Stages in Disease Development

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OBJECTIVE

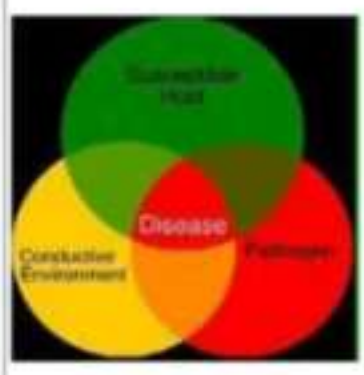
- Be familiar with disease triangle
- Clarify the factors for successful disease development
- Identify stages in disease development

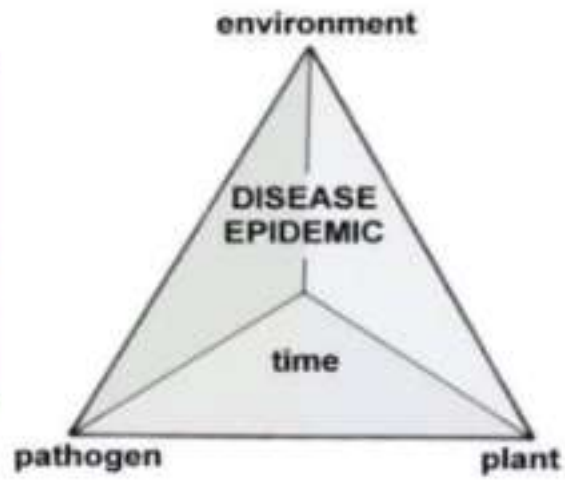
Outline

- Disease Triangle
- Factors for successful disease development
  1) Properties of pathogen
  2) Properties of host
  3) Properties of environment
- Stages in disease development
  1) Inoculation
  2) Penetration
  3) Infection
  4) Growth and Reproduction
  5) Dissemination

Disease Triangle

Factors for successful disease development



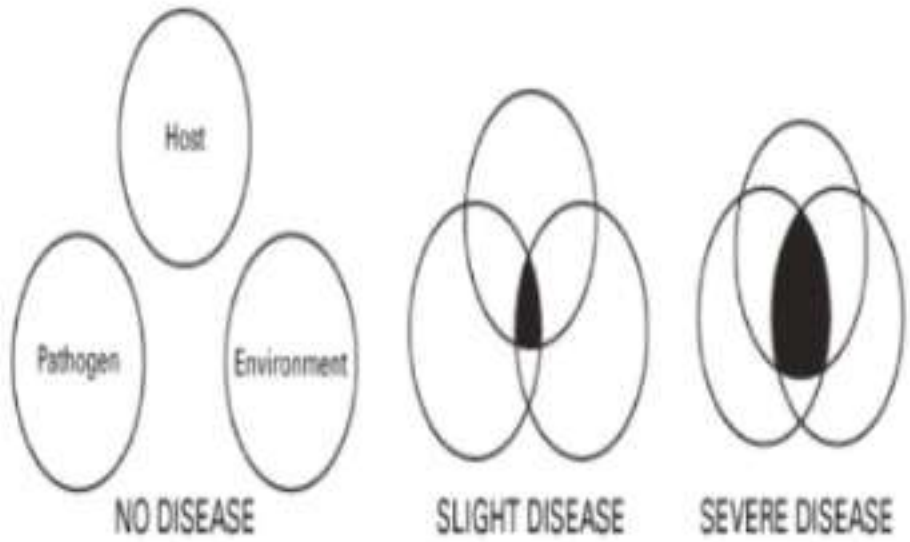


Disease Triangle

- Three important components of plant disease :
  - Susceptible host
  - Virulent pathogen
  - Favorable environment

- For disease to occur all three of these must be present.

Disease Triangle



Factors for successful disease development

1) Properties of Pathogen

- Level of virulence
- Adaptability
- Dispersal efficiency
- Survival efficiency
- Reproductive fitness

2) Properties of Host

- Susceptibility
- Growth stage & form
- Population density & structure
- General health

3) Properties of Environment

- Temperature
- Rainfall / Dew
- Leaf wetness period
- Soil properties
- Wind

Stages in Disease Development

Stages in Disease Development

1) Inoculation
2) Penetration
3) Infection
4) Growth and Reproduction
5) Dissemination of Pathogen

1) Inoculation

- **Inoculation : The arrival of pathogen on the host**
- **Inoculum**
  - The pathogen (s) that land on the host or
  - Any part of the pathogen that can initiate infection

