LESSON TWO: PLANT DISEASES CAUSED BY FUNGI

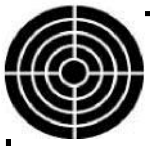
2.1. Introduction

Fungi are microscopic organisms that reproduce by means of spores. Only those with cell wall containing chitin are classified as true fungi.

Most plant diseases are caused by fungi and most of them tend to become a problem, especially during the wet weather season.

Some of fungal diseases can cause up to 100% loss in crops.

2.2. Lecture objectives



At the end of this lecture the student should be able to

1) Understand detailed biology of plant pathogenic fungi
2) Correctly diagnose plant pathogenic fungi
3) Discuss management strategies of plant pathogenic fungi

2.3 BIOLOGY, DIAGNOSIS AND MANAGEMENT OF PLANT FUNGI

2.3.1 BIOLOGY OF FUNGI

Fungi are small, generally microscopic, eukaryotic usually filamentous, branched, spore bearing organisms that lack chlorophyll. Some fungi are referred to as **obligate parasites or biotrophs**. These can grow and multiply only by remaining, during their entire life, in association with their living host plants. Others are known as **non-obligate parasites**. They require a host plant for part of their life cycle but can complete their cycles on dead organic matter, or they can grow and multiply on dead organic matter as well as on living plants. Fungi that are non-obligate parasites can be **facultative saprophytes** or **facultative parasites** depending on whether they are primary parasites or primary saprophytes.

Most fungi have a filamentous vegetative body called a **mycelium**. The mycelium branches out in all directions. The individual branches of the mycelium are called **hyphae** and are generally uniform in thickness, usually about 2 to 10 micrometers in diameter, but in some fungi may be more than 100 um thick. A fungus reproduces by means of spores. Spores are reproductive bodies consisting of one or a few cells.

2.3.1.1 Distribution

Fungi are primarily terrestrial organisms although a few are freshwater or marine. Many are pathogenic and infect important plants and animals. Fungi also form beneficial relationships with other organisms. For example, about three-fourths of all vascular plants form association (called **mycorrhizae**) between their roots and fungi.

2.3.1.2 Nutrition and metabolism

Fungi are incapable of synthesizing their own food because they lack the photosynthetic pigment i.e. they are heterotrophic. Their mode of nutrition is either saprophytic or parasitic. Saprophytic fungi secure their nutrients from dead organic material. Like many bacteria, fungi can secrete hydrolytic enzymes that solubilize polymeric substrates and then absorb the product. Generally parasitic fungi grow on living plants and animals including human beings from which they obtain nourishment form the living protoplasm. Some fungi e.g. Mycomycetes engulf bacteria, various spores and bits of decaying organic matter thereby feeding in an animal like fashion i.e**. holozoic** mode of feeding. The digested material is then absorbed through the cell membrane. Some fungi have special root like structures (rhizoid), which absorb food. Parasitic fungi often produce special hyphal branches referred to as **haustoria**, which penetrate the cells of the host and obtain food from the protoplasm. Some fungi form symbiotic associations with the roots of higher plants. These are the **mycorrhizal fungi**. Others associate with algae= lichens. **Glycogen** is the primary storage polysaccharide in fungi. Most fungi use carbohydrates (preferably glucose or maltose) and nitrogen compounds to synthesize their own amino acids and proteins. Many specific elements (calcium, magnesium,

copper, zinc, and iron) are also required by fungi. Fungi are usually aerobic and can obtain energy by fermentation, such as in the production of ethylo alcohol from glucose. No fungi can be described as obligately anaerobic.

2.3.1.4 Reproduction

Reproduction in fungi can be either **asexual** or **sexual**. In asexual reproduction, there is no union of nuclei, sex cells, or sex organs.

1. Asexual reproduction

During the asexual phase of fungal reproduction, various spores may be produced, depending on the species. These include various **conidia**, which are asexual spores borne externally on hyphae or specialized conidiophore structures. **Conidia** are not enclosed in a specialized structure but are formed at the tip or sides of hyphae

2. **Sexual reproduction in fungi**

Fungi also can produce various types of sexual reproductive spores. Some sexual spores of fungi are formed within a specialized structure known as the ascus (ascomycetes). These spore are called ascospores.

2.4. Symptoms caused by fungi on plants

Plant parasitic fungi cause local or general symptoms on their hosts and such symptoms may occur separately or concurrently or may follow one another. In general, fungi cause local or general necrosis of plant tissues, and they often cause reduced growth (stunting) of plant organs or entire plants. A few fungi cause excessive growth of infected plants or plant parts. The most common necrotic symptoms are as follows;

Leaf spots: Localized lesion on host leaves consisting of dead and collapsed cells.

Blight: General and extremely rapid browning and death of leaves, branches, twigs, and floral organs.

