# Plant Disease Management

## General Principles of Control

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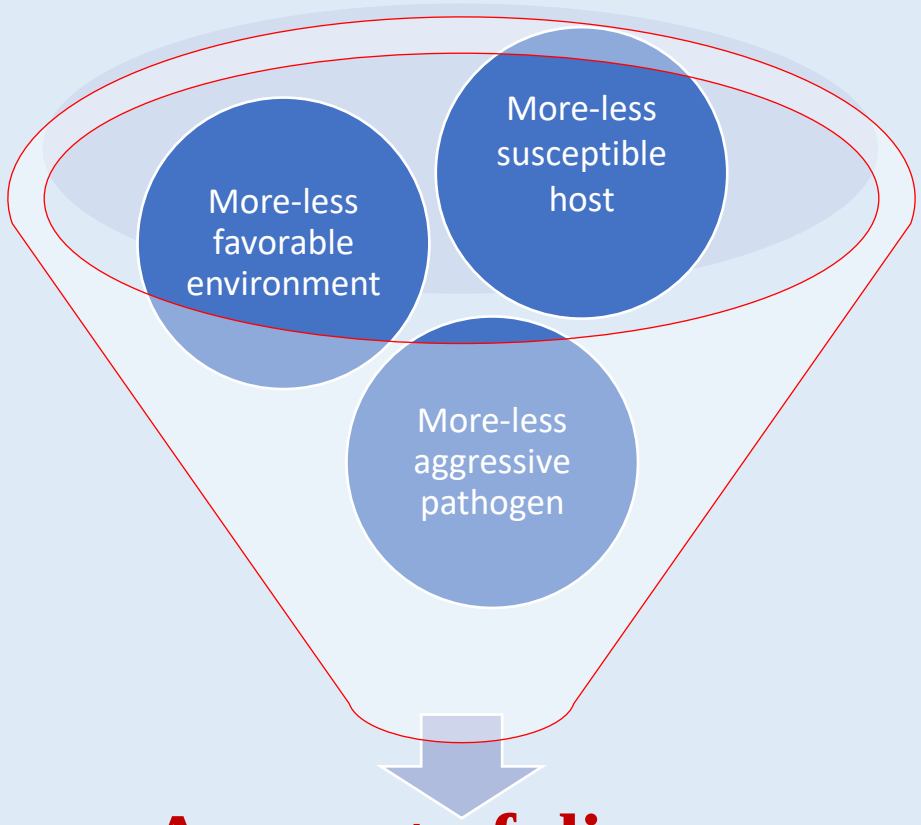
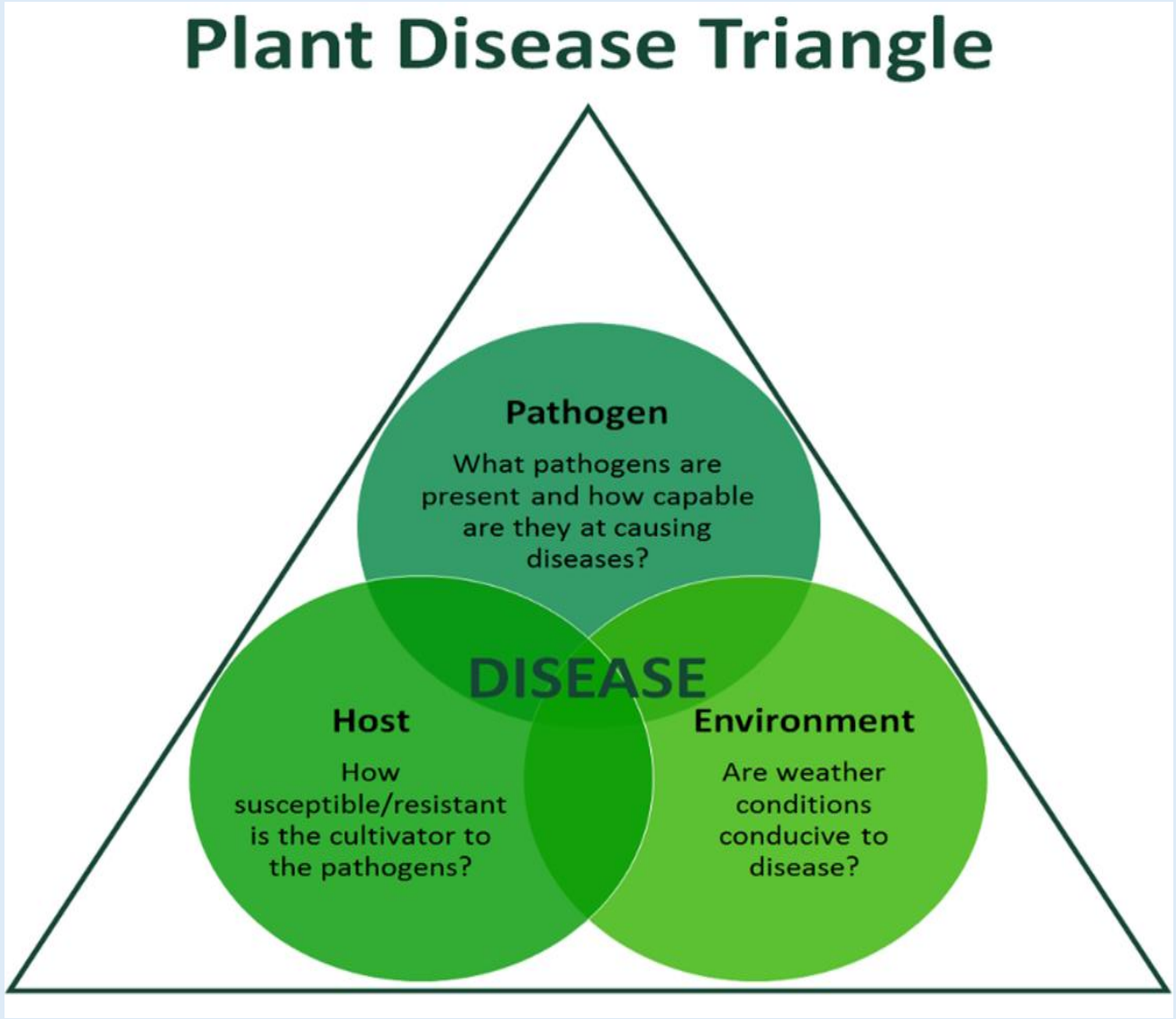
# Plant Diseases

