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Topic – Disease Development in Phytopathology

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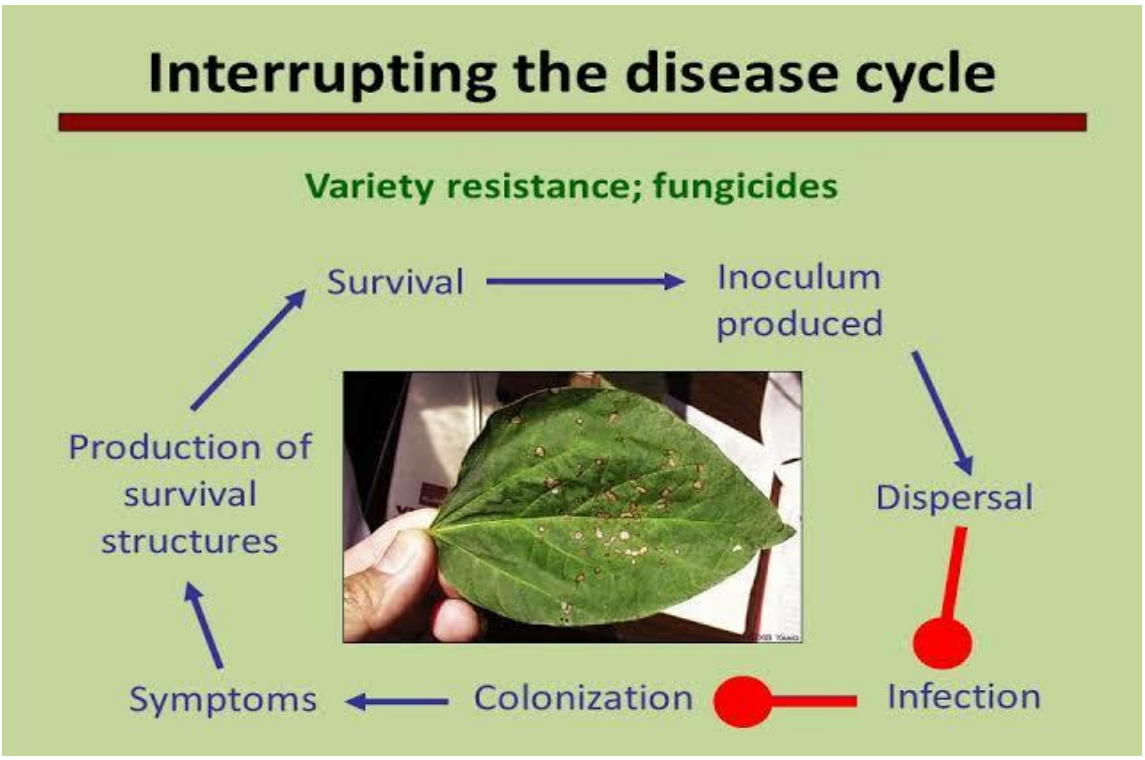
DISEASE DEVELOPMENT IN PHYTOPATHOLOGY

