

**FACULTY OF AGRICULTURE SCIENCES AND  
ALLIED INDUSTRIES**

**Course Material**

**Course Name: Fundamental of Plant Pathology**  
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**Course Instructor**

**Dr. Kartikay Bisen**  
**Faculty of Agricultural Sciences and Allied Industries**  
**Rama University, Kanpur**

### LECTURE1

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

Plant pathology is a science that studies plant diseases and attempts to improve the chances for survival of plants when they are faced with unfavorable environmental conditions and parasitic microorganisms that cause disease. As such, plant pathology is challenging, interesting, important, and worth studying in its own right. It is also, however, a science that has a practical and noble goal of protecting the food available for humans and animals. Plant diseases, by their presence, prevent the cultivation and growth of food plants in some areas; or food plants may be cultivated and grown but plant diseases may attack them, destroy parts or all of the plants, and reduce much of their produce, i.e., food, before they can be harvested or consumed. In the pursuit of its goal, plant pathology is joined by the sciences of entomology and weed science. It is conservatively estimated that diseases, insects, and weeds together annually interfere with the production of, or destroy, between 31 and 42% of all crops produced worldwide. The losses are usually lower in the more developed countries and higher in the developing countries, i.e., countries that need food the most. It has been estimated that of the 36.5% average of total losses, 14.1% are caused by diseases, 10.2% by insects, and 12.2% by weeds. Considering that 14.1% of the crops are lost to plant diseases alone, the total annual worldwide crop loss from plant diseases is about \$220 billion. To these should be added 6–12% losses of crops after harvest, which are particularly high in developing tropical countries where training and resources such as refrigeration are generally lacking. Also, these losses do not include losses caused by environmental factors such as freezes, rougths, air pollutants, nutrient deficiencies, and toxicities.

#### Plant Pathology-Definition

Plant pathology or phytopathology is the science, which deals with the plant diseases. It is concerned with health and productivity of growing plants. Phytopathology (Greek *Phyton*

=plant + *pathos* - disease, ailments + *logos* = discourse, knowledge) is the branch of agricultural, botanical or biological science which deals with the cause, etiology (aetiology), resulting in losses and management methods of plant diseases.

Plant pathology can also be defined as the study of the nature, cause and prevention of plant diseases. Plant pathology is related to most of the old and new sciences like biology, physics, chemistry, physiology, mathematics, genetics, soil science, biochemistry, biotechnology etc.

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.

### 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.

### Plant diseases

Plant diseases are recognized by the symptoms (external or internal) produced by them or by sick appearance of the plant. The term plant disease signifies the condition of the plant due to disease or cause of the disease. Plant disease is mainly defined in terms of the damage caused to the plant or to its organ. The other definitions for the term disease are:

1. Disease is a malfunctioning process that is caused by continuous irritation, which results in some suffering producing symptoms. This definition is accepted by both American Phytopathological Society and British Mycological Society.

2. Disease is an alteration in one or more of the ordered sequential series of physiological processes culminating in a loss of coordination of energy utilization in a plant as

a result of the continuous irritation from the presence or absence of some factor or agent.

3. A plant is said to be diseased when there is a harmful deviation from normal functioning of physiological process (Federation of British Plant Pathologists, 1973).

4. The disease can also be defined as 'any disturbance brought about by a living entity or non-living agents or environmental factors which interfere with manufacture, translocation or utilization of food, mineral nutrients and water in such a way that the affected plant changes in appearance with or without much loss in yield than that of a normal healthy plant of the same variety. In general disease is an interaction among the host, parasite and the environment.

### 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 1840, 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 limelight.

### 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.

### Losses in India

- Wheat rusts cause a loss of Rs.400 crore annually.
- In the years of epidemics, losses are Rs.5000 crore or more.
- Loose smut of wheat is estimated to cause an average loss of 3 per cent (about Rs. 500 crore) every year.
- Other plant diseases such as red rot of sugarcane, potato viruses, rice blast and blight, Karnal bunt of wheat, root knot of tomato, eggplant and cucurbits, apple scab, mango malformation, bunchy top of banana and sandal spike are responsible for huge losses.

### 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.

### **Plant Diseases Reduce the Quantity and Quality of Plant Produce**

### **Plant Diseases May Limit the Kinds of Plants and Industries in an Area**

### **Plant Diseases May Make Plants Poisonous to Humans and Animals**

### **Plant Diseases May Cause Financial Losses**

## **CAUSES OF PLANT DISEASES**

### **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), and 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, redroot 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.