- A plant disease is defined as “anything that prevents a plant from performing to its maximum potential”
- A plant becomes diseased when it is continuously disturbed by some causal agent
- This results in an abnormal physiological process that upsets the plant’s normal structure, growth, function, or other activities
- This interference with one or more of a plant’s essential physiological or biochemical systems produces characteristic pathological conditions or symptoms

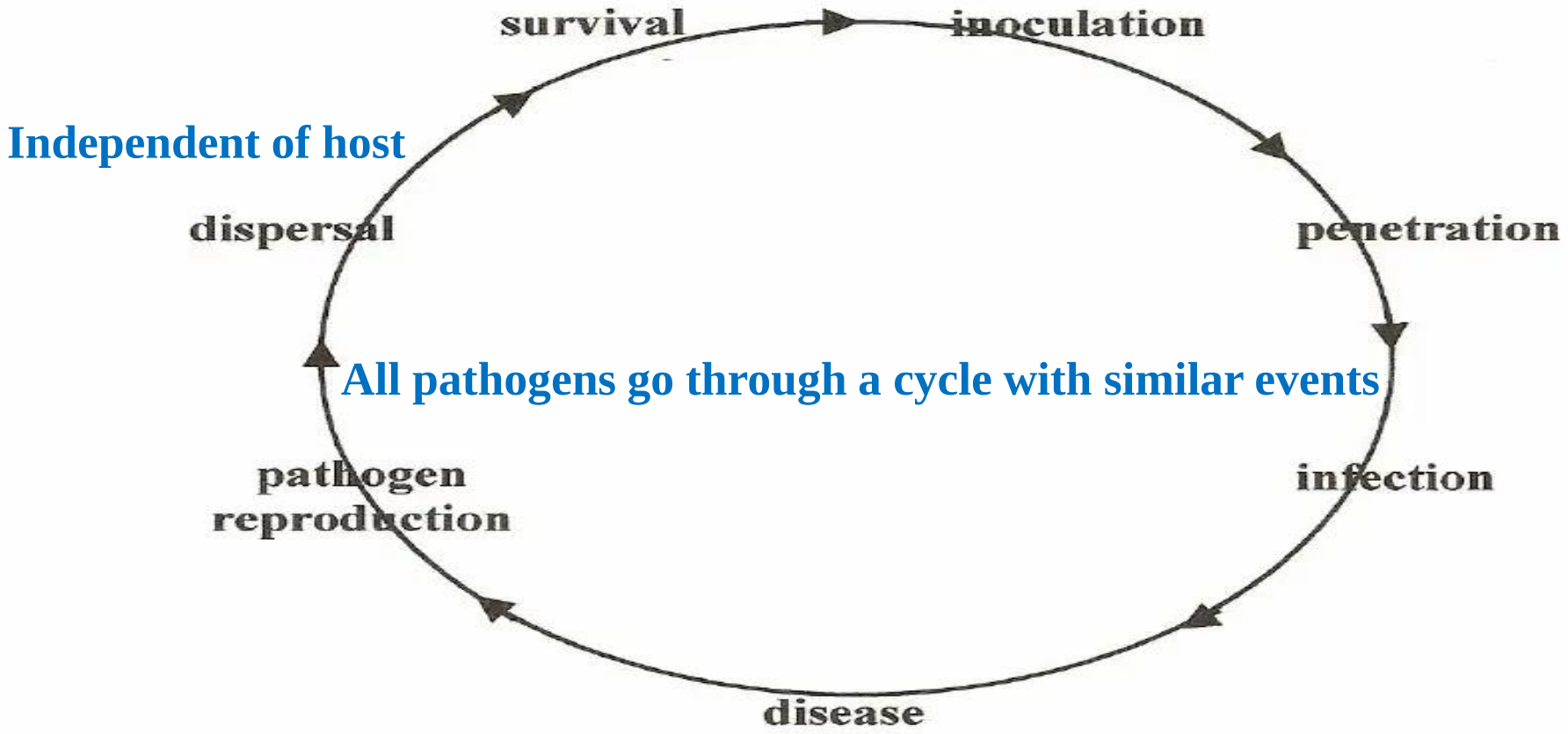
- **Purpose of disease management is to prevent disease from lower the profit or yield**
- **According to Vanderplank's Equivalence Theorem 'The amount of disease is a collective result of host, pathogen and environment'**
- **Changes in any component has an equivalent effect on disease**



- Therefore, disease management principles and practices are often centered around the concept of the Disease Triangle
- The management tactics often seek to manipulate one or more of the components of the disease triangle



# Disease Cycles




**Knowing how particular pathogens go through their disease cycle is important in developing management strategies**

# Points to be noted……

- Practices of disease management vary considerably from one disease to another depending upon the type of pathogen, the host and the biotic and abiotic factors involved
- Information on etiology, symptoms, pathogenesis and epidemiology of plant diseases are most considered points
- Contrary to management of human and animal diseases where every individual is attended, the plants are generally treated as populations and measures used as preventive rather than curative

# Management Strategies

**Understanding of:**

- **How disease cycles relate to disease severity**
- **How diseases increase over space, in severity, or over time**