Types of inoculum

- **Primary inoculum**
  - An inoculum that survives the dormant period & caused the first infections
- **Primary infections**
  - Infection caused by primary inoculum
- **Secondary inoculum**
  - An inoculum produced from primary infections
- **Secondary infections**
  - Infection caused by secondary inoculum

Landing or Arrival of inoculum

- Most is carried by wind, water, insects
- Only a small number actually lands on susceptible plants
- Vector born pathogens are much more efficient since the vectors have an attraction for plants
- E.g:
  - Germination of spores and seeds (fungus)
  - Hatching of nematode eggs
  - Attachment of Pathogen to Host (virus and bacteria)
  - Recognition Between Host and Pathogen (Pathogen recognize the host)

2) Penetration

- The initial invasion of a host by a pathogen:

1. Direct Penetration
2. Penetration Through Natural Openings
3. Penetration Through Wounds

Direct penetration

1) **Direct Penetration**

- Direct with haustoria
- Direct, subcuticular only
- Direct intercellular mycellium
- Direct, intercellular mycellium with haustoria
- Direct with appressorium (A), penetration peg (PP) and intracellular mycelium (IM)

Direct penetration

- The most common type of penetration by fungi and nematodes and the only type by parasitic plants
- Fungi use a fine hyphae produced by a spore or mycelium or penetration peg produced by an appressorium
- This is formed at the point of contact with the host

