

Plant Pathology

Plant Pathology or Phytopathology is the branch of agriculture, which deals with the study of plant diseases. The detailed study includes the importance and occurrence, symptoms, cause, etiology, disease cycle, epidemiology and management of diseases.

The major objectives of plant pathology are:

- i. To study the causes (biotic & abiotic) of plant diseases.
- ii. To study the mechanism of plant disease development.
- iii. To study the interaction between plant and pathogen in relation to environment and time.
- iv. To develop effective system of management of plant diseases to minimize the losses caused by them.

Disease

Disease may be defined as “abnormal changes in physiological processes which disturbs the normal activity of plant organs” (Kuhn, 1858).

Disease is a condition in which the functions of the organism are improperly discharged or, in other words, it is a state, which is physiologically abnormal and threatens the life of the being or organs (Ward, 1896).

Disease is a variation from normal physiological activity, which is sufficiently permanent or extensive to check the performance of normal functions by the plant or completion of its development (Butler, 1918).

Disease is a deviation from normal functioning of physiological processes of sufficient duration of intensity to cause disturbance or cessation of vital activities (American Phytopathological Society, 1940).

Disease is a harmful deviation from the normal functioning of process (British Mycological Society, 1950).

Disease is defined as all the malfunctions, which result in unsatisfactory performance of the plant or which reduce ability of the plant to survive and maintain its ecological niche (Wheeler, 1975).

Importance and losses caused by Plant Diseases

Plant diseases are of immense importance to human beings by making the difference between a happy life and a life haunted by hunger or even death from starvation.

1. The death of a quarter million people from starvation in Ireland in 1845 is just one example.

2. Wheat rusts have been appearing in epidemic form from time-to-time in many countries forcing the farmers to change their cropping pattern and food habits.
3. Leaf blight of rice (*Helminthosporium oryzae*) was one of the main reasons contributing to the Bengal famine in 1943.
4. Regular occurrence of coffee rust in Sri Lanka was responsible to reduce the coffee export by 93 percent from 1871 to 1893, which ultimately forced the growers to substitute it with tea. This situation promoted coffee cultivation in Brazil and it became the major coffee producing and exporting country.

On global basis, of about 35 percent annual crop loss, 12 percent is due to diseases other than nematodes, 11 percent due to nematodes, 7 percent due to insect pests and 3 percent due to weeds (Cramer, 1967).

1. Plant diseases also result in increased prices of products to consumers.
2. They destroy the beauty of the environment by damaging plants around homes, along streets, in parks and in forests.
3. Plant diseases may limit the kind of plants and industries in an area.
4. Plant diseases reduce the quantity and quality of plant produce.
5. Plant diseases may make plants poisonous to humans and animals.
6. Plant diseases may cause financial losses.

Causes of Plant Diseases

1. Abiotic
2. Mesobiotic
3. Biotic

Classification of Plant Diseases on the basis of occurrence

1. **Endemic Diseases:** The diseases, which are of regular occurrence from year to year in moderate to severe form but are confined to a particular country or district.
2. **Epiphytotic Diseases:** The diseases, which occur widely but periodically. It may be present constantly in a locality but assumes a severe form only occasionally due to conducive environment.
3. **Sporadic Diseases:** The diseases, which occur at very irregular intervals and locations and in relatively few instances.
4. **Pandemic Diseases:** When a disease is prevalent throughout the country, continent or the world, it is known as pandemic disease.

Symptoms of Plant Diseases

Most plant diseases are named after their most characteristic symptoms. Symptoms are plant response against pathogenic attack.