**1. Monocyclic = single cycle (simple interest) {primary inoculum is the only inoculum available for the entire season There is no secondary inoculum and no secondary infection}**

**Ex. Verticillium wilt, Cereal Cyst Nematode**

**2. Polycyclic = multiple cycles/year (compound interest) {Repeated disease cycle through secondary infection by Asexual spores}**

**Ex. Downy mildews, Powdery mildews, Late blight of potato, Leaf spots, Blights, Grain rusts, Aphid borne viruses, Root-knot nematodes**

**III. Polyetic (multi-year) cycles {Pathogens take several years before to produce a new infections}**

**Ex. Dutch elm disease, Pear decline, Fungal vascular wilts, Mycoplasmal yellows, Viral infections**

**All the principles that characterize the modern concept of plant disease management are based on:**

**(a) Reduction in the initial inoculums or the rate of disease development**

**(b) Management of the pathogen population, by inducing defense or by modifying the environment**

**(c) Interruption of dispersal, survival or further disease development**

- **Strategies before pathogen is present: attempts to prevent introduction or establishment of pathogen**
- **Strategies after pathogen is present: procedures once pathogen becomes established**

# Fundamental Principles of Plant Disease management

1. Avoidance
2. Exclusion
3. Eradication
4. Protection
5. Immunization
6. Therapy

# 1. Avoidance

- It involves avoiding disease by planting at time when, or in areas where inoculums is absent or ineffective due to environmental conditions
- The major aim is to enable the host to avoid contact with the pathogen or to ensure that the susceptible stage of the plant does not coincide with favourable conditions for the pathogen

## The main practices under avoidance are:

- ✓Choice of Geographical area
- ✓Selection of the field, choice of sowing/ planting time
- ✓Selection of seed and planting material
- ✓Use of Short duration / disease escaping varieties
- ✓ Modification of agronomic/cultural practices

**Examples:**

- **The potato cultivation at high altitude is relatively free from viruses; as prevailing environmental conditions do not permit the buildup of vector populations**
- **Early planting of potato or wheat, in indo Gangetic plains may escape late blight or stem rust damage respectively.**
- **Bean anthracnose is common in wet areas**
- **Smut and ergot of pearl-millet are serious in areas where rainfall occurs for long durations during flowering of the crop**
- **De-weeding of some of the early-appearing weeds supporting aphids to feed**

# 2. Exclusion

- It means preventing the entrance and establishment of pathogens in uninfected crops in a particular area.

**The main practices under Exclusion are:**

- ✓Seed certification
- ✓Crop inspection and Treatment
- ✓Eradication of inoculums and insect vectors
- ✓Quarantine measures regulatory control

**This is also called as “Regulatory Plant Pathology”**

**Examples:**

- **Prevention of *Verticillium*, nematodes or other soilborne organisms by cleaning farming equipment to remove contaminated debris and soil that can harbor pathogens**
- **Recommendations for the control of diseases through some kind of "clean seed" program for dry beans, including *Pseudomonas syringae* pv. *phaseolicola* (the causal agent of halo blight), *Xanthomonas phaseoli* (the common blight pathogen), and *Colletotrichum lagenarium* (the fungus responsible for anthracnose)**

# 3. Eradication

- The process of reducing, inactivating, eliminating or destroying inoculums at the source
- This involves eliminating the pathogen from infested areas

**The main practices under Eradication are:**

- ✓Eradication of alternate and / or collateral hosts
- ✓Crop rotations
- ✓Field sanitations
- ✓Heat or chemical treatments of plant materials or soil
- ✓Biological control