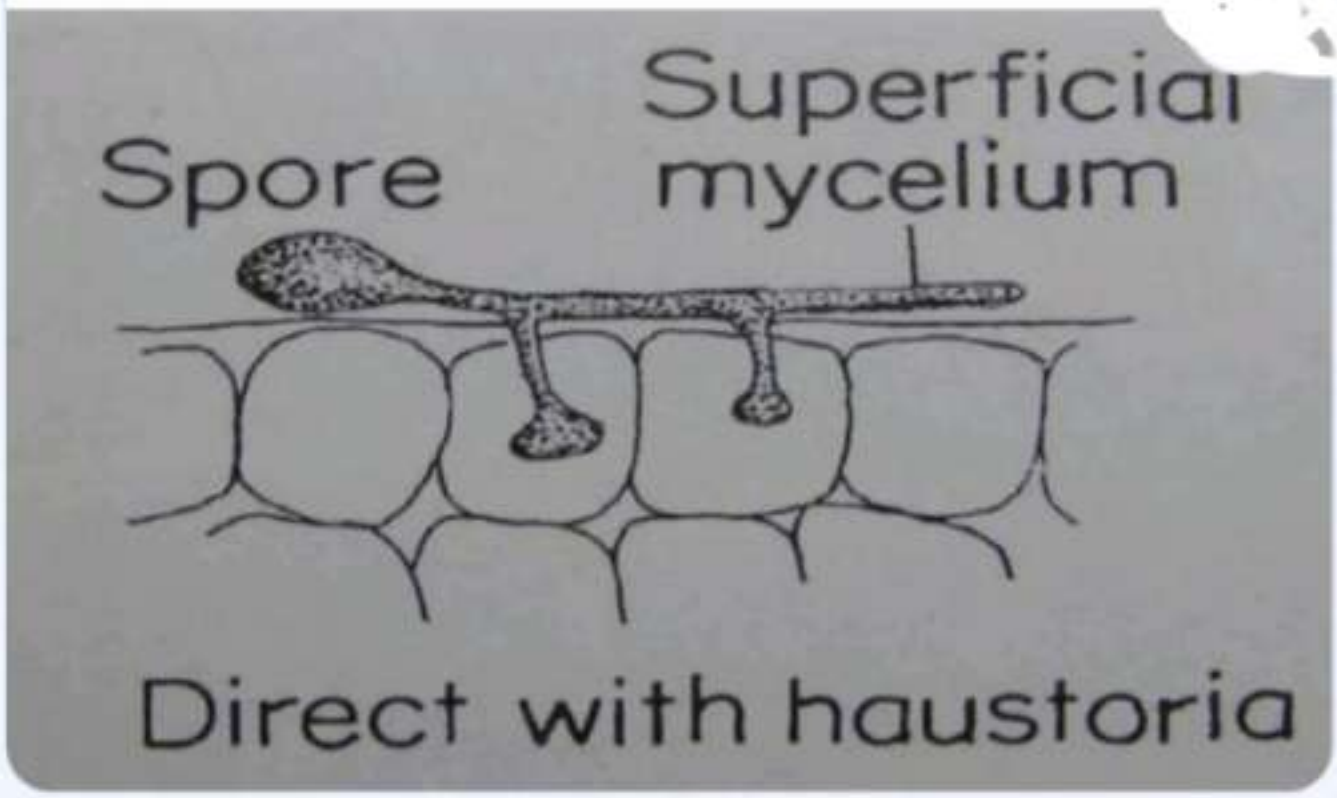
Direct penetration

- The penetration is through mechanical force and softening of the cell walls by an enzyme
- Most fungi form an appressorium at the end of the germ tube
- Then a penetration peg emerges from the flat surface of the appressorium and pierces the cuticle and cell wall

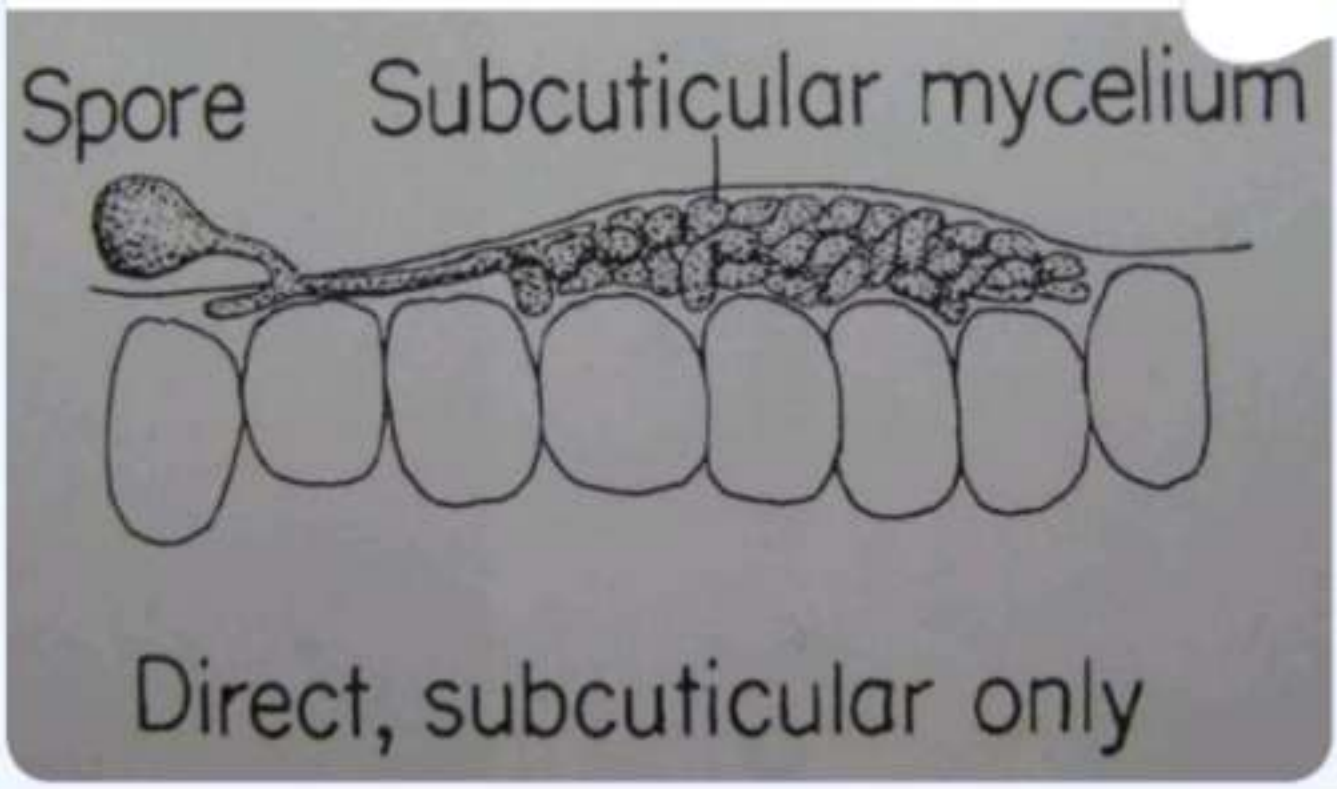
Direct penetration

- The peg grows into a fine hyphae then reaches a normal diameter once it is inside the cell
- As in the case of apple scab, the fungus penetrates only the cuticle and stays between the cuticle and the cell wall
- Parasitic plants also penetrate the same way

