COURSE CODE: *BOT 425*
COURSE TITLE: *Plant Mycology*
NUMBER OF UNITS: *2 Units*
COURSE DURATION: *2 Hours per week*

COURSE DETAILS:

Course Coordinator: Dr. (Mrs.) I.A. Kehinde, *B.Sc., M.Sc., Ph.D.*
Email: iakipm2004@gmail.com
Office Location: COLNAS
Other Lecturer: None

COURSE CONTENT:

Principles and concepts in plant pathology, causes of host-parasite relationship, infection and pathogenesis. Culture of fungi, Diagnostic features, recognition and control, diseases of major importance.

COURSE REQUIREMENTS:

The course is compulsory for all 400 level students of Botany option of the Biological Sciences Department. The students are expected to attend and participate fully in all the theory and practical classes with not less than 70% attendance.

READING LIST:

1. **Agrios, G.N.** ***Plant Pathology.*** **Elsevier Academic Press, New York.**
2. **Oudejans, J.H.** ***Agro-pesticides, Properties and Function in Integrated Crop Protection.***

LECTURE NOTES

Pathogen is what causes diseases on plants.
Wilting is caused by a fungus
Plant pathology is defined as the study of plant disease.

A plant can be said to be diseased when there is an harmful deviation from the normal functioning of the physiological process

A disease can easily be known when there is continuity. A plant may be damaged but not diseased.

A disorder may be caused by non-parasitic agents such as adverse soil condition.

A pathogen is any agent which causes damage it is generally used for living organism some capable of attacking plants e.g. fungi and bacteria.

A parasite is an organism or virus living in or on a living organism, deriving requirements needed for its growth but the host does not derive anything in return. A parasite is also a pathogen if it causes disease.

A pathogen which obtains nourishment from the living cell of the host is said to be a BIOTROPH

The one killing the host cells and living on the dead remains is known as the NECROTROPH

The one living 1st as a biotroph then later becomes a necrotroph is known as HEMIBIOTROPH

Most but not all pathogens are also parasite in that they derive the materials they need for growth from a living plant.

An obligate pathogen (Biotroph) cannot be grown in the absence of the host or can be said to be restricted to the living tissue.

Facultative pathogens are those which can be grown in artificial culture and are able to colonize both living and dead tissues.

Saprophyles (saprobes) derive the materials needed by them from dead organic matter.

A disease is a condition of abnormal structure and or function in a plant resulting from the plant interaction with a causal agent and characterised by certain symptoms and signs.

A symptom is a visible or otherwise, detectable expression of abnormal physiological, development, or behavior in a plant resulting from disease. Symptoms often involve changes in form, colors, odor, texture and structure.

SIGNS: Any observable part or remnant of the causal agent (pathogen) on / around the host. Common signs include vegetative or reproductive structure of the pathogens (mycelium or spores)

Different symptoms found in the plant

Death or disintegrating of the cell tissues and or organs, discoloration of the pathogen (yellow, purple etc) wilting, abnormal growth and development e.g. tumor formation, lack of seed formation or the curling of leaves.

Wilting: This is a form of drying caused by the interference of the normal supply and movement of water into pathogen.

Rot: Disintegration of tissues which can be accompanied by release of cell fluid such that there is an exuding from the partially disintegrated tissue.

Soft rot: The rotten part is soft and moist.

Dry rot: Rotten part relatively dry and firm

Mummification: Shriveling and wrinkling in fruits

Damping off: Like wilting but in emerging or very young seedling.

Defoliation: This is the shedding of the whole organ. The flower or bud of fruits can be shed i.e bud drop or flower drop.

Necrosis generally means death of plant tissue.

THE CAUSES OF DISEASES

Plant growth can be limited by some numbers of factors, such as non-parasitic inanimate or non transmissible causes and those due to parasitic, animate and transmissible agents. Certain diseases caused by viruses or macro plasma – like organisms closely resemble non-parasitic diseases in their symptoms.

DISEASES DUE TO NON-PARASITIC AGENTS/CAUSES

It is non-transmissible. Immediately the causal factor is removed, it gets back to performing well. Although the damages that can be done may cause a set back in the growth rates, the damage can also predispose plants to attack by pathogen.

