

# Plant Disease Epidemiology

## Epidemic & Epidemiology

When a pathogen spread and affect many individuals within a population over a relatively large area and within a short time, the phenomenon is called an **epidemic**.

A similar definition of an **epidemic** is the dynamics change in plant disease in time and space.

## Epidemic

Slow epidemic (Tardive epidemic)

- Occurs in monocyclic diseases
- On perennial plants
- e.g. Citrus tristeza

Fast epidemic (Explosive epidemic)

- In polycyclic diseases
- Annual crops
- e.g. Rice blast, Potato blight

Plant disease epidemiology as a sub discipline of plant pathology is concerned with the factors that cause plant epidemics. Epidemiology can be defined as the study; population of pathogen in the population of host and the resulting disease under the influence of environmental and human factors. Epidemiology is concerned simultaneously with populations of pathogens and host plants as they occur in an evolving environment, i.e. the classic disease triangle.

## Elements of an Epidemic

1. Host
2. Pathogen
3. Environment

Interactions of the 3 main components are described by the disease triangle.

## Disease Triangle

Three critical factors or conditions must exist for disease to occur: a **SUSCEPTIBLE HOST PLANT**, a **VIRULENT PATHOGEN**, and the right mix of **ENVIRONMENTAL CONDITIONS**.

The relationship of these factors is called the disease triangle.

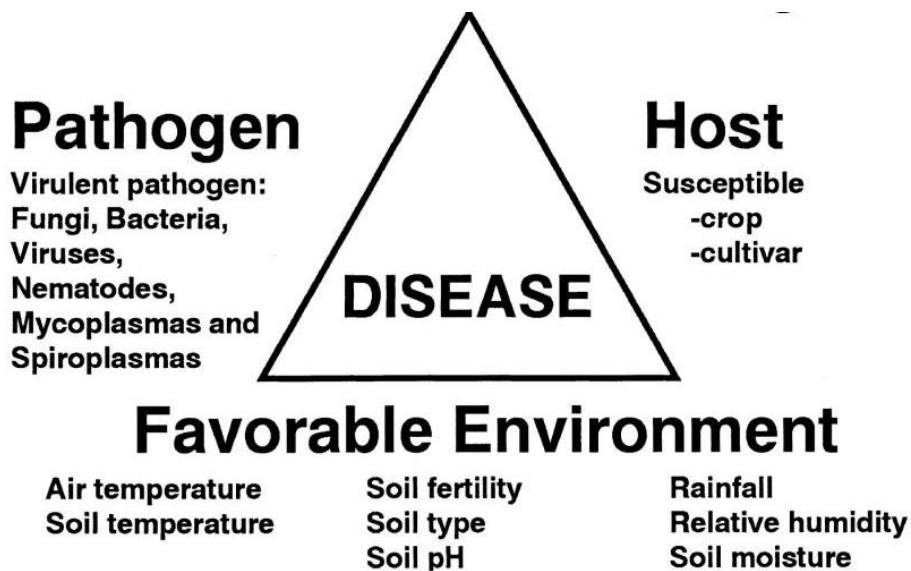


Fig. 1. Disease triangle

### 1. Host factors

- i. Levels of genetic resistance or susceptibility of host
- ii. Degree of genetic uniformity of host in a particular field
- iii. Type of crops
  - Annual crops & foliar or fruit diseases develop much more rapidly (in weeks)
  - Perennial woody diseases take longer time to develop (in years)
- iv. Age of host plants
  - Some plants are susceptible only during growth period & become resistant during mature period

### 2. Pathogen factors

- i. Levels of virulence
- ii. Quantity of inoculum near hosts
- iii. Type of reproduction of the pathogen
  - Polycyclic or monocyclic pathogens
- iv. Ecology of the pathogen
  - Depends on the type of pathogen
- v. Mode of spread of the pathogen
  - Air-borne, soil-borne, vector-borne

### 3. Environmental factors

- i. Moisture
  - Rain, dew, high humidity
- ii. Temperature
  - Affects disease cycles of pathogens

Disease development is also affected by

#### 4. Time

Interactions of the 4 components are described by the disease tetrahedron.

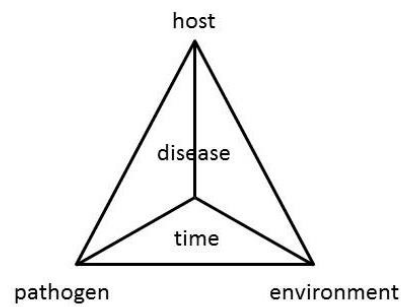


Fig 2. Disease tetrahedron

#### 5. Humans

Interactions of the 5 components are described by the disease pyramid.

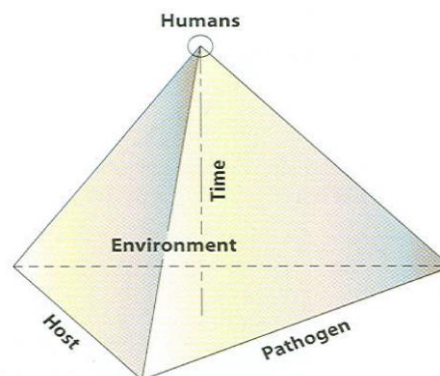


Fig. 3. Disease pyramid.

#### 4. Time factors

- Season of the year
- Duration & frequency of favorable temp. & rains
- Appearance of vectors, etc.

#### 5. Human factors

- Site selection & preparation
- Selection of propagative materials
- Cultural practices
- Disease control measures

## **Comparison of Epidemic disease**

**Compound interest/ Polycyclic diseases** - those diseases which have more than one generation in a cropping season. e.g. late blight of potato

Characteristics of the compound interest diseases are as follows:

1. The pathogens produces spores at a very rapid rate
2. The spores are disseminated by rapid means such as air
3. The incubation period and sporulation period is short
4. It needs to complete its life cycle in heteroecious host
5. Replication of the cycle of disease in the same crop during the seasons. So several or many generation of the pathogen in the life cycle of the crop.

**Simple interest/ Monocyclic diseases** - those diseases which have only generation in one cropping season e.g. loose smut of wheat

1. Only one generation of the pathogen in the life of the affected crop
2. The primary inoculum is seed or soil borne and secondary infection rarely occurs during the season
3. All late infection noticed in the field are from the pre-existing inoculum in the soil.

Examples: Soil borne fungi as causing wilts and root rots and seed and soil borne smuts such as loose smut of wheat, covered smut of barley, Sorghum etc.

## **Measurement of Plant Disease and Yield Loss**

1. Disease incidence: The number of plant units that are diseased in relation to the total number of units examined. It commonly used to measure the spread of a disease
2. Disease severity: The amount of plant tissue that is diseased. Measured using assessment scales or by determining the area under a disease progress curve.
3. Yield loss: The proportion of yield that the grower will not be able to harvest due to disease as a results in economic loss.

## **New Tools for Measurement of Epidemiology**

1. Molecular tools: Polymerase Chain Reaction (PCR), Enzyme-Linked Immuno Sorbent Assay (ELISA), DNA Fingerprinting, etc. for rapid & accurate detection & identification of pathogens
2. Data management: Geographic Information System (GIS), Global Positioning System (GPS), Remote Sensing, etc. to assist in disease control strategies
3. Disease modeling & forecasting: To predict the probability of outbreaks.