Following is a list of common symptoms produced by plant pathogens

- I. **NECROSIS:** Death of plant tissue, which often becomes blanched, and brittle.
 1. **Leaf spots:** Well defined lesions of limited extent.
 2. **Shot holes:** When the dead tissue of a leaf spot falls away as a characteristic feature of disease.
 3. **Blight:** A general, extensive and rapid killing of leaves, flowers and twigs.
 4. **Stripe:** Narrow elongated lesion
 5. **Blotch:** Large, irregular spots or blots on leaves, shoots and stem.
 6. **Scorch:** Burning of leaf margins, generally due to extensive heat.
 7. **Pustules:** Small blister-like elevations of dead host epidermis as spores of the pathogen emerge. They may be white (white rusts) or yellow, orange, brown or black (true rusts)
 8. **Downy mildews:** Foliage blights or leaf spots characterized by a fine silky growth of a fungus belonging to the family Peronosporaceae. They attack young, tender green parts.
 9. **Seedling blight and Damping off:** Seedlings die suddenly and fall on the ground.
- II. **Change of color**
 1. **Chlorosis:** Yellowing of normally green tissue due to chlorophyll degradation or failure of chlorophyll formation. It may appear by itself or may appear as a zone around a necrotic spot. It may be due to nutrient deficiency or due to a pathogen.
 2. **Silvering:** The change of colour of an organ to silver due to an increase in the air spaces between host cells or due to loosening of the cuticle.
 3. **Reddening:** Development of red pigment (anthocyanin).
 4. **Mosaic:** Symptoms of certain virus diseases of plants characterized by intermingled patches of normal green and light green or yellow.
 5. **Sooty molds:** There is no actual change in colour of the plant organ. Instead there is a sooty coating on foliage etc., formed by dark fungal mycelium that lives on honeydew secreted by insects.

6. **Powdery mildew:** Like sooty molds, there is a fungal growth on the host surface, which in this case is white to grey and powdery. But the pathogen, in this case is an obligate parasite.

III. Wilting: Drooping of foliage and tender shoots of plants caused by interference with the normal movement of water within the plants. In pathological wilts, the lower leaves generally wilt first.

IV. ABNORMAL ENLARGEMENT IN PLANT TISSUES: This results from increase in size (hypertrophy) and/or number of cells (hyperplasia).

1. **Witches' broom:** Broome like growth caused by dense clustering of branches of woody plants.
2. **Galls:** Swelling produced on plants as a result of infection by certain pathogens.
3. **Canker:** The area of necrosis caused by a pathogen becomes surrounded by successive layers of cork cells.
4. **Scab:** Roughened, crust like diseased area on the surface of a plant organ. The development of cork layers is less conspicuous than in canker.
5. **Root Knots:** Galls caused by nematodes in roots especially of vegetable crops.

V. Reduction in size

1. **Stunting:** The whole plant becomes smaller than the normal due to disease.
2. **Smalling of leaves:** The leaves of affected plants remain smaller than the normal ones.

VI. Unusual development or transformation of organs

1. **Smut:** Plant parts especially grains are replaced by soot like spore masses.
2. **Ergot:** Grains are replaced with dark hard bodies of fungus hyphae.
3. **Fruit mummies:** Diseased fruits dry out rapidly and become hard or mummified due to fungus growth.

VII. Disintegration of tissue

1. **Wet rot:** Disintegration of diseased tissues, especially succulent parts, accompanied by a release of cell fluid.
2. **Dry rot:** Disintegration of plant tissues, which crumble to a dry mass.
3. **Wood rot:** Wood or trees are rotted by the fungus. When lignin component of the wood is broken down by the fungus, it results into a **white rot** and when the cellulose component of the wood cell walls is broken down, it results into a **brown rot**.

4. **Root and Foot rot:** Rotting and shredding of cortical tissue of the roots and lower part of the stem. First signs of root and foot rot appear in the form of wilting of shoot. Plants with root rot can generally be pulled out of the soil very easily.

VIII. Gummosis: In certain diseases of trees, there is an excessive gum formation.

History of Plant Pathology

The history of Plant Pathology is as old as human civilization. Even when the humans lived as nomads and used to eat only leaves, fruits and seeds, plant diseases took their toll, causing leaves to mildew and blight and fruit and seeds to rot. When man began to grow one or few kinds of food plants, part of the crop was lost to diseases thus delimiting food supplies and hunger was common.

Homer (1000 B.C.) mentioned the therapeutic properties of sulphur on plant diseases. Democritus (470 B.C.) recommended the control of blights by sprinkling plants with the olive grounds left after extraction of the olive oil.

The Greek philosopher Theophrastus (300 B.C.) was the first to study and write about diseases of trees, cereals and legumes.

Magnus (about A.D. 1200), in Germany proposed that the mistletoe plant was a parasite that obtained its food from the host plant, which it makes sick. He also noted that pruning out the parts carrying the mistletoe could cure the host plant.