Classification of plant diseases

Pl. Path. 111 (Cr. Hrs. 3+1)

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Classification of plant diseases

- On the basis of extent to which plant diseases associated with plant
  - Localized
  - Systemic
- On the basis of natural perpetuation and mode of infection
  - Soil borne
  - Air borne
  - Seed borne

- On the basis of symptoms
  - Rusts
  - Smuts
  - Rots
  - Blight
  - Leaf spot
  - Canker
  - Wilt
  - Downy mildews
  - Prowdery mildew
  - Anthracnose

- **On the basis of host plants**
  - Cereal diseases
  - Vegetable diseases
  - Fruit diseases
  - Forest diseases
  - Ornamental diseases
- **On the basis of crop**
  - Diseases of Wheat
  - Diseases of maize etc
- **On the basis of organ they attack**
  - Root diseases
  - Shoot diseases
  - Fruit diseases
  - Foliage diseases

On the basis of occurrence and distribution

- **Endemic :** when a diseases more or less constantly prevalent from year to year in a moderate to severe form in a particular country. E.g., Wart disease of potato is endemic to Darjeeling
- **Epidemic or epiphytotic:** A disease occurring periodically but in a severe form involving major area of the crop. it may be constantly present in locality but assume severe form occasionally e.g. Rust, Late blight, Mildews

- **Sporadic:** Diseases which occur at very irregular interval and location in a moderate to severe form e.g., leaf blights, wilt
- **Pandemic:** diseases occurring throughout the continent or sub-continent resulting in mass mortality e.g., Late blight of potato

Based on pathogen generations

- Simple interest/ Monocyclic diseases

  those diseases the increase of which is analogous of increase in money due to simple interest i.e those diseases which have only generation in one cropping season e.g. loose smut of wheat
- Compound interest/ polycyclic diseases

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

  these are also polycyclic diseases but they complete their disease cycle in more than one year over years e.g. Cedar Apple Rust

- **On the basis of cause (Pathogen identity)**
  - **Most useful base of classification as it indicate**
    - **Cause of the disease i.e. fungus or virus etc**
    - **Possible disease development and host pathogen interaction**
    - **Management practices to be applied.**
- Infectious/ parasitic (Biotic)
  - Fungi, bacteria, virus, viroids, phytoplasma, RLBs, nematodes, higher parasitic plants etc.
- Non infectious (Abiotic)
  - nutrional deficiencies e.g. khaira disease of rice due to Zn deficiency, unfavourable environment e.g. frost injury, physiological wilt etc

Introduction to Plant Pathology

Plant pathology (gr., path -“suffering”- “ology”, the science of) is the study of **plant** diseases and the abnormal conditions that constitute **plant** disorders. Etiology is the determination and study of the cause of disease. A pathogen can be living or non-living, but usually refers to a live agent.

What is a plant disease?

- A plant **disease** is any abnormal condition that alters the appearance or function of a plant. It is a physiological process that affects some or all plant functions. Disease may also reduce yield and quality of harvested product.

- Disease is a process or a change that occurs over time. It does not occur instantly like injury.

What is a plant disease?

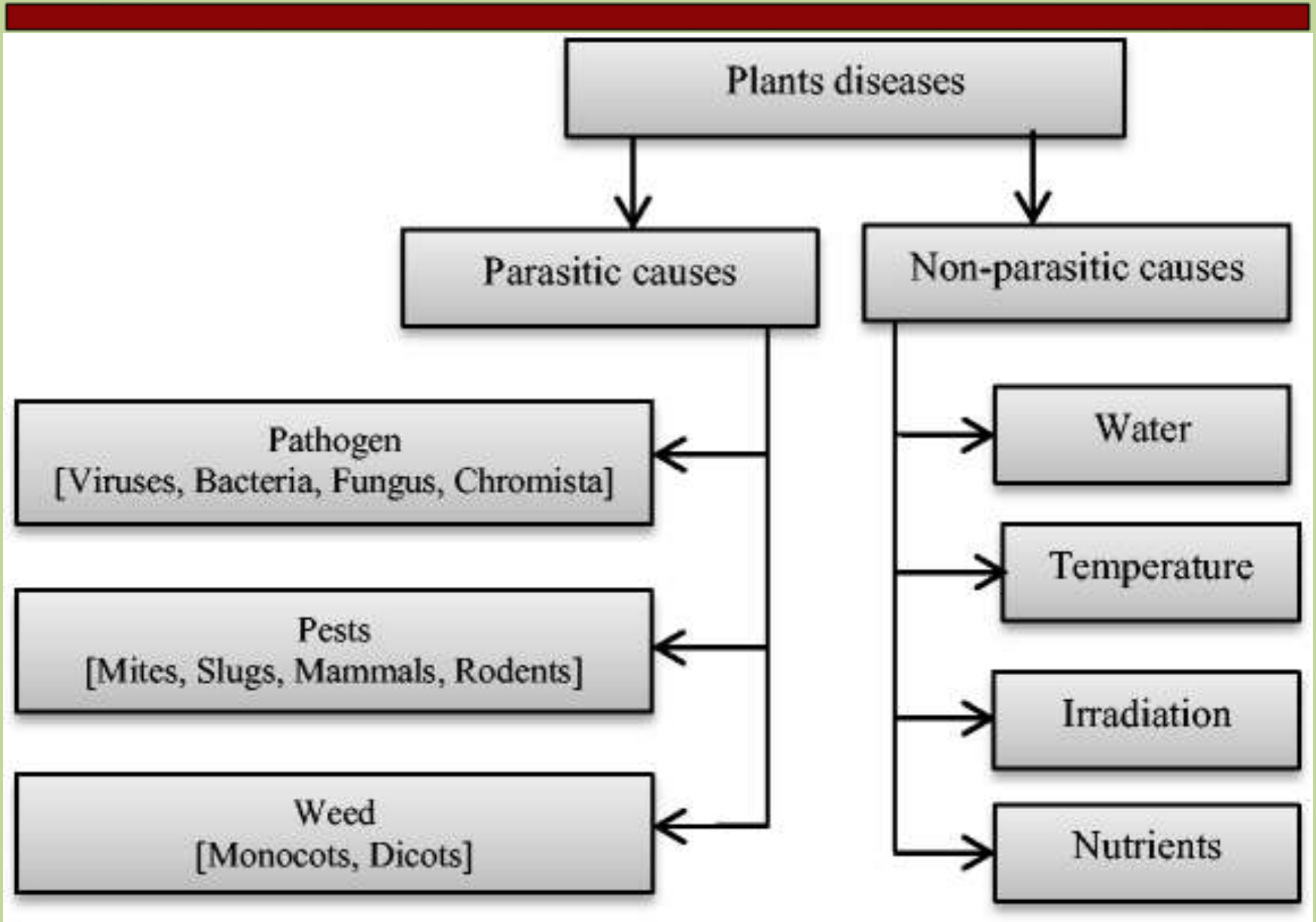
- Visible effects of disease on plants are called **symptoms**. Any detectable changes in color, shape, and/or functions of the plant in response to a pathogen or disease-causing agent is a symptom.

- **Signs** of plant disease are physical evidence of the pathogen, for example, fungal fruiting bodies, bacterial ooze, or nematode cysts. Signs also can help with plant disease identification.

What causes plant disease?

- Infectious plant diseases are caused by living organisms that attack and obtain their nutrition from the plant they infect. The parasitic organism that causes a disease is a **pathogen**. Numerous fungi, bacteria, viruses, and nematodes are pathogens of corn and soybean in Iowa.

- The plant invaded by the pathogen and serving as its food source is referred to as a **host**.


Plants diseases
Parasitic causes
Non-parasitic causes
Pathogen
[Viruses, Bacteria, Fungus, Chromista]
Pests
[Mites, Slugs, Mammals, Rodents]
Weed
[Monocots, Dicots]
Water
Temperature
Irradiation
Nutrients

