

## **Lecture -1**

### **INTRODUCTION TO THE SCIENCE OF PHYTOPATHOLOGY: ITS IMPORTANCE, SCOPE AND CAUSES OF PLANT DISEASES**

**Aim: To acquaint the students with the science of phytopathology; its objectives, general concepts and classification of plant diseases**

#### **Science of Phytopathology or Plant Pathology and Its Importance**

- Plant pathology has been accepted as broad area of research and technology at the national and international level.

#### **Plant Pathology- Definition**

- Plant Pathology, also known as Phytopathology is a branch of agricultural, biological or botanical science which deals with the study of diseases in plants - their causes, etiology, epidemiology, resulting losses and management.

#### **Relation to other Sciences**

- Plant pathology is related to many other sciences such as virology, mycology, bacteriology, microbiology, physiology, chemistry, genetics, biotechnology etc., all of which provide the knowledge required for the correct diagnosis and management of plant diseases.

#### **Objectives of Plant Pathology**

- To study living, non-living and environmental causes of diseases or disorders of the plants.
- To study the mechanism of plant disease development.
- To study interaction between host/susceptible and the pathogens.
- To develop systems of management of plant diseases and reducing losses caused by them.

#### **Importance of Plant Diseases or Plant Pathology**

##### **Losses they cause.**

- About 34% of the crop produce is lost annually due to diseases, insect-pests and weeds on the global basis (Cramer, 1967); out of which, 12% is lost due to diseases (caused by fungi, bacteria or viruses), 11% due to nematodes, 7% due to insect-pests and 3% due to weeds.
- When plant protection measures are not implemented, annual loss of 30-50% are common in major crops including horticulture (Encyclopedia Britannica, 2002)

##### **Epidemics**

- Late blight of potato caused by *Phytophthora infestans* was responsible for causing Irish famine in 1845 by destroying the potato crop, the staple food of the people.
- Hundreds of thousand people died of hunger and disease, and there was a large scale migration of the population to other countries including North American continent.
- The population of Ireland was 8 million in 1940, which was reduced to 4 million after the famine.
- This single disease forced man to realize the importance of plant diseases, and brought the science of Plant Pathology to lime light.

##### **Other Famines**

- Wheat rust epidemics occurred from time to time in many countries. Wheat rusts forced farmers to change their cropping pattern and wheat was replaced by corn or maize or rye.
- Brown spot of rice caused by *Helminthosporium oryzae* was responsible for Bengal famine in 1943, which many people think one of the reasons for the division of Bengal
- Coffee rust caused by *Hemileia vastatrix* forced to cut down the coffee plants in Sri Lanka in 1867.
- Powdery mildew of grapevines caused by (*Uncinula necator*), by 1854, reduced the French wine production by 80 per cent.
- In 1878, the downy mildew caused by *Plasmopara viticola* ultimately led to the discovery of Bordeaux mixture.

##### **Effect on Society**

- Infected grains or the fruits may contain toxins (such as aflatoxin, fumonisin) which cause insanity, paralysis, stomach disorder and liver cancer.
- The money spent on the management of plant diseases is also a loss because in the absence of diseases this money could be saved.
- There are many other implications on the transport and agro-based industry in the event of plant disease inflicted yield loss.
- There is restriction on the movements of food grains and other agricultural produce due to the threat of quarantine pathogens and pesticide residues in the produce causing further loss.

### **Causes of Plant Diseases**

- Plant diseases are caused by a variety of pathogens.
- The word pathogen can be broadly defined as any agent or factor that incites 'pathos' or disease in an organism. Thus in strict sense, the pathogens do not necessarily belong to living or animate groups.

### **Abiotic (Inanimate) factors**

- They include mainly the deficiency or excess of nutrients, light, moisture, aeration, abnormality in soil condition, atmospheric impurities etc. Examples are: Black tip of mango (due to SO<sub>2</sub> toxicity), khaira disease of rice (due to Zn deficiency), whiptail of cauliflower (Mo deficiency), hollow and black heart of potato (due to excessive accumulations of CO<sub>2</sub> in storage), bitter pit of apple (due to Ca deficiency).

### **Mesobiotic causes**

- These are the disease incitants which are neither living nor non-living. They are considered to be on the threshold of life. They are:
- **Viruses:** They are infectious agents made up of one type of nucleic acid (RNA or DNA) enclosed in a protein coat. Examples of viral diseases of plants are: potato leaf roll, leaf curl of tomato and chillies, and mosaic disease of many plants.
- **Viroids:** They are naked, infectious strands of nucleic acid. They cause diseases like potato spindle tuber, citrus exocortis, chrysanthemum stunt, cadang cadang of coconut palm, star crack of apple, etc.

### **Biotic (Animate) causes**

This category includes the pathogens which are animate or living or cellular organisms. They are:

- Prokaryotes like bacteria which are unicellular prokaryotic microorganisms lacking true nucleus. Examples of diseases caused by true bacteria are: brown rot or wilt of potato, soft rot of potato and vegetables, , citrus canker, etc.
- i) **Phytoplasma** are wall-less prokaryotes and cause diseases like peach X.
- ii) **Fastidious bacterium**, *Xylella fastidiosa* causes almond leaf scorch, Pierce's disease of grapevine.
- **Eukaryotes** are the organisms with true nucleus.
    - i) **Fungi:** Potato wart, powdery mildew, rust, smuts, red rot of sugarcane (nearly 80% of plant diseases are caused by fungi).
    - ii) **Straminopiles (Oomycetes):** Downy mildews, late blight of potato, white rust of crucifers, damping off etc.
    - iii) **Protozoa:** Hart rot of coconut palm and phloem necrosis of coffee.
    - iv) **Algae:** Red rust of mango or papaya or litchi
    - v) **Metazoan animals (Nematodes):** Root knot of vegetables, ear cockle of wheat, citrus decline etc.
    - vi) **Parasitic flowering plants (Phanerogamic plant parasites):** Dodder, Striga, Orobranche, Loranthus, Phoradendron, etc