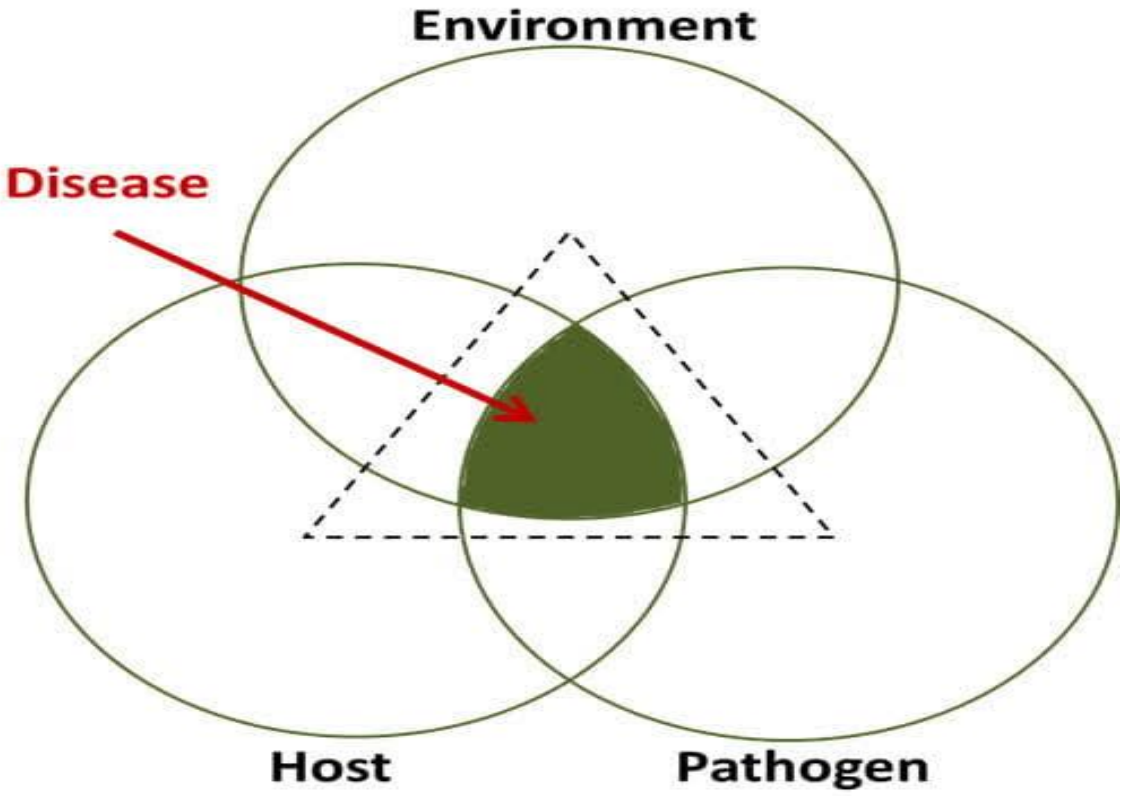
A disease cycle is the chain of events involved in the development of disease, including the stage of development of a pathogen and the effect of the disease on the host plant. All infectious diseases causing agent go through a disease cycle. In an infectious disease there is a series of more or less distinct events which occur in sequence and lead to development of the disease . The disease cycle involves the changes in the plant and the plant symptom as well as those in the pathogen. The main event of a disease cycle includes

1. Inoculation
2. Prepenetration
3. Penetration
4. Infection

5. Growth and Reproduction of the pathogen
6. Dissemination of the pathogen and
7. Seasonal carry – over of the pathogen.



Disease Triangle



In some disease there may be several infection cycles within one disease cycle .

1. Inoculation: Inoculation is coming in contact of a pathogen with a plant . The pathogen that lands on or is otherwise brought into contact with the plant is called inoculum .
    - In fungi inoculum may be spores , mycelial fragments .

- In bacteria virus and viroid
- In nematodes inoculum may be adult , larva or egg.
- In parasitic plants it is plant fragments or seeds .
- Inoculum that survives the off season periods and causes the original infection in the growing season is called primary inoculum and the infection is primary infection.
- Primary infection actually spreads the disease in the field under favourable conditions, it is called secondary inoculum that bring secondary infections.
- The inoculum of the most pathogen is carried to host plant passively by wind , water , insect etc.

2. PREPENETRATION: This phase is actual entry of the pathogen. Such events include :
    - Germination of spore and seeds
    - Hatching of egg (nematodes)
    - Attachment of pathogen to host and
    - Recognitions between host and pathogen

3. PENETRATION: This is the actual entry of the pathogens into their host plants . Pathogen penetrates plant surface in different ways , such as –
    - Direct penetrations through intact plant surface .
    - Penetration through natural opening and
    - Penetration through wound .

4. INFECTION: During infection pathogens grow or multiply or both within the plant tissue .
    - Invasion of the plant tissue by the pathogen and reproduction of pathogen in or on infected tissue are infect two concurrent sub stage of disease development within the stage of infection.
    - Successful infection results in the appearance of symptoms on the host plant. Some infections may remain latent .
    - Different pathogens take varying period of time in development of the symptoms of disease caused by them
    - The time interval between inoculation and the appearance of disease symptom is called the incubating period.
    - During infection, necrotrophic and bio trophic pathogen bring about different effects on the attacked cell while deriving their nutrients.
    - Necrotrophs besides deriving nutrients also produce harmful chemicals- enzymes , toxin , growth regulators etc. Involved in disease development.
    - Bio tropic do little harm while deriving nutrients from their hosts.
    - Inoculum potential plays important role in the infection process.