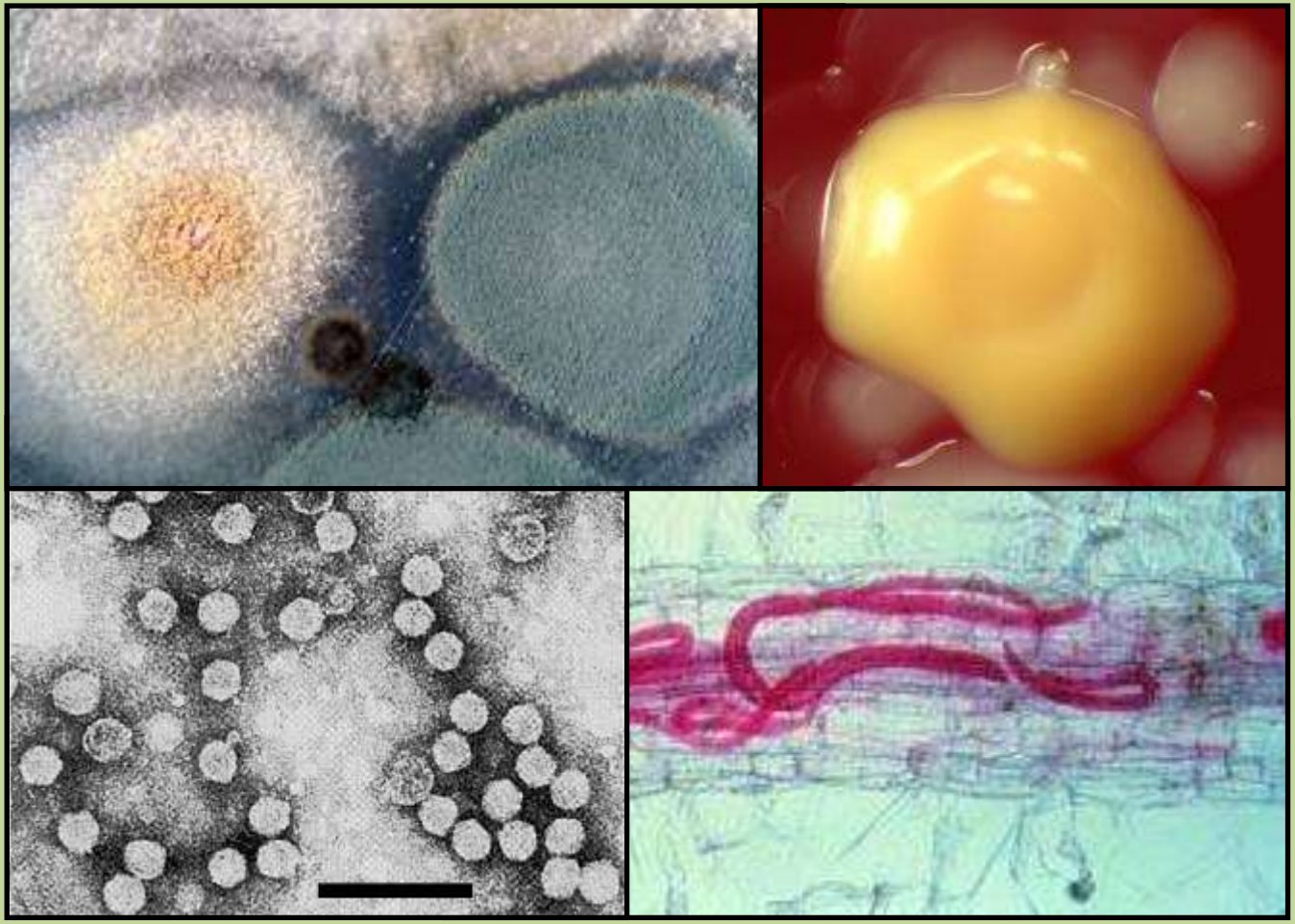
Role of the environment

- A **favorable environment** is critically important for disease development – even the most susceptible plants exposed to huge amounts of a pathogen will not develop disease unless environmental conditions are favorable.

Types of pathogens

Fungi

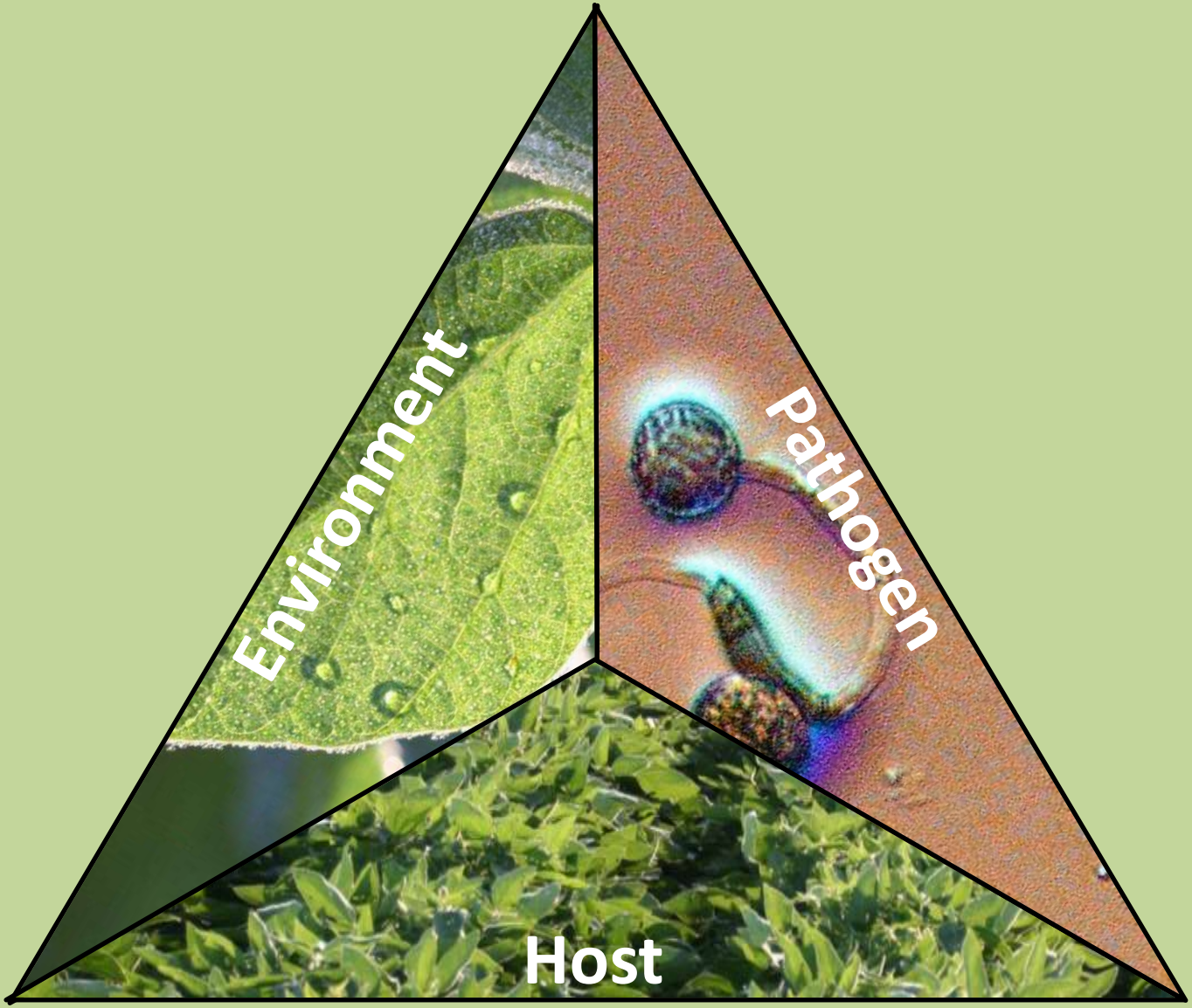
Bacteria

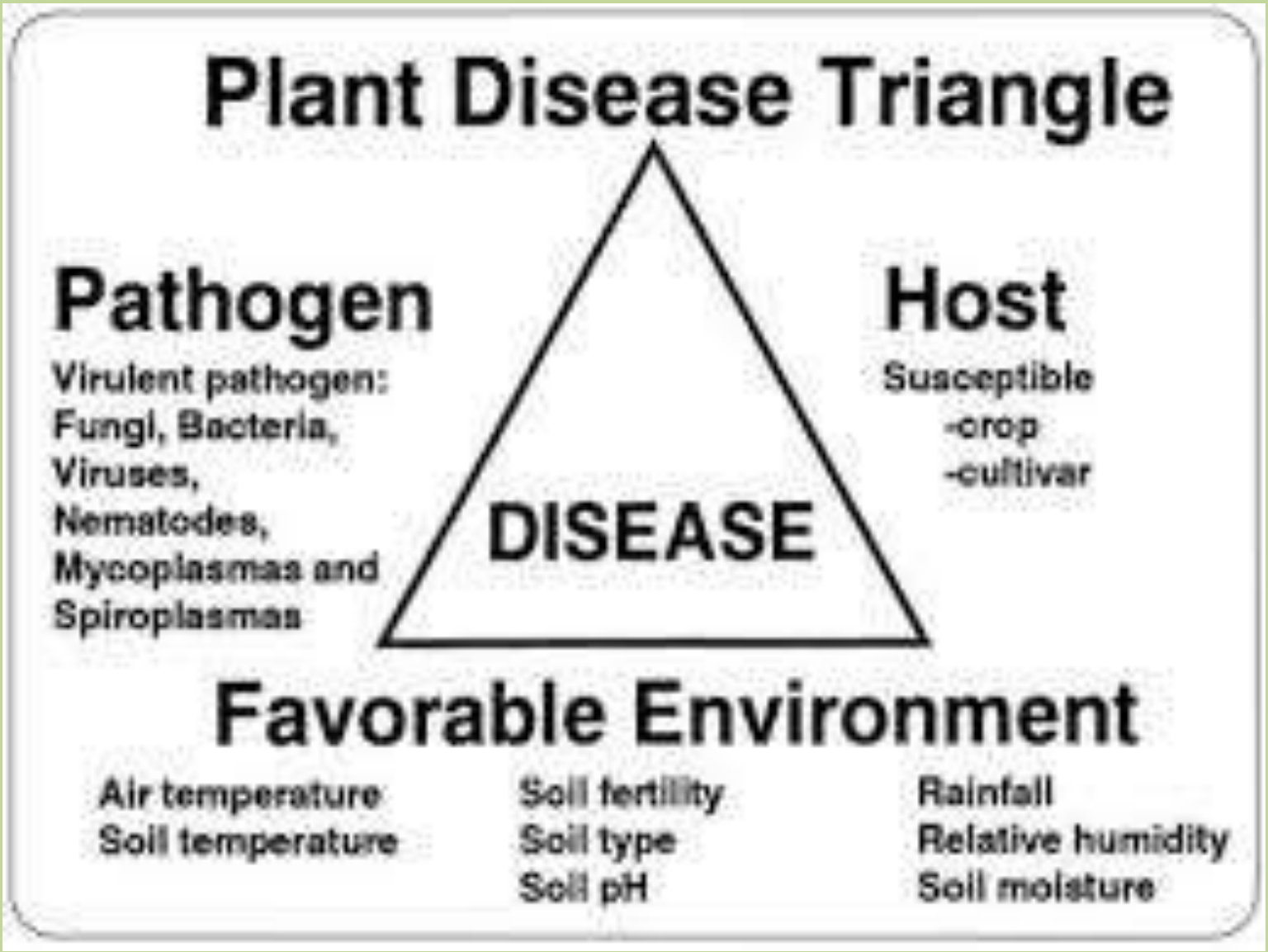


Viruses

Nematodes

The Disease Triangle




Plant Disease Triangle
Pathogen
Virulent pathogen:
Fungi, Bacteria,
Viruses,
Nematodes,
Mycoplasmas and
Spiroplasmas
Host
Susceptible
-crop
-cultivar
DISEASE
Favorable Environment
Air temperature
Soil temperature
Soil fertility
Soil type
Soil pH
Rainfall
Relative humidity
Soil moisture

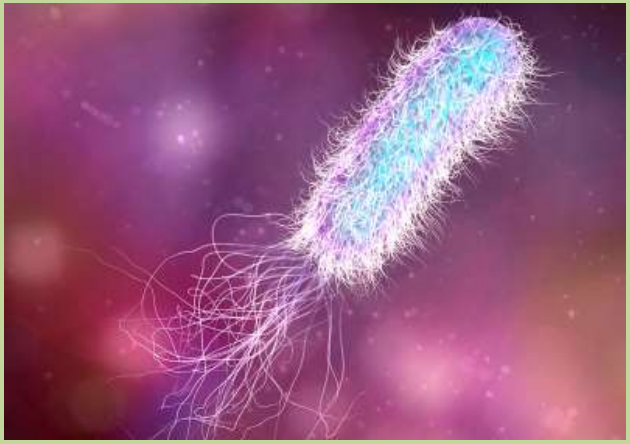
The disease triangle is an important concept in plant pathology. Disease will ONLY occur if these three factors interact simultaneously.