**Examples:**

- **Eradication of the golden nematode by removing infested soil, fumigating soil in infested fields and eventually abandoning infested potato fields for housing developments and other uses**
- **Citrus canker eradication was done by removal and burning of diseased trees and destruction of entire citrus groves and nurseries in some cases**
- **Removal of apple or pear branches infected by the fire blight bacterium (*Erwinia amylovora*) and pruning to remove blister rust cankers (caused by *Cronartium ribicola*)**
- **Hot water seed-treatment of cereal seeds to kill smut mycelium in the seed and heat treatment to eliminate viruses from fruit tree**
- **Soil fumigation by gas-forming, volatile and water soluble chemicals such as carbon disulfide, methyl bromide, or chloropicrin into soil to kill target pathogens**

# 4. Protection

- Principles of avoidance, exclusion and eradication may not be sufficient to prevent many fast spreading infectious pathogen, brought by wind
- This can be achieved by creating toxic barrier between the plant surface and the inoculums

**The main practices under Protection are:**

- ✓Chemical sprays and Dusts
- ✓Modification of environment
- ✓Modification of host nutrition

**Examples:**

- **Bananas are covered with plastic sleeves as soon as the fruit are set to protect the fruit from various pests including fruit decay fungi**
- **Use of broad-spectrum and systemic fungicides for control of specific groups of diseases such as downy mildews, rusts, smuts or powdery mildews**
- **Effective biological control through the fungus *Peniophora gigantea* to inoculate tree stumps to prevent infection of adjacent trees by the wood decay fungus *Heterobasidion annosum***
- **Application of the nonpathogenic bacterium *Agrobacterium radiobacter* to fruit trees before planting to prevent infection by the crown gall bacterium (*Agrobacterium tumefaciens*)**

# 5. Host resistance (Immunization)

- This is in – built mechanism of host to resist various activities of pathogen
- The infection or subsequent damage by pathogen can be reduced through genetic manipulation

**The main practices under Host Resistance are:**

- ✓The classical breeding techniques like selection, mutation and hybridization
- ✓Use of biotechnological tools such as tissue culture, genetic engineering and protoplast fusion

**Examples:**

- **Development of resistance has been most successful against the more specialized pathogens such as rust fungi smut fungi, powdery mildew fungi, and viruses**
- **Development of genetically-modified organisms from the bacterium *Bacillus thuringiensis* to protect against insect attacks**

# 6. Therapy

- The only practice applied to the population of plants after infection has taken place
- Therapy is a curative procedure and is applied to individual plants

