

LESSON ONE: Plant diseases

1.1. Introduction



Plants, whether cultivated or wild, grow and produce well as long as the soil provides them with sufficient nutrients and moisture, sufficient light reaches their leaves, and the temperature remains within a certain “normal” range. Plants, however, also get sick. Sick plants grow and produce poorly, they exhibit various types of symptoms, and, often, parts of plants or whole plants die. The agents that cause disease in plants are the same or very similar to those causing disease in humans and animals. They include pathogenic microorganisms, such as viruses, bacteria, fungi, protozoa, and nematodes, and unfavorable environmental conditions, such as lack or excess of nutrients, moisture, and light, and the presence of toxic chemicals in air or soil. Plants also suffer from competition with other, unwanted plants (weeds), and, of course, they are often damaged by attacks of insects.

Plant pathology is the study of the organisms and of the environmental factors that cause disease in plants; of the mechanisms by which these factors induce disease in plants; and of the methods of preventing or controlling disease and reducing the damage it causes. Each discipline studies the causes, mechanisms, and control of diseases affecting the organisms with which it deals. Plant pathology is an integrative science and profession that uses and combines the basic knowledge of botany, mycology, bacteriology, virology, nematology, plant anatomy, plant physiology, genetics, molecular biology and genetic engineering, biochemistry, horticulture, agronomy, tissue culture, soil science, forestry, chemistry, physics, meteorology, and many other branches of science.

1.2 Lecture objectives



At the end of the lesson the student will

- 1) Understand all that entails plant diseases and the economic importance of plant pathogens.

1.3 Plant diseases

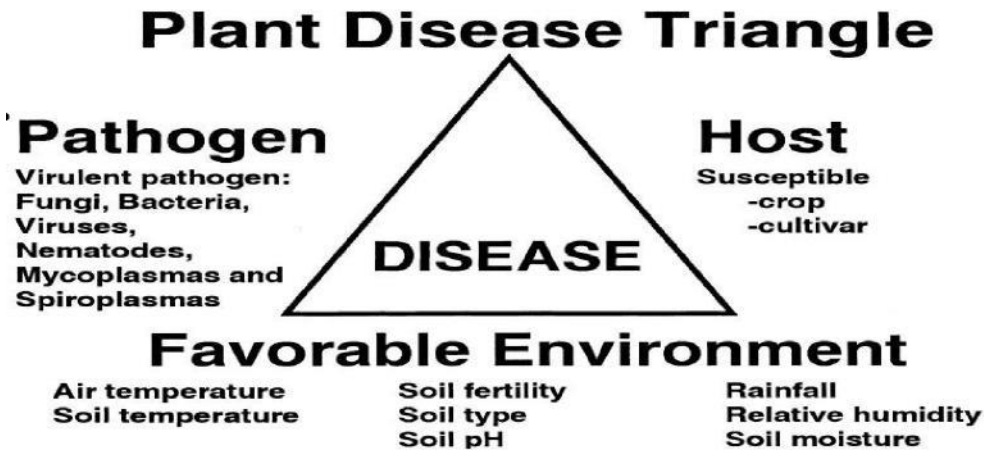
In Plant pathology, plant disease is an impairment of the normal state of a plant that interrupts or modifies its vital functions. Plant diseases are sometimes grouped according to the symptoms they cause e.g. root rots, wilts, leaf spots, blights, rusts, smuts, to the plant organ they affect e.g. root diseases, stem diseases, foliage diseases, or to the types of plants affected e.g. field crop diseases, vegetable diseases, turf diseases, etc. One useful criterion for grouping diseases is the type of pathogen that causes them (causal agent). The advantage of such a grouping is that it indicates the cause of the disease, which immediately suggests the probable development and spread of the disease and also possible control measures.

1.4 Disease causing organisms: In plant pathology we limit ourselves to biotic causes.

- **Biotic**
 - Fungi (Mycology)
 - Bacteria (Bacteriology)
 - Nematodes (Nematology)
 - Viruses (Virology)
- **Other disease causing organisms**
 - Protozoa
 - Mycoplasma like organisms (MLOs)
 - Rickettsia like organisms
 - Parasitic plants (RLOs)
 - Physiological disorders

1.5 Plant disease triangle

The plant disease triangle is a concept that best explains how diseases result. For disease to occur there has to be the right combination of pathogen factors, host factors and environmental factors as depicted below.