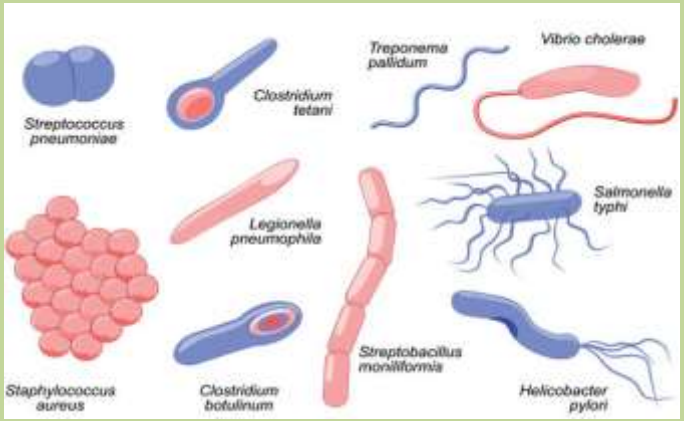
A susceptible **host** plant, a **pathogen,** and a **favorable environment** are the three factors composing the plant disease triangle. All three factors are necessary for development of a plant disease, thus, disease can be affected by altering any of these three factors. For example, the **host** plant can be changed by growing disease-resistant varieties. The **pathogen** can be removed by tilling residue, rotating crops so that pathogens do not survive year to year on the same crop, controlling insects that carry pathogens to plants, or using fungicides to kill the pathogen. Finally, the **environment** can be managed so that it is less favorable for disease, such as by changing row spacing or draining low areas.

Groups of plant pathogens - Fungi

- Vast majority are beneficial
- Can cause plant, human, and livestock diseases
- Most cannot be seen without a microscope
- Lack chlorophyll
- Composed of growing structure of delicate, threadlike filaments called hyphae
- Reproduce by forming spores

Groups of plant pathogens - Bacteria

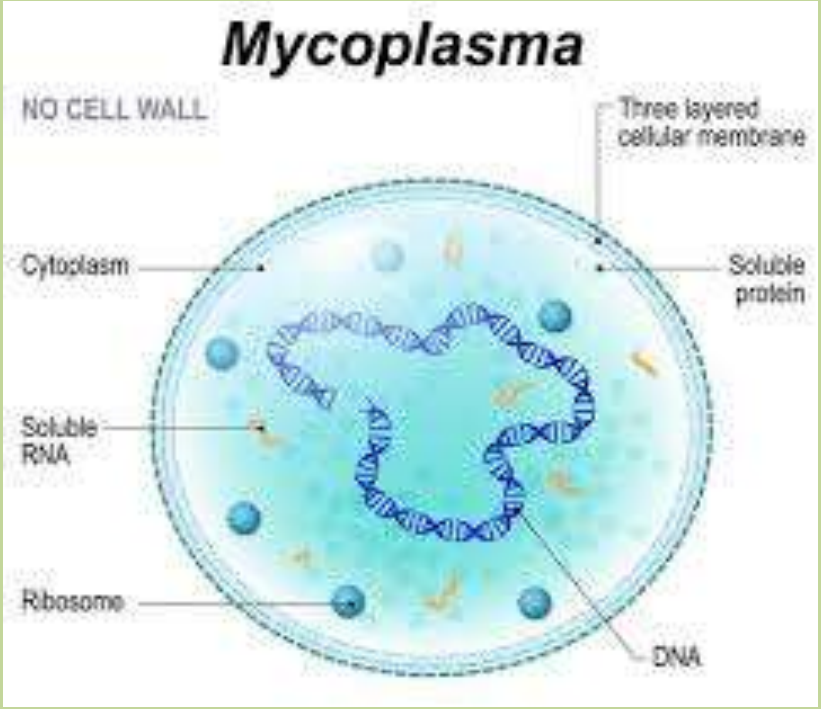




- Extremely small organism requiring microscope to be seen
- Bacteria population can increase in number in short time period
- Cells clump together in masses called colonies
- Obtain food from dead or decaying organic matter or living tissue
- Spread plant to plant by wind-driven rain
- Gain entrance through natural plant openings or injuries

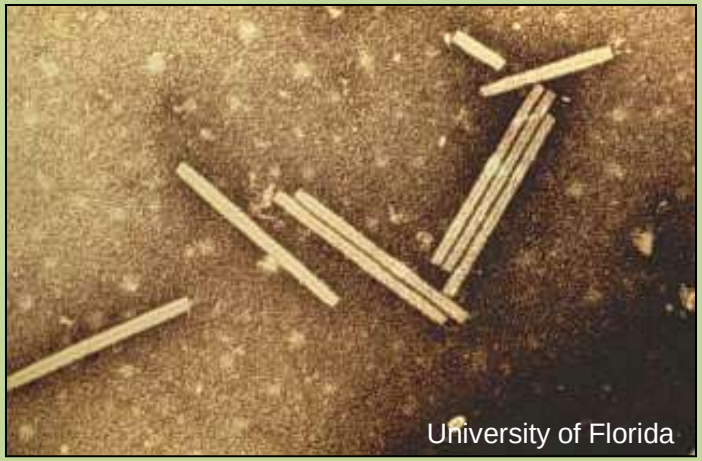
Mycoplasma

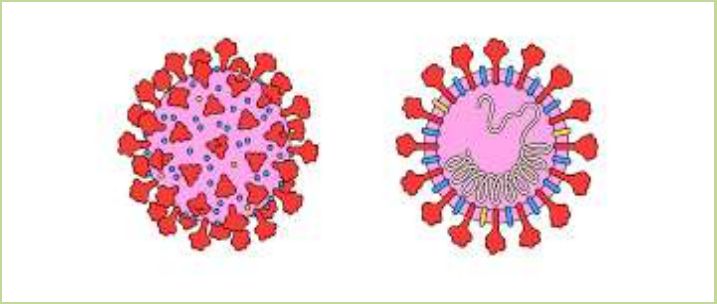
- **Mycoplasma** (plural **myco plasmas** or mycoplasmata) is a genus of bacteria that lack a cell wall around their cell membranes. This characteristic makes them naturally resistant to antibiotics that target cell wall synthesis (like the beta-lactam antibiotics). They can be parasitic or saprotrophic.



Groups of plant pathogens - Viruses

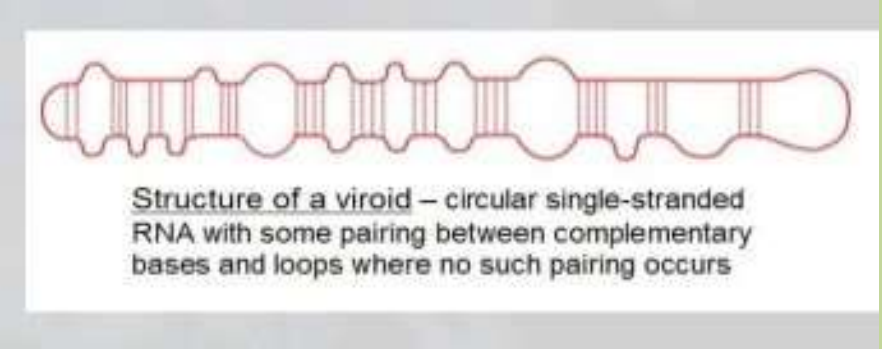
- Most familiar because they cause human and animal diseases such as influenza, polio, rabies, smallpox, and warts
- Cause some destructive plant diseases
- Measure only about one-millionth of an inch in size
- Are not complete living systems
- Survive only in living cells
- Transmitted by insects which are called vectors