**The main practices under Therapy are:**

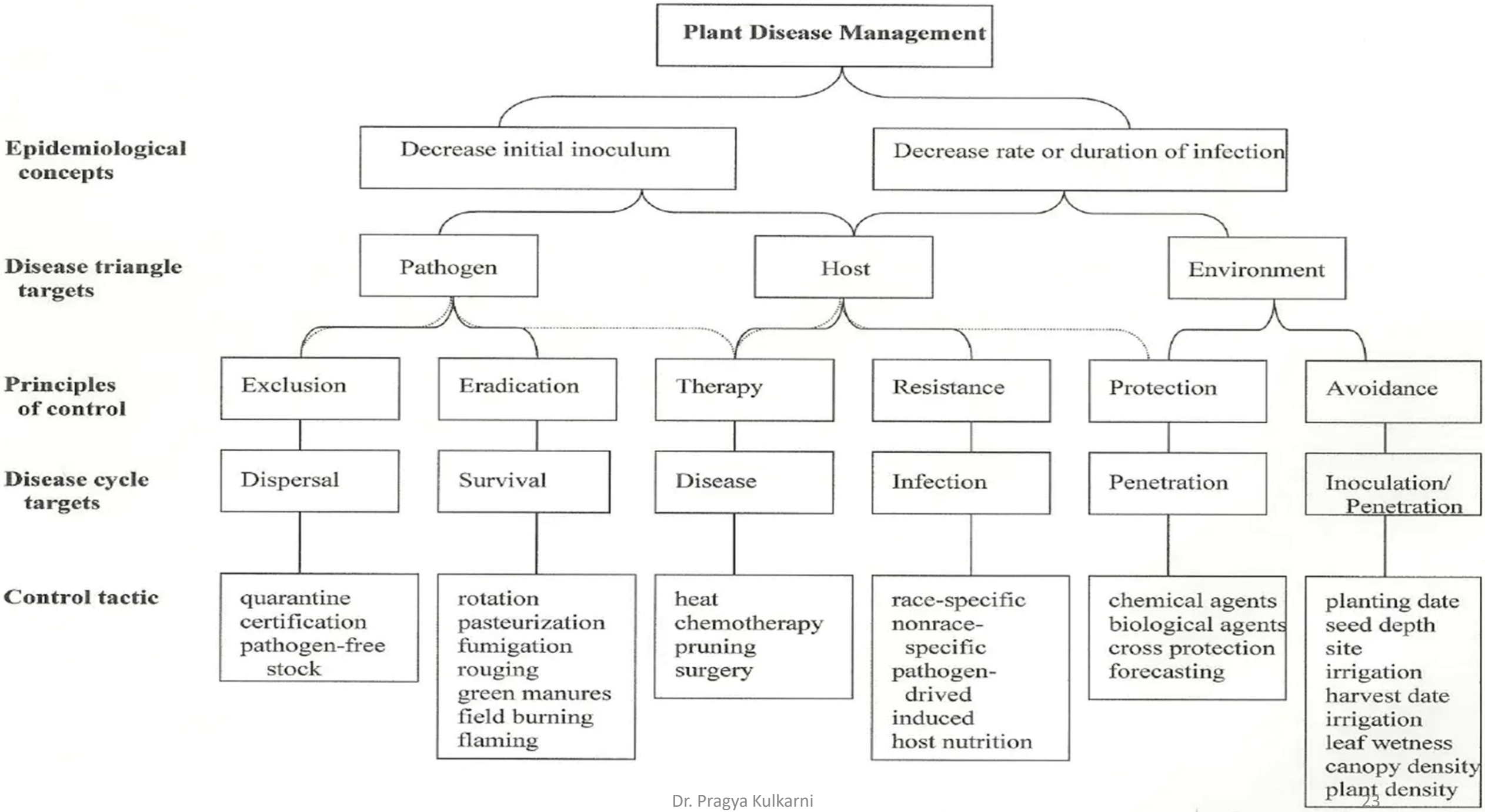
- ✓Chemotherapy: The use of chemicals to inactivate the pathogen
- ✓Thermotherapy: The exposure of diseased plants or parts of them to hot water or high air temperature for different periods of time

**Examples:**

- **Loose smut of wheat is controlled by treating the seeds with hot water**
- **Hot water treatment has been used to kill nematodes in bulbs, corms, tubers and fleshy roots**
- **Dormant chrysanthemum stools can get rid of foliar nematodes by submerging in water at 112°F (44°C) for 30 minutes**

# Conclusion

- Under the concept of disease management these principles have been classified into following categories:
  - Management of physical environment (cultural control)
  - Management of associated micro biota (biological antagonism)
  - Management with chemicals (Chemical control)
  - Management of host genes (Host resistance)
  - Management with therapy (Physical, chemical)


Plant Disease Management
Epidemiological concepts
Decrease initial inoculum
Decrease rate or duration of infection
Disease triangle targets
Pathogen
Host
Environment
Principles of control
Exclusion
Eradication
Therapy
Resistance
Protection
Avoidance
Disease cycle targets
Dispersal
Survival
Disease
Infection
Penetration
Inoculation/ Penetration
Control tactic
quarantine
certification
pathogen-free stock
rotation
pasteurization
fumigation
rouging
green manures
field burning
flaming
heat
chemotherapy
pruning
surgery
race-specific
nonrace-specific
pathogen-drived
induced
host nutrition
chemical agents
biological agents
cross protection
forecasting
planting date
seed depth
site
irrigation
harvest date
irrigation
leaf wetness
canopy density
plant density

# Thank You…..