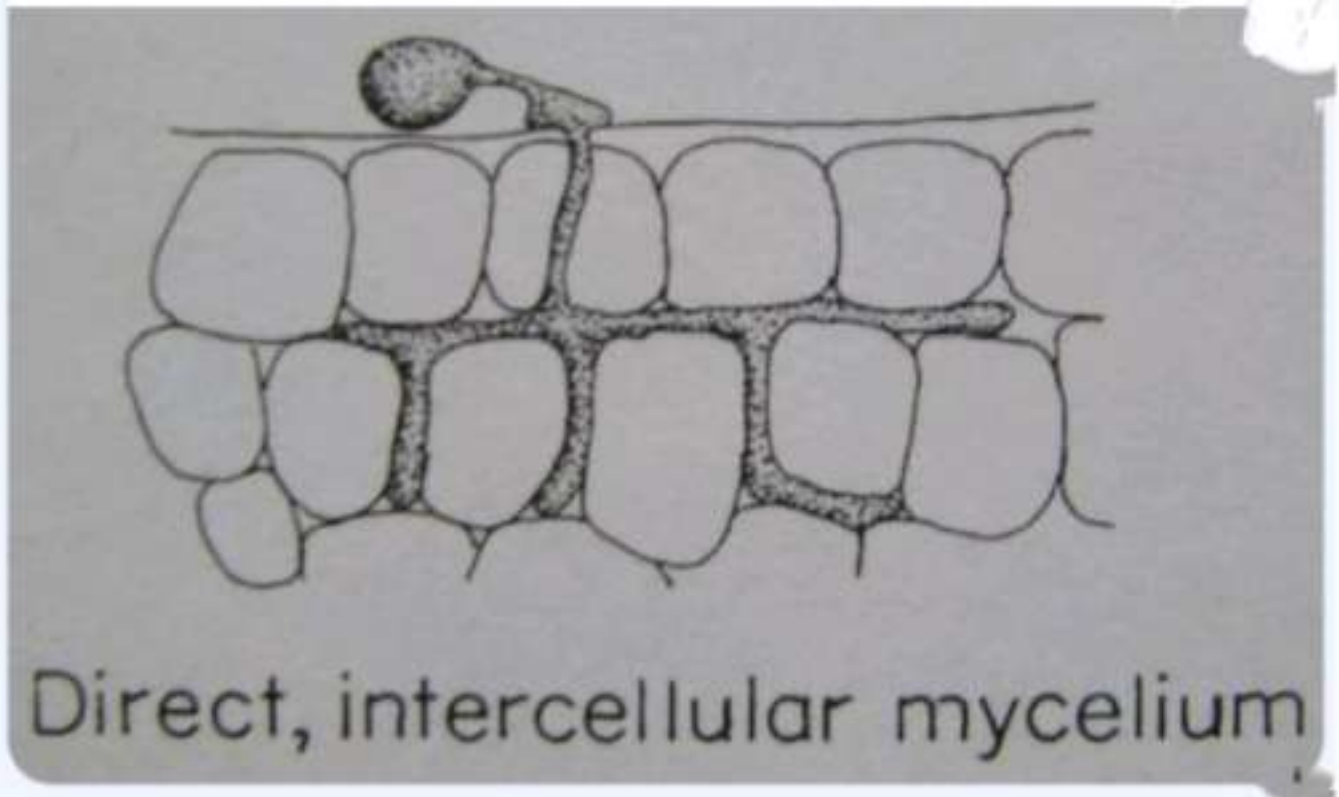
Direct With Haustoria



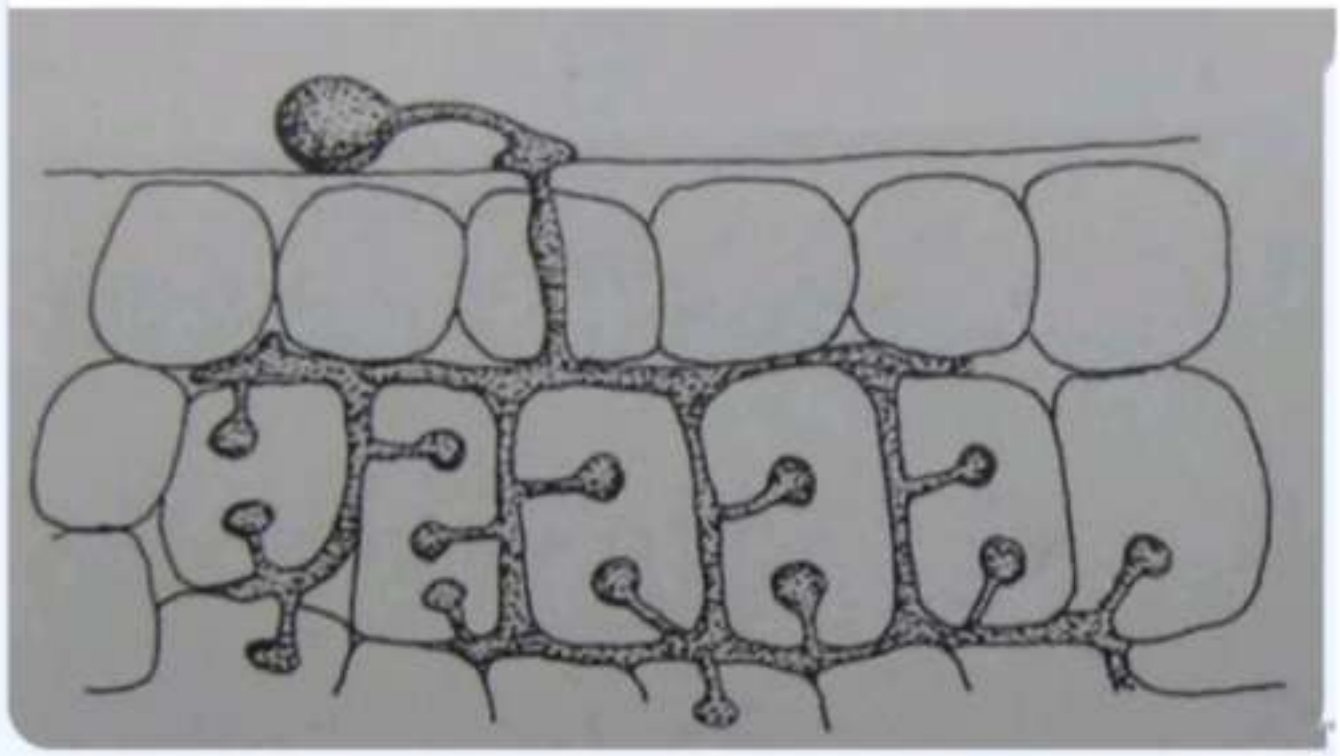
Direct, subcuticular only



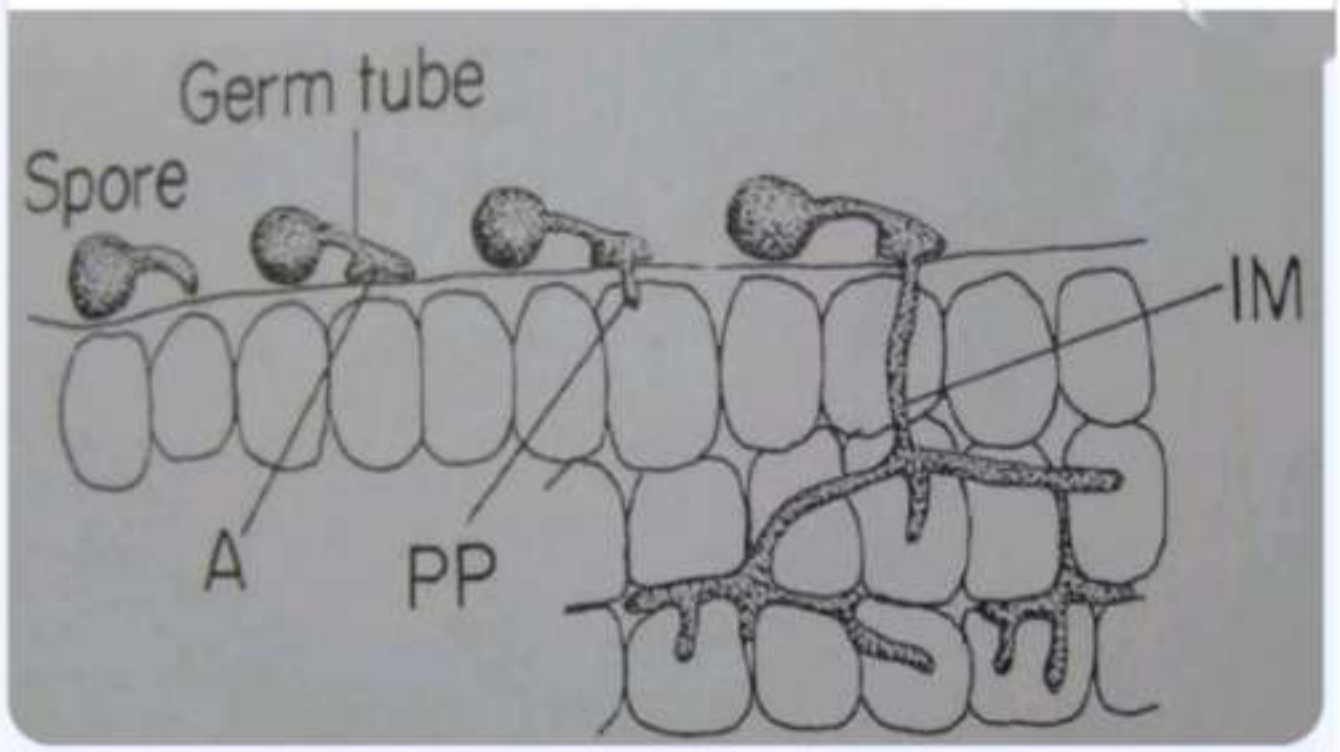
Direct, Intercellular Mycelium



Direct, Intercellular Mycelium with Haustoria

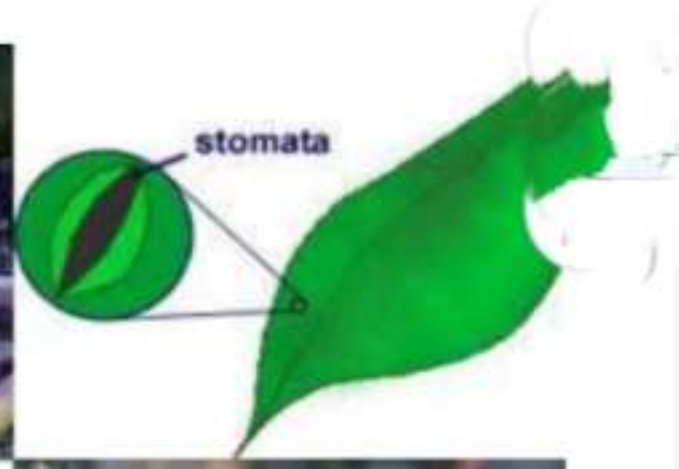


Direct with appressorium (A), penetration peg (PP) & intracellular mycelium (IM)



2) Penetration Through Natural Openings

- Stomata
- Lenticels (opening on fruits, stems and tubers –filled with loosely connected cells – allow the passage of air)
- Hydathodes (permanently open pores at the margins and tips of leaves)



3) Penetration Through Wounds

- Through various types of wounds
- Natural cracks between main and lateral roots
- Openings made by fungus