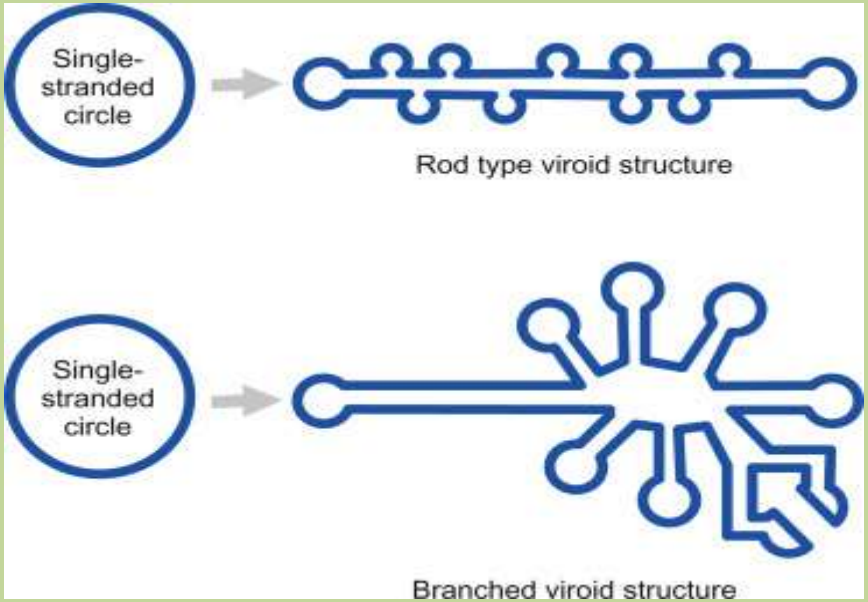




Viroids

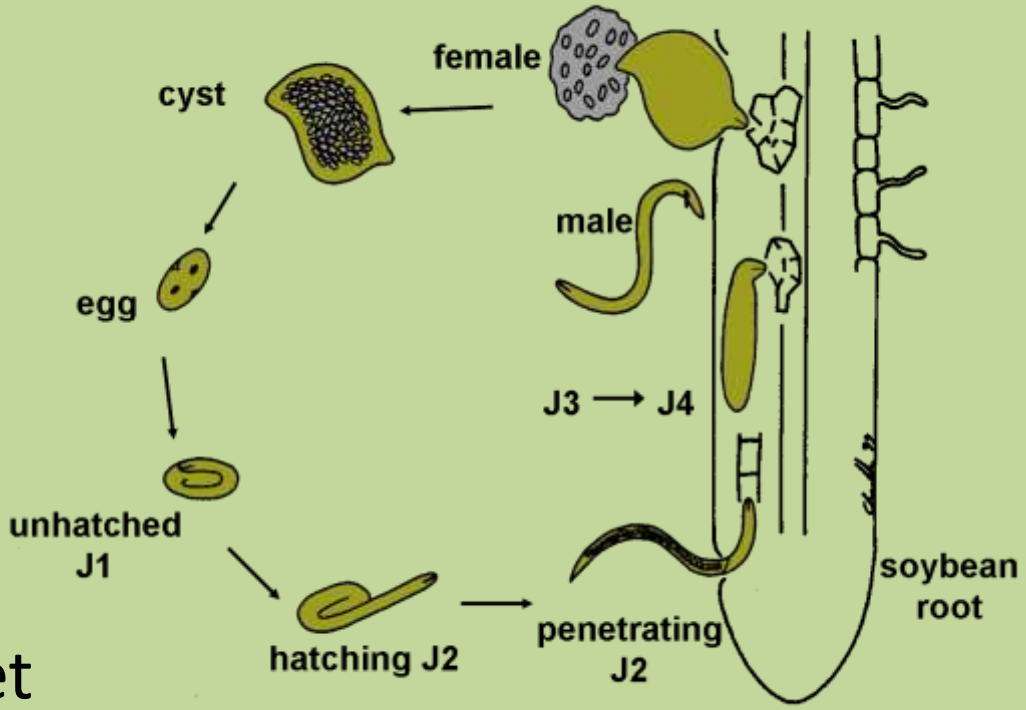
- Viroids are the smallest infectious pathogens known. They are composed solely of a short strand of circular, single-stranded RNA that has no protein coating. All known viroids are inhabitants of higher plants, and most cause diseases, whose respective economic importance on humans vary widely.





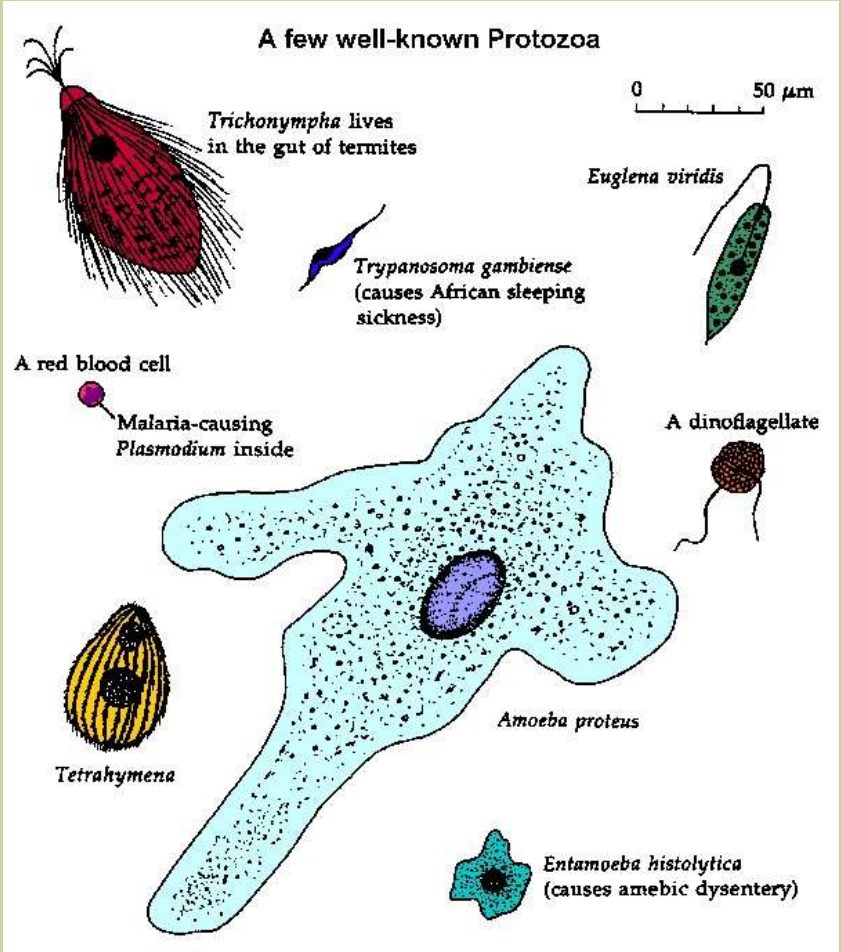
Groups of plant pathogens - Nematodes

- Round, slender, threadlike worms
- Some are parasites on animals, insects, fungi, other nematodes, and plants
- Plant-parasitic nematodes have a stylet
- Most live in the soil and feed in or on plant roots

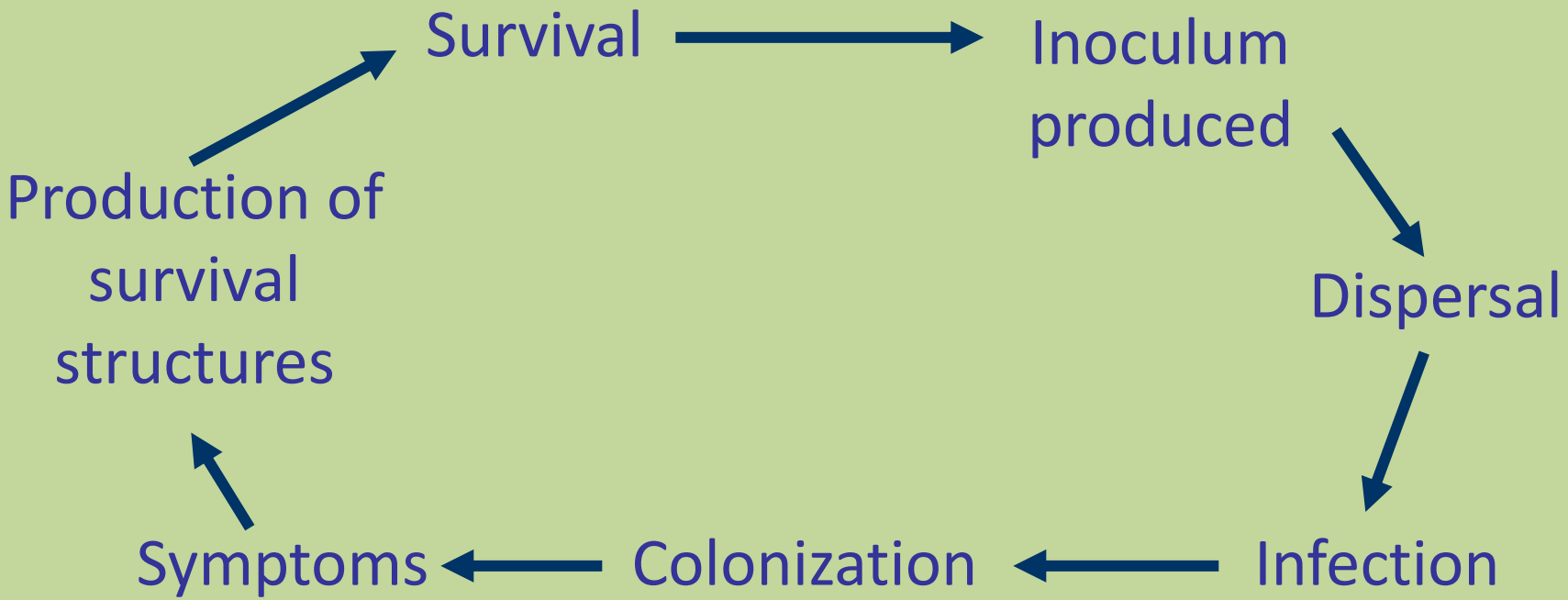


Protozoa

- **Protozoa** is an informal term for a group of single-celled eukaryotes, either free-living or parasitic, which feed on organic matter such as other microorganisms or organic tissues and debris.
- **Protozoan** infections are responsible for **diseases** that affect many different types of organisms, including plants, animals, and some marine life. Many of the most prevalent and deadly human **diseases** are caused by a **protozoan** infection, including African Sleeping Sickness, amoebic dysentery, and malaria.



