

Plant diseases and forests

Forest pathology is the study of tree diseases including diseases of trees in forests, plantations, nurseries, urban areas, and landscape settings. In addition, forest pathology also encompasses the science of wood degradation and decay. Forest pathology is a sub-discipline of plant pathology which is the study of plant diseases. A **plant disease** is defined as a sustained disruption in physiological or structural functions of a plant due to an attack by a pathogen that results in death, damage to cells or tissues, reduced growth or vitality, or economic losses. A disease is an interaction between a pathogen and its host that can only occur under certain environmental conditions.

Host-specificity

Plant pathogens cannot attack and parasitize any plant species; instead, plant pathogens are host-specific. A host is a plant that can be infected and parasitized by a specific plant pathogen. Most plant pathogens have only one or a few suitable host species; however, some pathogens can attack hundreds of plant species. The mechanisms that determine which pathogens can attack which plants are very complicated and result from complex interactions and signals between the two organisms.

Trees have evolved structural and chemical defences such as thick bark, waxy leaf coatings, root secretions, and anti-microbial toxins that prevent infections. These "pre-formed" defences are always in place and provide general protection from all microorganisms. But certain plant pathogens have developed virulence factors that enable them to overcome general plant defenses. Virulence factors such as enzymes that degrade plant tissues, special structures that can pierce plant cells, or specialized metabolic pathways that can neutralize host toxins, may allow a microorganism to become pathogenic. In response, plants have developed methods to detect pathogens that can overcome pre-formed defences,

Forest and Shade Tree Diseases - Lecture 2 (2022-2023)

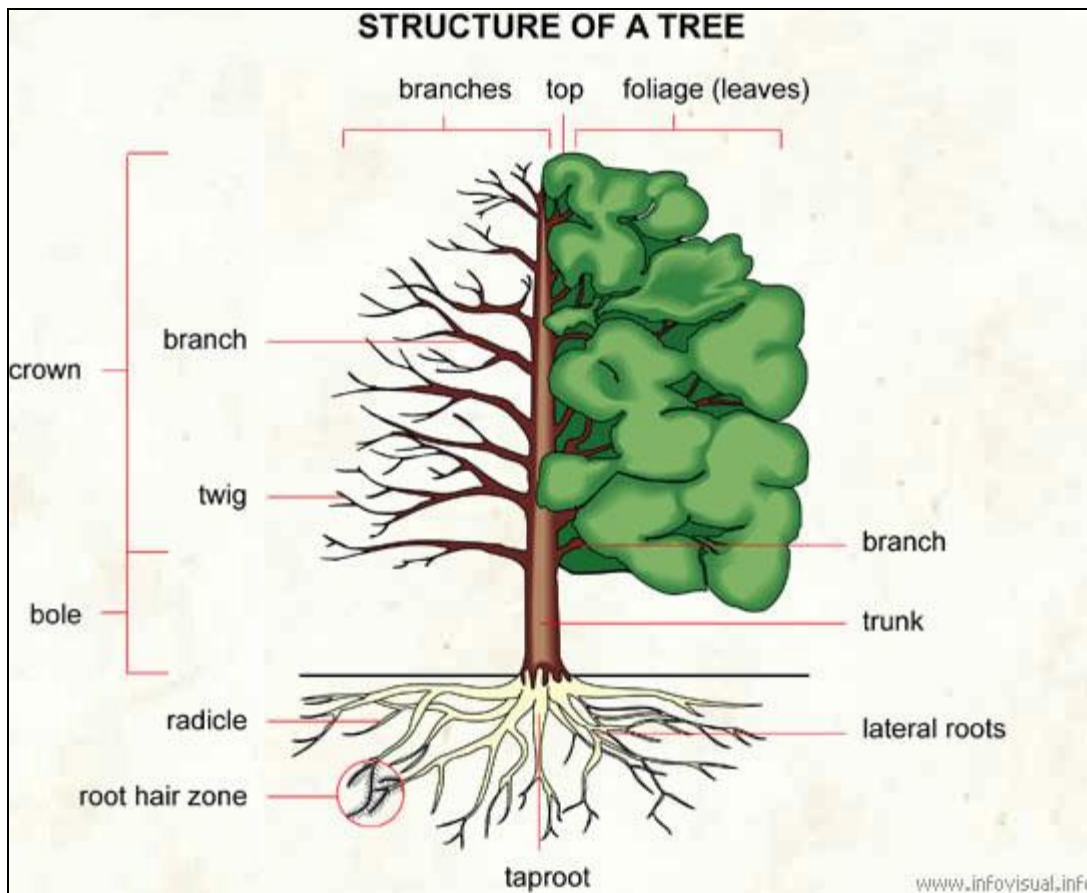
3rd Stage student, Plant Protection Dept. Assist. Prof. Dr. Ramadan Yousif Mohamed

and in response, they initiate powerful "induced" defences. When one of these pathogens is detected during the infection process, induced defences such as increased production of anti-microbial compounds or instantaneous death of infected cells can prevent the pathogen from parasitizing the plant and causing disease. Of course, pathogens continue to adapt induced plant defences by hiding the chemical signals that alert plants to an attack or adding developing additional virulence factors.