1.6 How plant pathogens infect their hosts

- **Cell wall-degrading enzymes:** These are used to break down the plant cell wall in order to release the nutrients inside e.g. celluloses degrading enzymes, cutinases, Pectinases, Amylose
- **Toxins:** These can be non-host-specific, which damage all plants, or host-specific, which cause damage only on a host plant. e.g. Victorin, Alterin,
- **Effector proteins:** These can be secreted into the extracellular environment or directly into the host cell, often via the type three secretion system. Bacteria, fungus and oomycetes are known for this function.
- **Growth regulators.** Growth regulators act by influencing growth regulators in the plant, plant pathogens are able to utilize host tissues to their advantage e.g. Auxins, Cytokinin, Giberellins, ethylene, Abscissic acid, Dormin etc
- **Polysaccharides-** Fungi, bacteria and nematodes release varying amounts of mucilaginous substances that coat their bodies and provide interface between the outer surface of the micro-organism and the environment e.g. *Ralstonia solanacearum*

1.7 Losses caused by plant diseases

Plant diseases are of paramount importance to humans because they damage plants and plant products on which humans depend for food, clothing, furniture, the environment, and, in many cases, housing. Plant diseases, however, also result in increased prices of products to consumers; they sometimes cause direct and severe pathological effects on humans and animals that eat diseased plant products; they destroy the beauty of the environment by damaging plants around homes, along streets, in parks, and in forests; and, in trying to control the diseases, people release billions of pounds of toxic pesticides that pollute the water and the environment.

1.7.1 Reduction of the quantity and quality of plant produce

The kinds and amounts of losses caused by plant diseases vary with the plant or plant product, the pathogen, the locality, the environment, the control measures practiced, and combinations of these factors. The quantity of loss may range from slight to 100%. Plants or plant products may be reduced in quantity by disease in the field, as indeed is the case with most plant diseases or by disease during storage, as is the case of the rots of stored fruits, vegetables, grains, and fibers. Frequently, severe losses may be incurred by reduction in the quality of plant products. For instance, whereas spots, scabs, blemishes, and blotches on fruit, vegetables, or ornamental plants may have little effect on the quantity produced, the inferior quality of the product may reduce the market value so much that production is unprofitable or a total loss. For example, with apples infected with apple scab, even as little as 5% disease may cut the price in half; with others, e.g., potatoes infected with potato scab, there may be no effect on price in a market with slight scarcity.

1.7.2 Plant diseases limit the kinds of plants and industries in an area

Plant diseases may limit the kinds of plants that can grow in a large geographic area. Plant diseases may also determine the kinds of agricultural industries and the level of employment in an area by affecting the amount and kind of produce available for consumption or processing. However, plant diseases are also responsible for the creation of new industries that develop chemicals, machinery, and methods to control plant diseases.

1.7.3 Plant diseases make plants poisonous to humans and animals

Some diseases, such as ergot of rye and wheat, make plant products unfit for human or animal consumption by contaminating them with poisonous fruiting structures.

1.7.4 Plant diseases cause financial losses

In addition to direct losses in yield and quality, financial losses from plant diseases can arise in many ways.

- Farmers may have to plant varieties or species of plants that are resistant to disease but are less productive, more costly, or commercially less profitable than other varieties.
- They may have to spray or otherwise control a disease, thus incurring expenses for chemicals, machinery, storage space, and labor.
- Shippers may have to provide refrigerated warehouses and transportation vehicles, thereby increasing expenses.
- Plant diseases may limit the time during which products can be kept fresh and healthy, thus forcing growers to sell during a short period of time when products are abundant and prices are low.

- Healthy and diseased plant products may need to be separated from one another to avoid spreading of the disease, thus increasing handling costs.
- The cost of controlling plant diseases, as well as lost productivity, is a loss attributable to diseases.

Summary



Plant pathogens are of economic importance in the world. Some causes diseases on the crops during the growth stage and others during storage. There are also beneficial pathogens which help in control of these plant diseases.