Disease cycle



Adapted from P. Vincelli, 2005

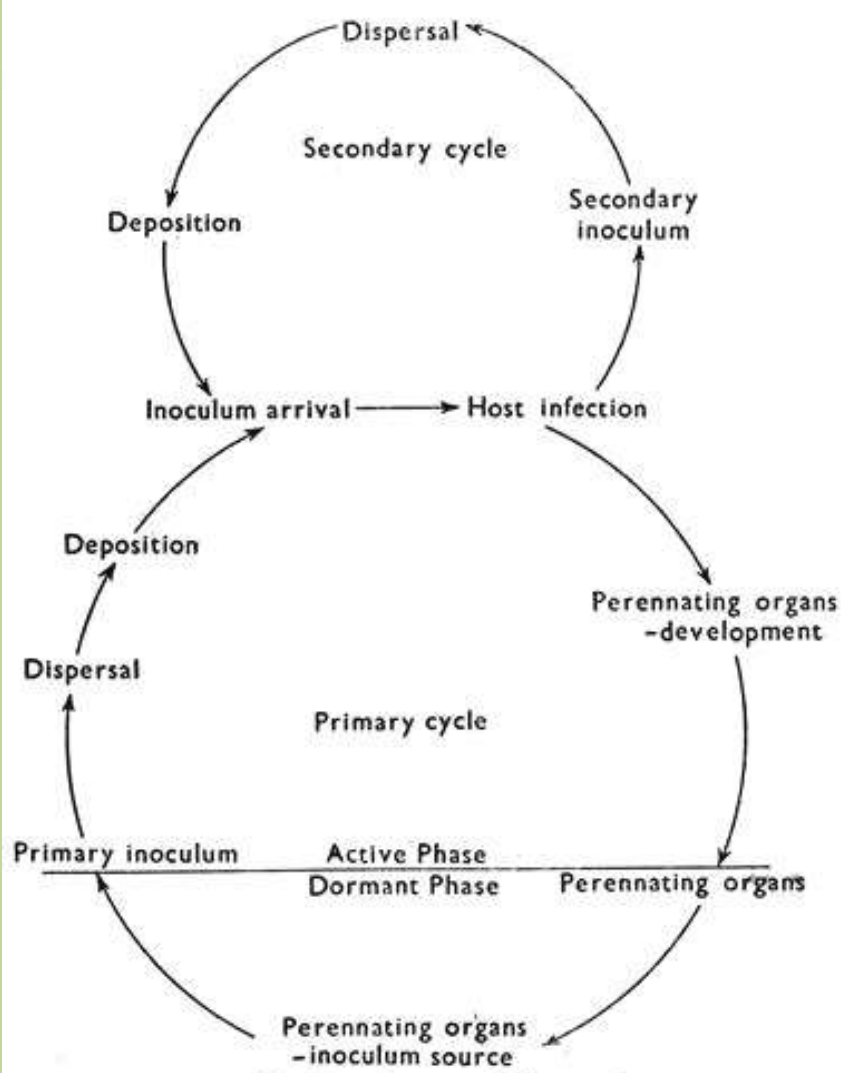


Fig. 345. General pattern of disease cycle.

Comparison of disease cycles

	Fungi	Bacteria	Viruses	Nematodes
Survival	Crop residue Soil Alt. hosts -	Crop residue Soil Alt. hosts Insect vectors	- - Alt. hosts Insect vectors	Crop residue Soil - -
Dispersal	Wind Rain Insects	Wind Rain Insects	- - Insects	Tillage Equipment Water run-off
Infection	Directly Wounds Insect feeding	- Wounds Insect feeding	- - Insect feeding	Directly - -

Inoculum

Source of inoculum varies for each disease

- May be produced on residues left in the field
- Present in the soil
- Present in weeds or other crops in the area
- Present in or on the seed
- Present in soil sticking to equipment or tools
- Carried by wind or water
- Carried by insect vectors
- Carried in by animals, birds, and people

Spread of inoculum

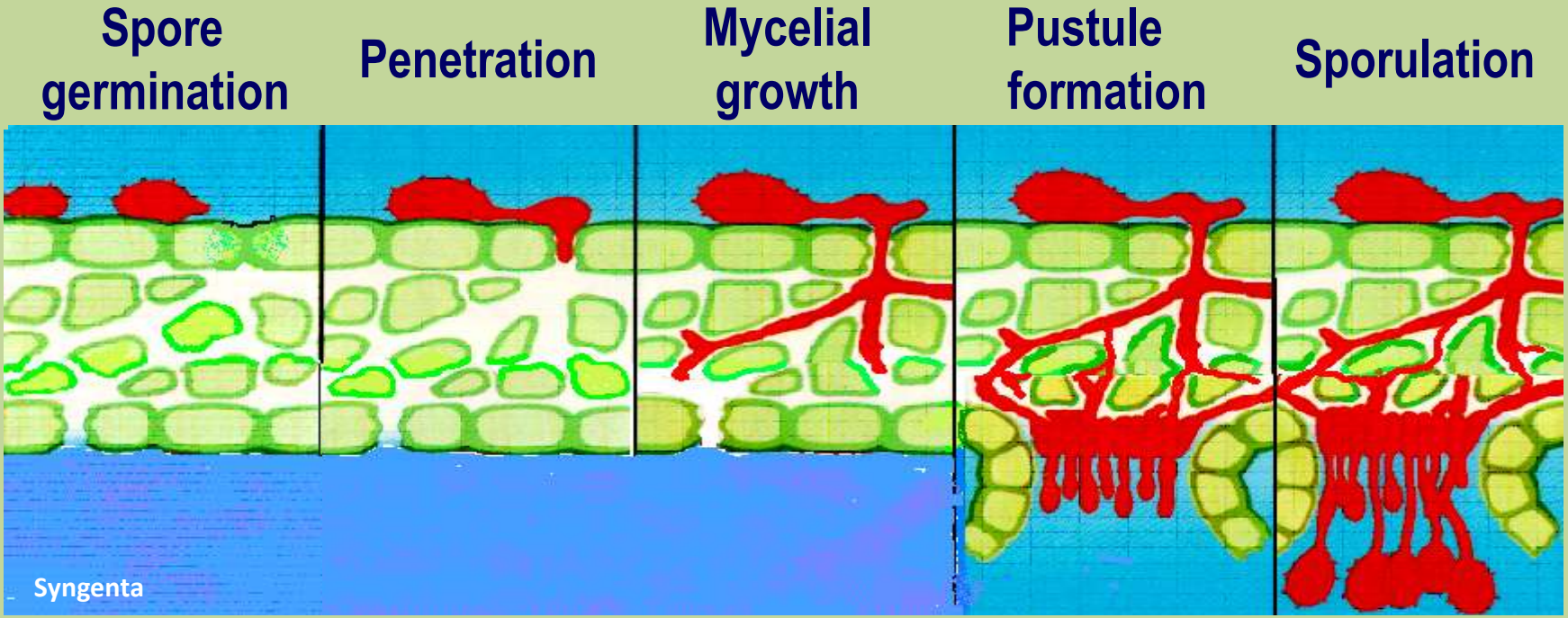
Two ways

1. Plant placed in soil that contains a pathogen

2. Inoculum moves from its source to host plant

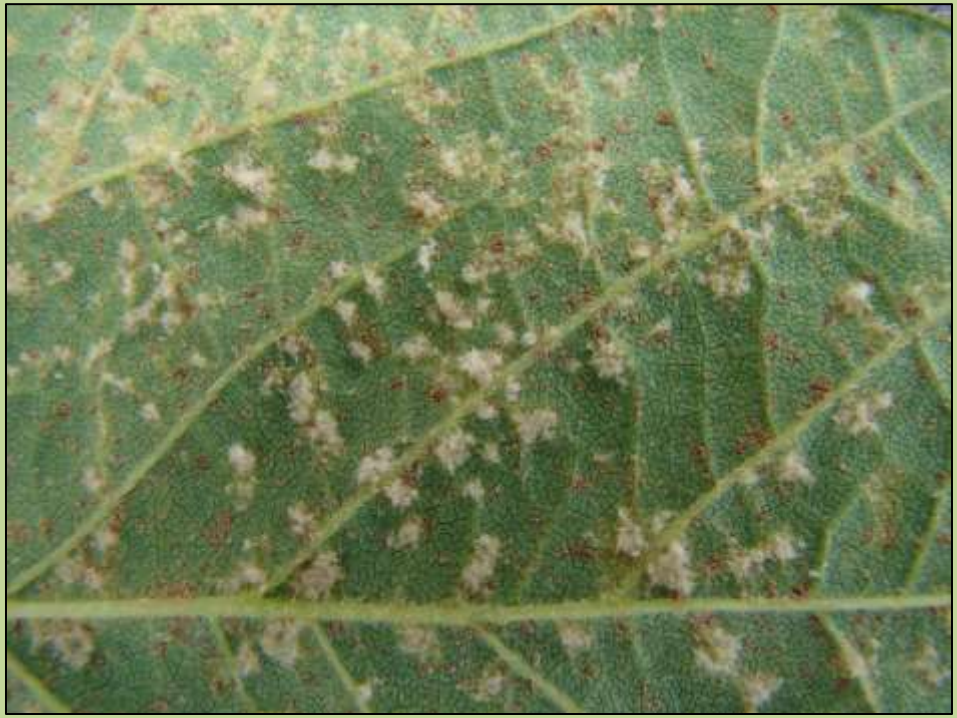
Penetration of inoculum and infection

- **Infection** occurs when a pathogen successfully enters a plant and grows, reproduces, and spreads within the plant
- Pathogens enter a host through natural openings, wounds on plant surfaces, or by penetrating directly into the plant



Secondary cycles

- Some diseases have only one cycle during the growing season (often root rots)
- Some diseases develop secondary or repeating cycles during the growing season (often foliar diseases)
- Number of cycles depends on the pathogen, susceptibility of the host, and environmental conditions

