Week 2

GENERAL CONCEPTS AND CLASSIFICATION OF PLANT DISEASES

Aim: To acquaint the students with general concepts and classification of plant diseases

Definitions and Concepts

Disease: According to Horsfall and Diamond (1959), disease may be defined as a malfunctioning process that is caused by continuous irritation by a pathogen and/or environmental factor resulting in some suffering producing symptoms.

Disorder: The diseases caused by the deficiency of nutrients or unfavourable environmental are sometimes termed as disorders or physiological disorders.

Pathogen: It is the agent responsible for inciting 'pathos' i.e. ailment or damage.

Parasite: These are the organisms which derive the food materials needed for their growth from other living organism (the host). All the pathogens are parasites but all the parasites are not pathogens. As some of the parasites live on their hosts without causing any damage to them as symbiotic relationships, e.g., Rhizobium bacterium in legume roots, mycorrhizae and lichens.

Biotrophs are the organisms which regardless of the ease with which they can be cultivated on artificial media obtain their food from living tissues only in nature in which they complete their life cycle). They were earlier also called obligate parasites, e.g., rusts, smuts, powdery mildews etc.

Saprophytes/saprobes are the organisms which derive their nutrition from the dead organic matter. Some parasites and saprophytes may have the faculty or (ability) to change their mode of nutrition.

Facultative saprophytes are ordinarily parasites which can grow and reproduce on dead organic matter under certain circumstances. They are also called hemibiotrophs which attack the living tissues in such a way as biotrophs but continue to grow and reproduce after the tissues is dead.

A parasite is called necrotrophic when it kills the host tissue in advance of penetration and then lives saprophytically, e.g. Sclerotium rolfsii and Pythium species. Similar to necrotrophs are facultative parasites which live as saprophytes but under favourable conditions they can attack living plants and become parasites. The necrotrophs are also known as perthotrophs or perthophytes.

Pathogenicity is the ability of a pathogen to cause disease under a given set of environmental conditions. Whereas, pathogenesis is the chain of events that leads to development of a disease in the host.

Parasitism is a phenomenon by which a plant parasite becomes intimately associated with the plant; it draws nutrition and multiplies and grows at the expense of the plant host.

Virulence is a measure or degree of pathogenicity of an isolate or race of the pathogen. The term aggressiveness is often used to describe the capacity of a pathogen to invade and grow in the host plant and to reproduce on or in it. This term like virulence is used as measure of pathogenicity.

Immunity of a plant against a disease is absolute quality. It denotes the freedom of plant from disease, when the pathogen cannot establish parasitic relationship with the host. High resistance and low susceptibility approach immunity.

Disease resistance is the ability of an organism to overcome completely or in some degree the effect of a pathogen or other damaging factor; whereas susceptibility in the inability of the plant to resist the effect of the pathogen or other damaging factor.

Hypersensitivity is the extreme degree of susceptibility in which there is rapid death of the cells in the vicinity of the invading pathogen. It halts the further progress of the pathogen. Thus, hypersensitivity is a sign of very high resistance approaching immunity.

Infection is the establishment of the parasitic relationship between the pathogen and host following entry or penetration.

Incubation period is the time elapsing between penetration and completion of infection i.e. development of the disease symptoms.

Invasion and colonization is the growth and multiplication of the pathogen through the tissue of the host varying extent.

Effects of Disease

- The diseased plants do not function or look normal showing structural abnormality and / or physiological disorder and cannot grow, develop and reproduce to its genetic potential.

Classification of Plant Diseases

Based on plant part affected

- Localized, if they affect only specific organs or parts of the plants.
- Systemic, if entire plant is affected. or

They can be classified as root diseases, stem diseases, foliage/foliar diseases, etc.

Based on perpetuation and spread

- Soil borne -when the pathogen perpetuates through the agency of soil.
- Seed borne -when the pathogen perpetuates through seed (or any propagation material).
- Air borne -when they are disseminated by wind e.g. rusts and powdery mildews.

Based on the signs and symptoms produced by the pathogens

- Diseases are classified as rusts, smuts, powdery mildews, downy mildews, root rots, wilts, blights, cankers, fruit rots, leaf spots, etc. In all these examples, the disease are named after the most conspicuous symptom of the disease appearing on the host surface.

Based on the host plants affected

They can be classified as cereal crop diseases, forage crop diseases, flax diseases, millet diseases, plantation crop diseases, fruit crop diseases, vegetable crop diseases, flowering plant diseases, etc.

Based on major Causes

They can be classified as fungal diseases, bacterial diseases, viral diseases, mycoplasmal diseases, etc.

Based on Infection Process

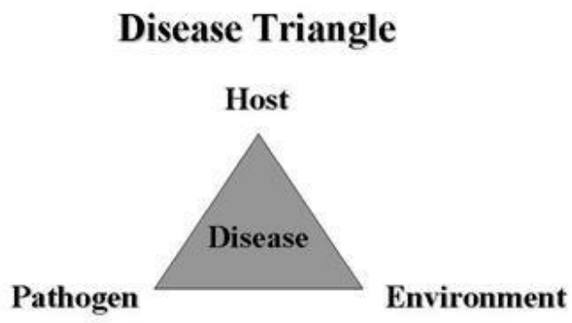
- Infectious -All the diseases caused by animate causes, viruses and viroids can be transmitted from infected host plants to the healthy plants and are called infectious.
- Non-infectious- Non-infectious diseases can not be transmitted to a healthy plant. Also referred as non-parasitic disorders or simply physiological disorders, and are incited by abiotic or inanimate causes like nutrient deficiency or excess or unfavorable weather conditions of soil and air or injurious mechanical influences.

Classification of Animate Diseases in Relation to Their Occurrence

- **Endemic diseases** -which are more or less constantly present from year to year in a moderate to severe form in a particular geographical region, i.e. country, district or location.
- **Epidemic or epiphytotic diseases** -which occur widely but periodically particularly in a severe form. They might be occurring in the locality every year but assume severe form only on occasions due to the favourable environmental conditions occurring in some years.
- **Sporadic diseases** occur at irregular intervals and locations and in relatively few instances.
- **Pandemic diseases**: A disease may be endemic in one region and epidemic in another. When epiphytotics become prevalent through out a country, continent or the world, the disease may be termed as pandemic.

Disease triangle

- The interaction of the host, the pathogen and the environment results in disease development. It is generally illustrated by a triangle, also called a disease triangle.



Disease development is dependent on three factors: host, pathogen and environment. The area within the triangle is the interaction of these components and represent the amount of disease.

Disease Development in Plant Population

This is determined by:

- **Host**: All conditions in host that favour susceptibility.
- **Pathogen**: Total of virulence, abundance etc.
- **Environment**: Total of conditions that favour the pathogen and predispose the host plants to pathogen attack.
- **Time:** Specific point of time at which a particular event in disease development occurs and the duration or length of time during which the event takes place.

'*Effective disease control or measures aim at breaking this E-H-P triangle'.*