy plant of the same variety must reproduce EXACTLY the same symptom(s).
- Pathogen must be re-isolated from inoculated plant and its identity confirmed as the same as the original isolate.

DISORDER

Abnormalities in plants caused by abiotic or noninfectious agents are termed as disorders

- Unfavourable environmental conditions
- High or low temperature
- Moisture stress or excess
- Hail injury
- Nutritional deficiencies
- Nitrogen deficiency
- Zn deficiency
- Soil conditions
- Air pollution