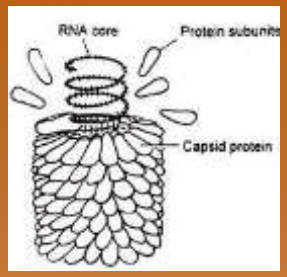


Pathogen survival

Pathogens survive season to season in:

- Soil
- Crop residue
- Weed or noncrop hosts
- Seed or vegetative plant parts
- Insects
- Mild climates

VIRUSE DISEASE



Tobacco Mosaic Virus (TMV)

Tomato Spotted Wilt Virus (TSWV)

Tomato Yellow leaf Curl Virus (TYLCV)

Cucumber Mosaic Virus (TMV)

Potato Virus Y (PVY)

African Cassava Mosaic virus (ACMU)

Plum Pox Virus (PPV)

Brown Mosaic Virus (BMV)

Cauliflower Mosaic Virus (ACMV)

BACTERIA DISEASE

Black Rot

Bacterial Cancer

Bacterial Soft Rot

Bacterial Leaf Spot

Bacterial Wilt

Bacterial Leaf Spot

Bacterial Blight

Bacterial Speck

Bacterial Brown Spot

FUNGAL DISEASE

Wilt of Gram

Downy Mildew of Cereals

Tikka Disease of Groundnut

Yellow rust of Wheat

Maize Smut

Covered Smut Barley

Red Rot of Sugarcane

Leaf Rus of Coffee

Early Blight of Potato

VIROID DISEASE

TOMOTO CHLORIC DWARF

APPLE FRUIT CRINKLE

CHRYSANTHEMUM CHLOROTIC MOTTLE

Plant Pathology

Terminologies

- **Disease:** Any malfunctioning of host cells and tissues that result from continuous irritation by a pathogenic agent or environmental factor and leads to development of symptoms (G.N.Agrios, 1997).

- **Disorder:** Non-infectious plant diseases due to abiotic causes such as adverse soil and environmental conditions are termed disorders. The common characteristic of noninfectious diseases of plants is that they are caused by the lack or excess of something (temperature, soil moisture, soil nutrients, light, air and soil pollutants, air humidity, soil structure and pH) that supports life. Non-infectious plant diseases occur in the absence of pathogens, and cannot, therefore, be transmitted from diseased to healthy plants.

- **Disease Incidence : the number of plants affected by a disease within a** population. E.g. soil borne diseases, nematodes
- **Disease Severity : the measure of damage done by a disease. OR** Amount of disease present in a population. E.g. Leaf, stem, seed diseases

- **Pathogen:** An entity, usually a micro-organism that can incite disease. In a literal sense a pathogen is any agent that causes pathos (ailment, suffering) or damage. However, the term is generally used to denote living organisms (Fungi, bacteria, MLO's, nematodes etc.,) and viruses but not nutritional deficiencies.

- **Parasite:** Organisms which derive the materials they need for growth from living plants (host or suscept) are called parasites.

- **Pathogenicity** is the ability of the pathogen to cause disease Pathogenesis is the chain of events that lead to development of disease in the host (or) sequence of progress in disease development from the initial contact between the pathogen and its host to the completion of the syndrome

- **Sign:** The pathogen or its parts or products seen on a host plant.

- **Symptom:** The external or internal reactions or alterations of a plant as a result of a disease. Syndrome: The set of varying symptoms characterizing a disease are collectively called a syndrome.

- **Biotroph:** An organism that can live and multiply only on another living organism. They always obtain their food from living tissues on which they complete their life cycle. Ex: Rust, smut and powdery mildew fungi.

- **Hemibiotroph (Facultative Saprophyte):** The parasites which attack living tissues in the same way as biotrophs but will continue to grow and reproduce after the tissue is dead called as facultative saprophytes.

- **Perthotrophs or perthophytes (Necrotroph):** A parasite is a necrotroph when it kills the host tissues in advance of penetration and then lives saprophytically Ex: Sclerotium rolfsii.

- **Inoculum:** It is the part of the pathogen which on contact with susceptible host plant causes infection (or) the infective propagules which on coming in contact with the host plant causes an infection are known as inoculum

- **Inoculum potential:** The energy of growth of a parasite available for infection of a host at the surface of the host organ to be infected (or) The resultant of the action of environment, the vigour of the pathogen to establish an infection, the susceptibility of the host and the amount of inoculum present

- **Incubation period:** The period of time (or time lapse) between penetration of a host by a pathogen and the first appearance of symptoms on the host. It varies with pathogens, hosts and environmental conditions.
- **Hypersensitivity:** Excessive sensitivity of plant tissues to certain pathogens. Affected cells are killed quickly, blocking the advance of obligate parasites. Infection is the establishment of parasitic relationship between two organisms, following entry or penetration (or) the establishment of a parasite within a host plant.
- **Hypoplasia** (from Ancient Greek ὑπο- hypo-, "under" + πλάσις plasis, "formation"; adjective form **hypoplastic**) is underdevelopment or incomplete development of a tissue or organ.
- **Hyperplasia** is the enlargement of a **plant** tissue due to excessive increase in the number of **plant** cells produced. **Hyperplasia** results in overdevelopment in size of **plants** or **plant** organs. **Hypertrophy** is excessive growth due to the enlargement of individual cells.

- **Systemic infection:** The growth of pathogen from the point of entry to varying extents without showing adverse effect on tissues through which it passes.
- **Epidemic or Epiphytotic disease:** A disease usually occurs widely but periodically in a destructive form is referred as epidemic or Epiphytotic disease. Ex: Late blight of potato – Irish famine (1845)
- **Endemic:** Constantly present in a moderate to severe form and is confined to a particular country or district. Ex: Club root of cabbage in Nilgiris Black wart of potato – Synchytrium endobioticum Onion smut – Urocystis cepulae
- **Sporadic disease:** Occur at very irregular intervals and locations and in relatively fewer instances. Ex: Udbatta disease of rice, Angular leaf spot of cucumber – Pseudomonas lachrymans

Tikka Disease of Groundnut

Host: Arachis Hypogea L.
Pathogen: Cercospora sp.,
One of the best known leaf spot diseases is that of Arachis hypogea L. (groundnut). Popularly it is called the tikka disease. The tikka disease is a serious disease occurring in areas where the groundnut crop is grown in India.

The spots appear on the host leaves when the plants are one or two months old. Later necrotic lesions appear on the stem as well. In fact there are two leaf spot diseases of groundnut caused by two different species of form genus Cercospora namely, *C. arachidicola*.

The leaf spot disease caused by the former is more common, dangerous and does greater damage than the latter. The spot produced by *C. personata* are numerous. These weaken the host plant and lead to defoliation which adversely affects size and quality of the fruit.

The latter remains small in size and fewer in number. Sundaram (1965) reported that in the case of severe infection the crop yield may be reduced to 22%.

Leaf Spot of Groundnut (caused by Cercospora sp.)

Causal Organism:
Tikka disease of groundnuts is caused by two species of Cercospora: *Cercospora personata* (Berk. & Curt.) Elle and Eve., now known as

Cercosporidium personatum (Berk. & Curt.) Deighton and *Cercospora arachidicola* Hori. The two form-species differ from each other with respect to the size, shape and colour of necrotic lesions they produce, conidia formation and the nature of the mycelium.

Symptoms of Tikka Disease:

1. Leaf spots are small, more circular and about 1-6 mm in diameter (A).

2. The necrotic lesions appear on both the leaf surfaces and change from dark brown to dark in colour.

3. Young spots lack bright yellow halo which, however, develops around the older ones.

Mycelium of Tikka Disease:

C. personata

4. The mycelium consists of hyphae which are entirely internal.

5. The septate hyphae ramify in the intercellular spaces and obtain nutrition by sending branched haustoria into the mesophyll (both spongy and palisade) cells.

6. The unbranched conidiophores arise in tufts from a dense, globular, and brown to black stroma (23-30 µ in dia.) and emerge by rupturing the host epidermis (B).

7. They are geniculate, olivaceous brown, 24-54 p long and 5-8 µ broad and are either aseptate or septate with 1-2 septa.

8. The conidiophores are confined to the lower surface of the host leaf and are seen arranged in concentric circles in the tuft.

9. The conidia (C) are obclavate or cylindrical, light coloured, 18-60 µ in length and 6-11 µ in breadth. They are septate with 1-7 septa and have bluntly rounded ends.

C. arachidicola:

1. The leaf spots are comparatively larger in size, irregularly circular in outline and 4-10 mm in diameter.

2. The leaf spots are often confluent and necrotic lesions occur on both the surfaces. Those on the upper surface are reddish brown to black and on the lower surface are light brown.

3. There is a yellow halo around each spot but halos on the lower surface are less distinct.

4. It consists of both external and internal hyphae.

5. The internal hyphae are both intercellular and intracellular. The haustoria are absent.

6. The unbranched conidiophores arise scattered from a deep brown stroma (25-100 p in dia.).

7. They are geniculate, yellowish brown and 15 to 45 p long and 3-5 p broad and are either aseptate or septate with 1 to 2 septa.

8. The conidiophores usually occur on the upper surface of the host leaf but occasionally are found on the lower surface as well and thus described as amphigenous. They are sparse and do not occur.

9. The conidia are obclavate hyaline or pale yellow to slightly olivaceous, 38-108 µ long and 8-6 µ broad. They are septate with 4-12 septa and have rounded to distinctly truncate base and sub-acute apex.

Disease Cycle:

Primary infection takes place by soil borne conidia, which in the soil and on seeds in the shells. The spread of the disease during the season is by means of wind disseminated conidia.

Penetration is direct through the epidermis and also by way of stomata. Chiefly it occurs through the upper epidermis. However, there is possibility of infection through both the leaf surfaces.