A plant that possesses the ability to prevent infection is completely **resistant** to that specific pathogen. Some resistant plants can become infected, but are able to minimize disease development and are therefore considered to be **partially resistant**. **Susceptible** plants are vulnerable to pathogen attacks that result in severe and damaging disease. Resistance and susceptibility form a continuum that ranges from completely resistant to highly susceptible. A plant can be resistant to one pathogen but susceptible to another. Each host-pathogen interaction is unique.

Forest Plant Diseases and Climate Change

Forest plant diseases are strongly influenced by weather and climate. For forest pathogenic fungi, bacteria, viruses, and other microorganisms, the temperature and moisture conditions interacting with seasonal phenology, and stress on the host determine infection severity and distribution. Extreme weather, i.e., drought or typhoons, can kill large expanses of trees directly by overwhelming tree physiological capability and structural strength. Expected changes in climate coupled with the increasing stresses of invasive species and lack of fire are creating conditions conducive for many forest plant diseases. Patterns and rates of wood decay, caused by forest fungi, are also expected to change, which will influence forest carbon cycles.



Disease and causes of disease:

Definition:

Disease is a structural and physiological disturbance of living tissues and organs in plants. Diseases of plants cause weakness of a plant or sometimes ending in death of the plant. Plant disease causes partial infection or the entire of the plant may be infected.

Causes:

Non-living or environmental

- Unfavourable conditions
- Unsuitable soil

Living organisms

- Fungi

Forest and Shade Tree Diseases - Lecture 2 (2022-2023)

3rd Stage student, Plant Protection Dept. Assist. Prof. Dr. Ramadan Yousif Mohamed

- Bacteria
- Viruses
- Nematode
- Parasitic seed plants

Recognition of disease

Symptoms:

Necrotic symptoms include spots, shot holes, etc.

Atrophic symptoms include slowing down the development of the plant (hypoplasia) as shown in dwarfing.

Hypertrophic symptoms involve overgrowth of the plant resulting of abnormal increase in the number of cells (hyperplasia). Galls and tumours are examples of this type of symptoms.

Sign

Signs are structures of the organism causing the disease visible on or near the affected plant. This appears during various stages in the development of the disease. Signs may include bacterial exudations (forcing out water or cell sap), gummosis and resinosis.

Parasitism and disease Development

Infectious diseases: are those that result from infection of a plant by a pathogen. In such diseases, the pathogen can grow and multiply rapidly on diseased plants, it can spread from diseased to healthy plants, and it can cause additional plants to become diseased, thereby leading to the development of a small or large epidemic. All plant pathogens are infectious and transmissible, meaning they can spread from one host plant to infect another.

Parasitism and pathogenicity

Parasite: is an organism that lives on or in some other organism and obtains its food from the latter.

Parasitism: the removal of food by a parasite from its host is called **parasitism**. A **plant parasite** is an organism that becomes intimately associated with a plant and multiplies or grows at the expense of the plant. The removal by the parasite of nutrients and water from the host plant usually reduces efficiency in the normal growth of the plant and becomes detrimental to the further development and reproduction of the plant. In many cases, parasitism is intimately associated with **pathogenicity**.

Pathogenicity: is the ability of a pathogen to cause disease, as the ability of the parasite to invade and become established in the host generally results in the development of a diseased condition in the host. In some cases of parasitism, as with the root nodule bacteria of legume plants and the mycorrhizal infection of feeder roots of most flowering plants, both the plant and microorganism benefit from the association, this called symbiosis or mutualism.

Symbiosis: is the phenomenon that a microorganism benefits from the association with other organisms. Of the large number of groups of living organisms, only a few members of a few groups can parasitize plants: fungi, bacteria, and mollicutes, parasitic higher plants, parasitic green algae, nematodes, protozoa, viruses, and viroids. These parasites are successful because they can invade a host plant, feed and proliferate in it, and withstand the conditions in which the host lives. Some parasites, including viruses, viroids, mollicutes, some fastidious bacteria, nematodes, protozoa,

Forest and Shade Tree Diseases - Lecture 2 (2022-2023)

3rd Stage student, Plant Protection Dept. Assist. Prof. Dr. Ramadan Yousif Mohamed

Biotrophs: the microorganism that can grow and reproduce in nature only in living hosts, and they are also called **obligate parasites**. All fungi causing downy mildews, powdery mildews, and rusts, are **biotrophs**. Other parasites (most fungi and bacteria) can live on either living or dead hosts and on various nutrient media, and they are therefore called **Non obligate parasites**. Some non obligate parasites live most of the time or most of their life cycles as parasites, but, under certain conditions, may grow saprophytically on dead organic matter; such parasites are **semibiotrophs** and are called **facultative saprophytes**. Others live most of the time and thrive well on dead organic matter (**necrotrophs**) but, under certain circumstances, may attack living plants and become parasitic; these parasites are called **facultative parasites**. Usually no correlation exists between the degree of parasitism of a pathogen and the severity of disease it can cause, as many diseases caused by weakly parasitic pathogens are much more damaging to a plant than others caused even by obligate parasites. Moreover, certain pathogens, e.g., slime molds and those causing sooty molds can cause disease by just covering the surface of the plant without parasitizing the plant.