Canker: Localized necrotic lesion on stem or fleshy organ, often sunken of a plant

Dieback: Extensive necrosis of twigs beginning at their tips and advancing toward their bases.

Root rot: Disintegration or decay of part or all of the root system of a plant.

Damping-off: Rapid death and collapse of very young seedlings.

Basal stem rot: Disintegration of the lower part of the stem

Soft rots and dry rots: Maceration and disintegration of fruits, roots, bulbs, tubers, and fleshy leaves

Anthracnose: Necrotic and sunken ulcer-like lesion on the stem, leaf, fruit or flower of the host plant caused mainly by a certain group of fungi.

Scab: Localized lesions on host fruit, leaves, tubers, etc. usually slightly raised or sunken and cracked, giving a scabby appearance.

Decline: Progressive loss of vigor; plants growing poorly; leaves small, brittle, yellowish, or red; some defoliation and dieback present.

All the symptoms above may be associated with pronounced stunting of the infected plants. In addition, certain other diseases, such as rusts, mildews, wilts, and even those causing excessive growth of some plants may cause stunting of the plant as a whole.

Symptoms associated with excessive enlargement or growth and distortion of plant parts include the following;

Club root: Enlarged roots appearing like spindles or clubs.

Galls: Enlarged portions of plant organs (stems, leaves, blossoms, roots).

Warts: Wart-like protuberances on tubers and stems

Witches'-brooms: Profuse, upward branching of twigs

Leaf curls: Distortion, thickening and curling of leaves.

In addition, to those just given, four groups of symptoms may be added.

Wilt: Generalized loss of turgidity and drooping of leaves or shoots.

Rust: Many small lesions on leaves or stems, usually of a rust color

Smut: Seed or a gall filled with a mycelium or black spores of the smut fungi

Mildew: Areas on leaves, stems, blossoms, and fruits, covered with whitish mycelium and the fructification of the fungus.

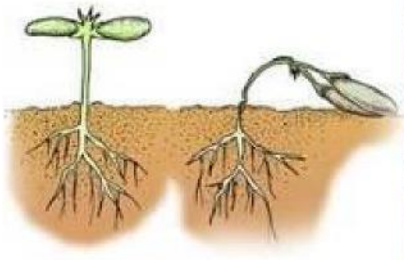
2.5 Common vegetable diseases caused by fungi

a) Club root of crucifers- caused by *Plasmodiophora brassicae*


b) Late blight of potatoes- caused by *Phytophora infestans*



c) Pythium seed rot, damping-off, root-rot and soft rot




d) Powdery mildews of various crops e.g cucurbits. Caused by many species of fungi of the family Erysiphaceae

e) Alterania leafspots- caused by a variety of *Alternaria* spp.

Figure 1. Plant fungal disease symptoms

2.6 Management of Fungal Plant diseases in Vegetables

2.6.1 Genetic Host Resistance

Using genetically resistant species, cultivars, varieties, and hybrids. In many of the major crops, cultivars resistant to prevailing diseases are available, and more are continually being developed by plant breeders. The use of genetically resistant plants, if available, should be the first line of defense for diseases caused by fungi.

2.6.2 Cultural Practices

- Planting only disease-free certified seed.
- Maintaining a balanced fertility program that avoids excessive or inadequate levels of key plant nutrients.
- Maintaining an effective water management program—maintain adequate soil drainage, monitor irrigation practices, and adjust accordingly, etc.
- Removing crop residues by burning or burying (plowing).
- Implementing crop rotation strategies to reduce or eliminate the interaction of susceptible plants with pathogens.
- Growing crops in climates unsuitable for pathogenic fungi
- Careful handling of the crop (vegetables and fruits) to prevent cuts, bruises, and wounding during harvest, transit, and storage.

2.6.3 Chemical Applications

- The use of preplant soil fumigants, the use of fungicide drenches or seed treatments with fungicides.
- Fungicide applications.
- Postharvest treatment of fruits and vegetables with fungicides.

2.6.4 Biological Control

- The use of biological control organisms to suppress the activity of deleterious fungi and FLOs.

2.6.5 Government Regulatory Measures

• The implementation of strict quarantines that exclude or restrict the introduction or movement of fungal and FLO pathogens or infected plant material.

In conclusion, a combination of measures is usually necessary for the satisfactory control of most fungal diseases. An integrated approach to disease management and control is a must for most fungal diseases of plants.

Summary

Understanding of fungal biology is important so as to know at what stage the pathogen is expected to attack the crop and also help in timely management of the pathogen.

Correct diagnosis of fungal pathogens is encouraged as wrong diagnosis can lead to easy spread of the pathogen and management become costly

Management of plant pathogenic fungi can be achieved through cultural, chemical and biological

NOTE

Integrated pest management is encouraged for fungal pathogens as no single management option is effective on its own.

ACTIVITY

> Visit a market place or a vegetable farm and collect samples showing symptoms of a fungus.