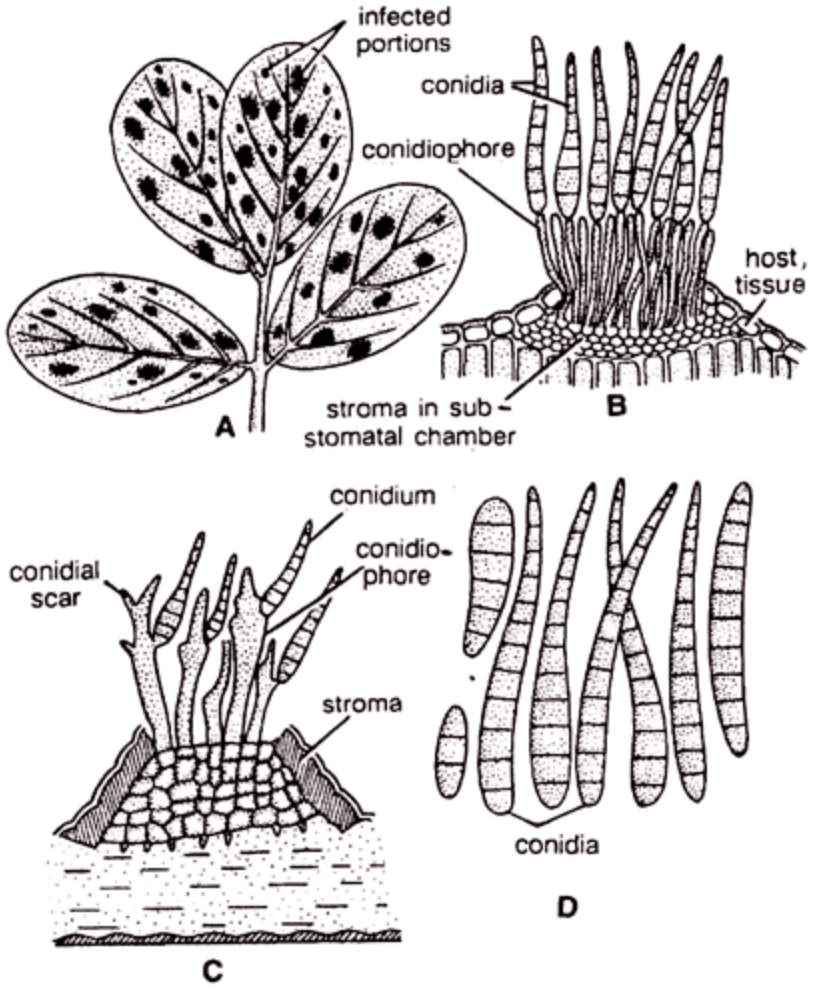


Fig. 1. (A–D). *Cercospora.* (A) Leaf spot disease of ground nut, (B) Conidiophore bearing conidia, (C) Logitudinal section of acervulus with geniculate conidiophores, (D) Conidia

Predisposing Factors of Tikka Disease:

According to Sulaiman and Agashe (1965), maximum predisposing factors for the development of disease prevail in the month of September. Prolonged low temperature and heavy dew favour severe infection.

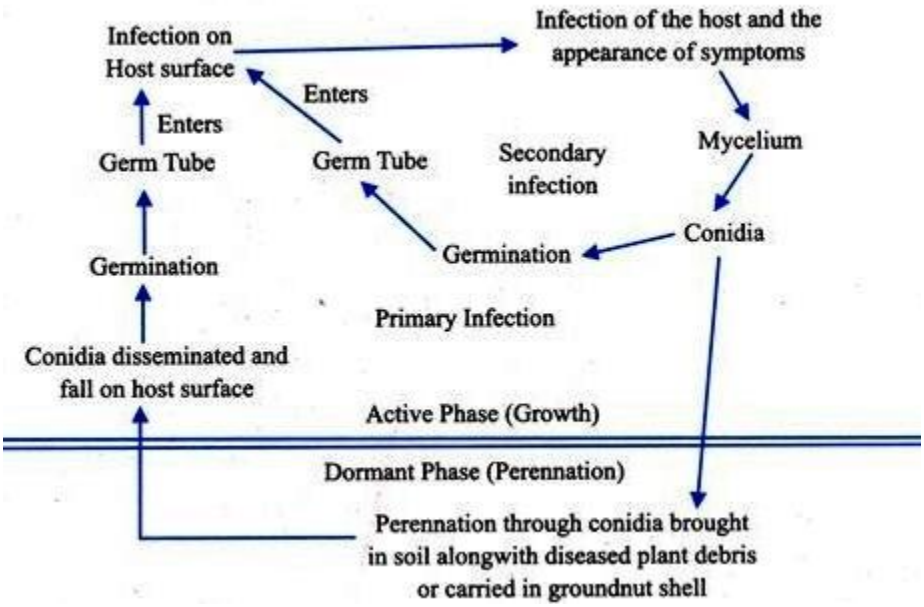
According to Shanta (1960) and Jensen and Boyle (1965), relative humidity plays an important role in infection. Ramakrishnan and Apparao (1965) reported that a period of 3 days of high humidity is essential for maximum infection.

Shanta studied the effect of NPK fertilizers on the incidence of disease and found that the application of nitrogen and phosphatic fertilizers increase disease incidence whereas potash decreases it slightly.

Ravindar Nath, Kulkami and Appaji Rao (1965) who carried on preliminary biochemical observations of Tikka disease, have suggested that ascorbic acid and riboflavin content of host leaves appear to play some part in susceptibility and resistance to the disease.

According to them, increase in riboflavin content of the leaves is correlated with resistance whereas increase in ascorbic acid is directly related to susceptibility.

Disease Cycle of Tikka disease in Groundnut



Control Measures of Tikka Disease:

Rotation of crops, seed treatment and disposal of infected host debris by burning or burying in deep pits eliminate chances of primary infection from the soil borne inoculum. The seeds within the shells are disinfected with sulphuric acid.

Without shells, they are soaked for half an hour in 0.5% copper sulphate solution. Agrosan GN dressing of naked seeds is equally effective.

To check secondary spread of disease in the field, spraying with suitable fungicides is the only remedy. Among the fungicides the use of Bordeaux mixture has given good results.

Addy and Dash (1967) recommended Dithane while Shanta (1960) considered red oxide of copper plus sulphur as highly effective. Sulaiman (1964) preferred copper dust (300 mesh) plus sulphur in the ratio of 1: 1. Harrison (1973) found that Daconil and Benlate are the two more effective fungicides than Dithane M45 for pea nut leaf spot disease control.

The sprays of these fungicides increased yield as much as 100%. Early maturing varieties are reported to possess resistance to the disease.

Citrus Canker Disease

Host: Citrus sp.
Pathogen: Xanthomonas sp.

Citrus Canker is a bacterial disease of worldwide distribution occurring wherever citrus is grown. It is a serious menace to our most valued citrus orchards causing objectionable blemishes on the fruit. The disease causes serious damage in India, China, Japan and Java.

The pathogen incites severe canker disease in a number of citrus species on stems, leaves and fruits. The disease attacks most of the species/varieties of citrus. The most susceptible species are the acid lime plants, the sweet orange and the grape fruit.

Symptoms of Citrus Canker Disease:
Crast-like disease lesions or scabby spots and small cankers (open wounds or dead tissue surrounded by living tissue) appear on all over ground parts of the plant such as leaves, young branches and fruits. The trees are, however, not commonly killed.

The lesions on the foliage, at first, appear on the lower surface as small round raised spots. These are translucent and of yellowish brown colour. Later the spots

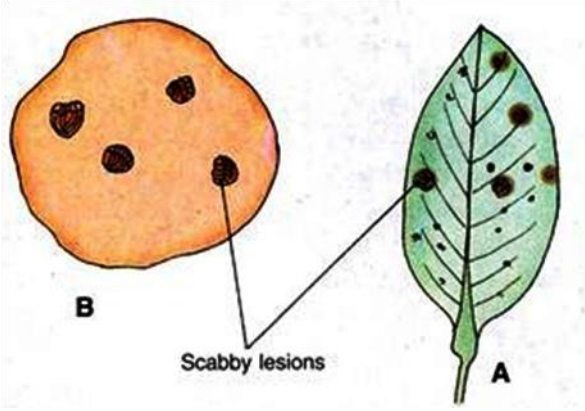
turn white or greyish and finally rupture. The older lesions are corky and brown, sometimes purplish.

Citrus Canker (caused by Xanthomonas sp.)

The necrotic brownish canker regions are surrounded by a yellowish brown to green raised margin and distinct watery yellow halo region. The yellow halo region is free from the pathogen. The cankerous lesions contain the pathogen in millions.

Mairie suggested that the halo regions are formed due to the response of the host tissue to a diffusible metabolite of the pathogen. Padmanabhan et al. (1975) reported accumulation of malic acid in the halo region due to increased respiration in this region.

The lesions on the twigs are usually irregular in form. The lesions on the fruit are similar to those on the leaves but lack the yellow halo.