Host range of pathogens

Pathogens differ with respect to the kinds of plants that they can attack, with respect to the organs and tissues that they can infect, and with respect to the age of the organ or tissue of the plant on which they can grow. Some pathogens are restricted to a single species, others to one genus of plants, and still others have a wide range of hosts, belonging to many families of higher plants. Some pathogens grow especially on roots, others on stems, and some mainly on the leaves or on fleshy fruits or vegetables. Some pathogens, e.g., vascular parasites, attack specifically certain kinds of tissues, such as phloem or xylem. Others may produce different effects on different parts of the same plant. With regard to the age of plants, some pathogens attack seedlings or the young tender parts of plants, whereas others attack only mature tissues.

Classification of forest diseases:

On the basis of cause:

1. Non-infectious – non-parasitic – physiological – physiogenic
2. Infectious diseases – parasitic

On the basis of hosts

1. By the type of hosts affected : Pine diseases, oak diseases, and maple diseases
2. By the type of hosts grouped for commercial purposes: fruit disease, shade tree diseases, and forest tree diseases

According of the part of the plant

1. Root diseases
2. Stem diseases
3. Foliage disease

According of various stages of development

1. Nursery diseases
2. Plantation diseases
3. Immature forest diseases
4. Merchantable forest diseases

Seed and seedling diseases:

Seed diseases:

Seeds are prone to attack by the fungi while still on the tree, during post-harvest operations in the field, storage and subsequent handling prior to sowing. The fungi may be borne as surface contaminants or they may be present in the seed coat or may penetrate the seeds even deeper attacking the embryo and thus damage the seeds to varying extents. It

Forest and Shade Tree Diseases - Lecture 2 (2022-2023)

3rd Stage student, Plant Protection Dept. Assist. Prof. Dr. Ramadan Yousif Mohamed

has been recorded that seeds of some leguminous (pod bearing) tree species are quite susceptible to attack by fungi while they are inside the pods on the trees and they are also damaged considerably in case they are not timely collected and properly stored. Number of fungi belonging to Mucorales and Fungi Imperfecti such as *Alternaria*, *Aspergillus*, *Cladosporium*, *Colletotrichum*, *Curvularia*, *Fusarium*, *Gloeosporium*, *Lasiodiplodia*, *Mucor*, *Penicillium*, *Phoma*, *Phomopsis* etc are associated with seeds of various forestry species, of which species of *Fusarium*, *Lasiodiplodia*, *Gloeosporium* and *Phoma* cause deep seated infection and damage the embryo.

Earlier reports show that seed mycoflora of neem during storage caused by *Aspergillus* spp. Also poor germination of neem seeds recorded due to *Fusarium* species. Teak seeds are attacked by a number of fungi in storage and during weathering of fruits. *Aspergillus flaus*, *A. niger*, *Chaetomium globosum*, *Curvularia pallescens*, *C. lunata*, *Fusarium moniliforme*, *F. oxysporum*, *Marasmius* sp. and *Stachybotrys atra*. Researchers isolated *Alternaria* sp., *Penicillium lanosum* and *Trichoderma viride* from seed coat and *Fusarium* sp. and *Helminthosporium* sp. from embryo of teak seeds. Pods of *Dalbergia sissoo* is attacked by *Phoma* sp. Other fungi recorded on pods include *Glomerella cingulata* and *Septothyrella dalbergiae*. *Fusarium* spp. on seeds of *Albizia lebbek* have been found to cause both pre-emergence and post-emergence damping-off disease together with *Rhizoctonia solani*, a soil inhabitant fungus.

Control measures of seed diseases

- **Proper storage of seeds.** Presence of contaminated or infected seeds in the seed lot may cause considerable spoilage of seeds particularly by moulds.

- **Timely collection**, proper drying and storage of seeds under suitable temperature and humidity are necessary to protect the seeds from biodeterioration. The seeds after collection should be dried so that the seed moisture content is reduced to about 10% on oven dry weight basis.
- **Seed dressing with a suitable fungicide.** This prophylactic (intended to prevent disease or infection) treatment is easy and economical and serves the dual purpose: firstly it helps in preventing fungal deterioration of seeds in storage and secondly it minimizes the chances of seed borne pathogenic fungi attacking the seedlings in the nursery.

Seedling diseases:

- Seedlings are susceptible to fungi that cause seed rot, damping-off, and root rot.
- Most seedling diseases are caused by fungi that live in soil (soilborne fungi).
- These fungi include Pythium species, and Rhizoctonia solani.
- Fungi that cause seedling diseases produce similar symptoms, so positive identification of the pathogen(s) that cause stand loss should be verified.
- Sometimes only one pathogen causes disease in a field.
- In other cases, two or more pathogens attack plants in the same field, or even the same plant, and result in a seedling disease
- **"complex." Ways to determine the cause(s) of seedling stand establishment problems include:**
 1. Laboratory analysis of symptomatic plants.
 2. Assay of soil samples.
 3. Knowledge of field history.