- Inoculum is that part of pathogen that is transmitted to or contacts a host and is capable of infecting the host .
- In fungi inoculum may be mycelial fragment , spores, rhizomorphs .
- In bacteria virus and viroids and in nematodes inoculum may be adult larva or eggs whereas in parasitic higher plants inoculum may be seeds or plant fragments.
- Some pathogen require only a few spores to cause successful infection, whereas other may require large number of spores , several hundred or several thousand.
- Horsfall (1932) used the term inoculum potential to denote the number of infective particles present in the environment of the uninfected host .
- Inoculum Potential is an important factor in infection. Diamond and Horsfall (1960,1965) used this term in the sense of the number of spores produced by a population of diseased plants.
- Inoculum Potential is a measure of the biological energy available for the colonization of a host . It is therefore, a function of the following inoculum density and the nutrients available to the infectious units that allow them to germinate or grow, the environment, genetic capacity of the organism to cause disease and the two sub stage of infection invasion and colonisation.

5. DISSEMINATION OF THE PATHOGEN:

- Dissemination is the transfer of inoculum from the site of its production to the host surface or all that happening between take off inoculum and its deposition on the host surface .
- A few pathogen such as nematodes , bacteria and fungal zoospore move short distances on their own from host to host very close to them
- Fungal hyphae can grow actively in soil towards near by roots.
- Transmission occurs at short or long distance called continuous or discontinuous dissemination respectively
- Continuous dissemination occurs at short distance and related to the dispersal of pathogen in a given geographical unit .
- Discontinuous dissemination involves a long jump transmission, ordinarily between two geographical units separated by physical barriers as oceans , mountain , desert etc. Usually the dispersal of inoculum is a passive process occurring with the help of external agents . Dispersal may be autonomous or passive.

AUTONOMOUS DISSEMINATION :

This is an active dispersal of inoculum . It is a normal practice in crop husbandry and distribution of plant and plants products that pathogen causing diseases of fruit and vegetables dissemination through the agency of soil , seed or plant parts .

- Contaminated seeds also carry pathogen such as smut . Plant parts used as planting stocks may be contaminated.
- A few pathogen as nematodes , fungal zoospore and bacteria can move very short distance on their own from one plant to another.
- Fungal hyphae and rhizomorphs can grow actively between tissues in contact and sometimes through the soil towards nearby roots .

PASSIVE DISSEMINATION:

This is the general and common way of dispersal of pathogen. The main agent of dissemination are -

Air, water , insect, other animals, man and fungi .

Air: Spores of most fungal pathogen which attack aerial parts of plant and the seeds of most parasitic plants are dispersed by air .Wind also helps in dissemination of bacteria, nematodes and fungal spore by blowing away rain splash droplets containing

these pathogens . Dispersal of air borne pathogens are given by Ingold (1971) and Gregory and Monteith(1967) .

Water: Water is an important method of liberation and dispersal of fungal spore . Coffee rust , cell of many bacteria ,slimy spores of fungi like *Fusarium* and *Colletotrichum* are dispersed by water splash, and plant parts infected with bacteria as *Xanthomonas malvacearum* are carried by water .

Insects: Insect particularly aphids, whiteflies and leaf hoppers are the most important vectors of virus .This has reached its climax in viruses , though also important in dispersal of bacteria and fungal pathogens eg *Erwinia amylovora , Pseudomonas savastoni*

Mites : Some viruses are disseminated by mites *Nigrospora oryzae* causing wheat disease is carried by mites .

Nematodes : Some viruses, bacteria and fungal pathogens are carried by nematodes. These are present internally as well as externally. Examples are *Cyanobacterium , Fusarium oxysporum etc.*

Man : Man is an important agent responsible for dispersal within crop area ,within the land mass or between land masses .Dispersal within field it occurs through handling through contaminated tools , through transport of contaminated soil on feet , equipment etc.

Fungi: Half of a dozen viruses transmitted by fungi eg *Olpidium brassicae* is found to transmit Tobacco necrosis virus (TNV) and Potato virus X (PVX) is transmitted by *Synchytrium endobioticum.*

6. SEASONAL CARRYOVER OF THE PATHOGEN :

In the absence of their host, the pathogen undergoes overwintering and over summering and they evolved means of survival during the period when host is absent.

- On perennial plants fungi survive as dormant mycelium in infected tissue
- Fungal pathogens infected aerial parts of deciduous plants usually survive as mycelia or spores on fallen infected larvae or fruit or on the buds scales .