3) Infection

- Establishment of pathogen with vulnerable cells or tissues of the host and obtain the nutrients from them
- Successful infection will produce symptoms

- Incubation period : The time interval between inoculation and the appearance of disease symptoms
- Latent infection : The state in which a host is infected with a pathogen but does not show any symptoms

4) Growth and Reproduction

- The pathogen will grow and multiply within the infected host.
- Fungi – spores
- Viruses – replicated by the cell
- Nematodes – reproduce by means of eggs
- 4. GROWTH & REPRODUCTION

5) Dissemination of Pathogen

- Pathogens are disseminated by several ways:
- By air
- While airborne – spores touch wet surfaces – get trapped – air movement stops / rains – washed out
- From the air – brought down by rain drops
- Winds also helps spreading by blowing away rain splash droplets containing pathogens

- By water
- Pathogens in the soil – dissemination by rain / irrigation water that moves on the surface / through soil
- By Insects, Nematodes & other Vectors
- Transmitted by insects during feeding, movement from plant to plant
- Nematodes can also transmit virus internally

- By Seed and Transplanting process
- Transported to other fields
- Are sold and transported to other areas

- By human
- Through handling of diseased and healthy plants
- Tools (pruning shears)
- Transporting contaminated soil on their feet / equipment
- Contaminated container
- Using infected seed / nursery stock