Causal Organism:

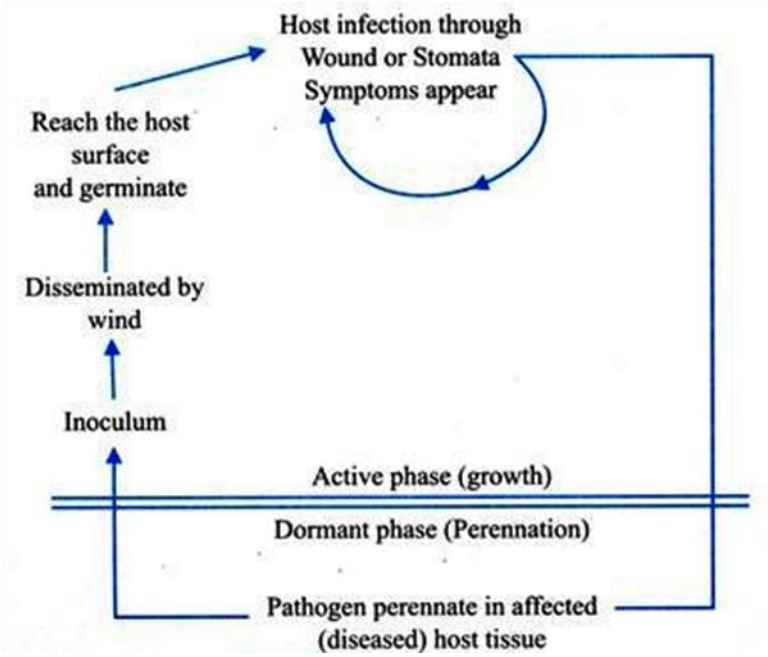
The causal organism is the bacterial pathogen Xanthomonas citri, now called X. campestris pv. citri (Hasse) Dowson. It consists of a short, motile rod (1.5-2.0 x 0.5- 0.75 µ) furnished with a single polar flagellum (monotrichous). It lacks endospore formation. It is a gram negative, aerobic form surrounded by a mucilaginous capsule. It forms chains.

The climate factors which favour the disease are the mild temperature and wet weather. The most suitable range of temperature appears to be 20ºC to 30ºC.

Disease Cycle:

Infection takes place through the stomata and wounds. The disease is not soil borne. The pathogen perennates in the old lesions on the twigs still attached to the host plant.

From there it is carried by driving rains and by insects to new localities. Man functions as the chief agent of dissemination by planting infected nursery stock in new localities.



Control Measures of Citrus Canker Disease:

To combat the disease in order to prevent economic loss or to reduce to a low level following measures can be suggested:

1. Eradication:
The disease is controlled by the eradication of diseased trees. This is accomplished by removing the trees with advanced infection and burning them.

2. Pruning:
The infected trees may be cured by removing the diseased foliage and branches with pruning scissors and then spraying the trees with one percent Bordeaux mixture at regular intervals.

3. The use of disease free nursery stock for planting is the best method of controlling the disease.

4. The fallen infected leaves and twigs should be collected and burnt.

5. Spraying:
Spraying with Bordeaux mixture and lime sulphur is a useful measure to protect the fruit. It should be done during the first three months after the beginning of fruit formation. Spraying should commence before the onset of rains and repeated during the rainy season.

6. Citrus nurseries should be raised in places away from the regions of heavy and protracted rainfall. There should be no **"khatti"** hedge around the nurseries.
7. Rangaswamy (1957) reported that the use of antibiotic sprays is useful in controlling the disease. Streptomycin sulphate and Phonomycin have been found to be effective. Vaheeddudin (1959) found that spraying with neem-cake is effective in controlling citrus canker.

Yellow Vein Mosaic of Bhendi

Host: Bhendi or Lady's finger plant

Causal organism: Begomovirus or Bhindi yellow Vein Mosaic Virus

Yellow vein mosaic of bhendi (*Abelomoschus esculentus*) or vein clearing of bhendi most devastating disease in all the bhindi growing regions of India. In case the plants get infected at early stages of development it causes 80% of crop loss.

Symptoms:

The diseased plants can be recognised from a distance due to the yellowing of entire network of veins Fig. 2. The characteristic symptoms of the disease are the homologous network of yellow veins enclosing islands of green tissue within. In severe cases entire leaf become chlorotic.

Infected plants stunted and bear very deformed and small, yellow green fruits. Distortion of leaf stalks and stem occur at the advance stage of infection. The disease cause heavy loss in yield, if the plants get infected within 20 days after germination.

Fig. 2. Yellow Vein Mosaic of Bhindi.

Etiology:

Disease Cycle:

The disease is transmitted by white fly Bemisia tabaci. The population is high during hot summer months, the crop is seriously affected then. The virus also survives on various weeds growing along the roadside for e.g., Croton sparsifolia, Ageratum etc.

Control Measures:

i. The vectors that are responsible for the spread of virus need to be controlled by spraying dimethoate 0.03 percent or monocrotophos 0.05 at 10 days intervals, (spraying must be done at late hours).

ii. Foliar spray of 5 to 10 ml neem oil in a litre of water at weekly intervals.

iii. Removing and destroying disease affected plants from crop fields to avoid secondary spread.

iv. To destroy the host weeds such as croton.

v. Crop rotation.

vi. Use seeds collected from disease free plants.

vii. Growing resistant varieties for e.g., Akra anamia, Akra Abhay. Punjab Padmini etc.

Little Leaf of Brinjal Disease

Host: Brinjal plant

Causative organism: Mycoplasma

This disease of brinjal was first reported in India in 1938. It was first considered a disease caused by virus. However, in 1969, it was attributed to a Mycoplasma-like organism. As far as known this disease occurs in India and Sri Lanka only. It is a serious disease of brinjal and can cause 100% yield loss in diseased plants.

Symptoms:

The characteristic symptom of the disease is the smallness of the leaves. Petioles get shortened. Lamina of the leaves becomes soft and pale yellow. Internodes of the top branches are shortened resulting in a bushy appearance of the affected plant. Mostly there is no flowering but if flowers are formed

they remain green. Fruiting is rare in affected plants. However, if any fruit is formed, it becomes hard, tough and fails to mature.

Etiology:

Pathogen: Phytoplasma:

Mycoplasma like bodies (MLB) have been detected in phloem cells of roots of brinjal plant affected with little leaf disease. The size of MLBs varies from 230 nm to 770 nm. Each MLB contains ribosomes and nuclear material suspended by 16.5 nm wide tripple layered unit membrane.

Disease Cycle:

It is a sap transmissible disease. It occurs in nature of Datura fastuosa, Vinca rosea etc. The disease is transmitted by the insects (leaf hoppers), Cestius phycytis (Eutettix phycites) and Empoosco devostolls. The pathogen also survives on weed hosts.

Control Measures:

1. Fort-nightly spray of the insecticides such as Ekalox or Folidol till the fruit set helps to check the spread of disease.

2. The insect vectors can also be controlled by spraying the crop by Dimethoate (Rogor-30 EC) or Oxydemiton methyl (Metasystox 25 EG) or Monocrotophos (monocil) @ 1 ml per litre of water.

3. Disease can be controlled when phorate @ 1.0 kg/ha is applied to the seed beds and seedlings are dipped in acqueous solution of 0.05% tetracyline along with 0.05% monocrotophos.

4. Growing of disease resistant varieties such as Brinjal round, Black beauty, Pusa purple cluster etc.

5. Use of barriers of trap crops.

6. Sowing can be adjusted to avoid main flights of the insects.

7. Crop rotation.

8. Early removal of infected plants.

Red rust of Tea

Host: Tea plant

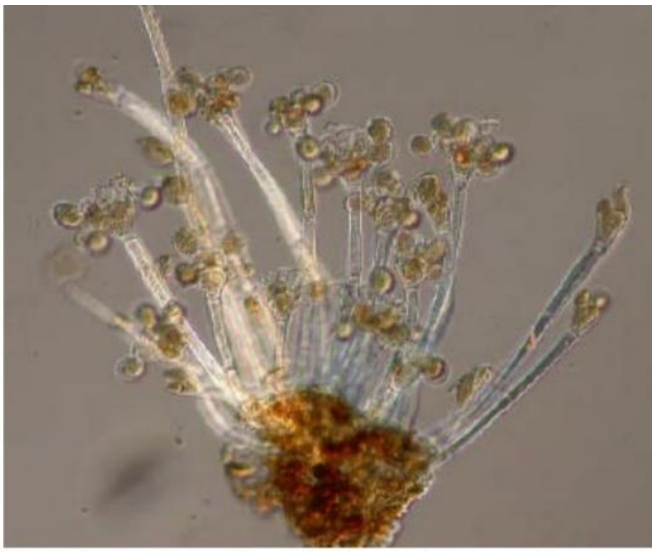
Causal organism: ***Cephaleuros parasiticus***

- It's the most important algal disease in tea.
- Vigorous growing and high-yielding tea cultivars has been found highly attacked.

Nature of Pathogen:

- Cephaleuros infection on tea has been called as 'Red rust'.
- They are the member of Trentepohliales, the genus cholorophyta which contains the photosynthetic organisms called green algae.
- They are aerophilic, filamentous green algae.
- They consists of branched filaments that comprises a thallus in the form of irregular discs.
- They are capable of both asexual and sexual reproduction. Asexual reproduction is much more important to typical infection and disease process.

- Unlike majority of pathogen Cephaleuros species it penetrates epidermis of plants.



***Cephaleuros parasiticus* thallus and sporangiophores. Upon making a slide mount in a drop of water, zoospores may be relseased immediately** (Photo: Fred Brooks, from material collected in American Samoa.)

Symptoms:

- Red rust causes severe damage to young tea by attacking and killing stem and leaf tissues in patches.
- Affected patches on the stem become most noticeable when the alga produces frutification which appears during the month of April to July.
- The patches are oval or oblong in shape.
- During August-March the lesions appear purplish in color there are no fruiting hair at this time but longitudinal cracks may be seen on surface
- It causes chlorosis and variegation.
- It causes defoliation, reduce photosynthesis, loss of fruit marketability, twig dieback and tissue necrosis.

Spread and survival:

- Primary inoculum: Crop debris and stubbles
- Secondary inoculum: It disperses as both motile zoospores and wind borne sporangia
- Favorable condition:
- Bright sunshine
- Disease emergence favored by high humidity and temperature.

Control Measures:

- By obstructing sunshine with the help of shed tree
- Skillful pruning and plucking of bud leaf
- Provide adequate space between plant to maximize air circulation around foliage
- 2% MOP and urea can be sprayed as a rehabilatory measure in the severly affected sections
- Spraying of fungicides like calixin, macuprax should be directed towards the young stems and lateral bearing rusty frutification