- In annual plants fungi survive as mycelia in infected debris or resting or other spore in infected plant debris or in soil .
- Some pathogenic fungi as Pythium , Rhizoctonia and Fusarium are able to survive indefinitely as saprophytes in soil. In absence of their host they are called soil inhabitants .Other specialized soil fungal pathogens are soil transients which generally live in close association with their host but may survive in soil for relatively short period of time as saprophytes.
- Bacteria like fungi also survive in infected plants seeds , tubers ,infected plant debris and some in soil .

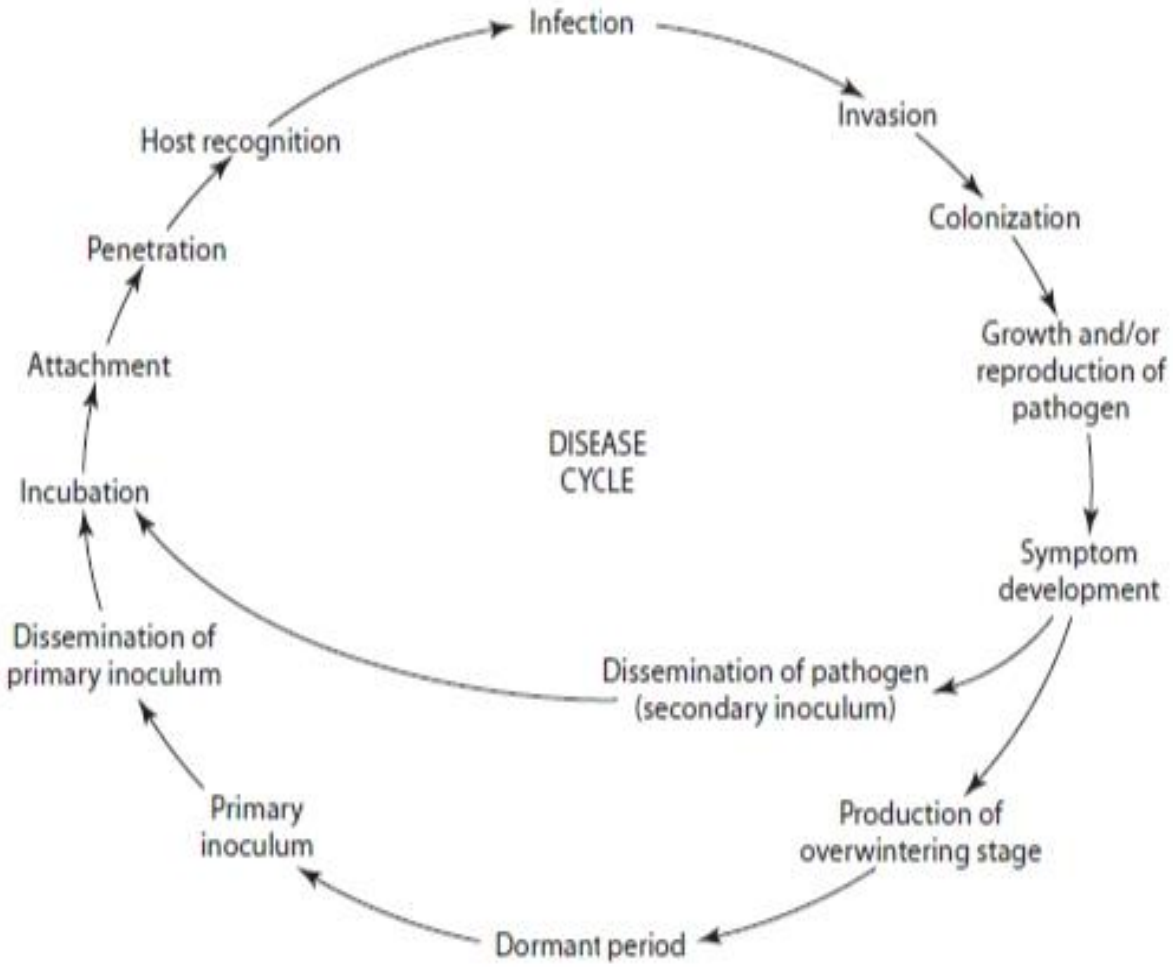


Figure: Disease cycle