The non-transmissible factors include:-

1. Adverse climatic conditions such as low temperature, adverse soil condition
2. Mechanical and Chemical injury.
3. Adverse soil condition could be by mineral deficiency or in excess of it.
4. Disturbances due to genetic origin such as chlorosis, cutting, dwarfing,, variegation.
5. Other factors such as drought can bring about wilting and eventually death of the plant

Disease could also be caused by combination of these factors.

DISEASES DUE TO PARASITIC AGENTS

The 2 major groups of organs which feed saprophytically and obtain nourishment by secreting extracellular enzyme into the medium in which they are feeding are the fungi and bacteria.

These organisms were thought not to be able to cause diseases in living organs due to some physical and chemical barrier, but due to their wide range of carbohydrate splitting enzymes, they are mostly important in plants. The viruses are becoming more rampant while bacteria due to their ability to breakdown protein are more important in animals. It can be said that the main causes of diseases in plant in the order of importance are:

Fungi, Viruses, Mycoplasma like organs, bacteria and parasitic flowering plants.

CONCEPT OF PLANT DISEASES

Usually a disease causes a progressive and continuous disturbance of cellular activities that eventually become manifest as symptom.

In the case of the fungal infection, the fungus keeps growing until it reaches the reproductive phase and starts to reproduce. The time that passes between the infected spot is known as the latency period.

The latency period is followed by the infection period during when the fungus produces a certain number of spores per day. The spores produced are dispersed and can start a new infection at other parts of the plant where a new cycle of the fungus begins again..

An infection may remain latent as an in apparent chronic infection that gives no sign of its presence (symptomless infection). In the case of many symptoms-less virus infection, the virus may vigorously multiply in the host. Such host are carriers of the virus.

Tolerance is the ability of a host to endure infection by a particular pathogen. The term tolerance is used when there is an apparent non-restricted and extensive colonization by a parasitic organism or virus.

Infection : invasion of the tissue by bacteria viruses, fungi and other internal parasites.

Infestation: Invasion of the body by organisms such as ticks or mites, which remain on the surface and do not enter the tissues.

Resistance: Absence of symptoms because infection and colonization have been restricted in their activity by the host defensive response implies resistance not tolerance.

The establishment of a parasitic relationship is known as infection i.e. the entry of a pathogen successfully into a susceptible pathogen, a host that is exempt to infection is said to be immune. Following infection is colonization i.e. the advance of pathogen within the tissue of the host. If specie is strictly confined to the tissue of the host in nature, they can sometimes be referred to as ecologically obligate pathogens. If infection is confined to just one part of the host, it is said to be a local infection.

If the pathogen spreads through the plant from a single point of infection so as to infect all or most part of the host, although often seeming to have little adverse effect on the tissue through which it grows or is transported, it is said to be a systemic infection

Virulence has been used to denote qualitative rather than quantitative differences in pathogenicity while aggressiveness is used to describe the capacity of a parasite to invade or grow in its host plant and to reproduce on or in it more rapidly than others (highly aggressive). Aggressiveness can also be used to measure pathogenicity.

THE HOST – PARASITE (PATHOGEN) RELATIONSHIP

The spreading of a disease depends on 2 factors.

1. Time
2. Environment

The time determines the cause of the disease as the pathogen population increases with the passage of time. Environmental factors such as climatic, soil conditions and cultivation methods have a great influence on the activity and development of the parasite and on the expression of the disease symptom.

The host – parasite relationship involves one living organism, the host that harbors another living organism or virus (the parasite). The latter being dependent on that host for its existence. It is obvious that the effect of such intimate co-existence depends not only on the hereditary properties of each of the partners but also on the environmental conditions which have great influence. The way an organism manifests itself (the phenotype) is the result of the interaction between its genotype and the environment.

The growth of the parasite in a host usually results in an increase that is detrimental to plants. However, there is a protective mechanism which may either prevent the parasite from establishing itself in the host or strangulate the developing parasite. Such a pathogen is therefore said to develop some resistance to the parasite. The ability of the host to show resistance to the pathogen makes infection an exception rather than a rule. The resistance can either the in-built or induced (defence).

RESISTANCE BY PROTECTION

Such protection may be:

1. Structural
2. Chemical
3. Absence of nutrients.

RESISTANCE BY DEFENSE: In case the resistance by protection fails and the pathogen succeed in entering the plant tissue, resistance by defense may develop whereby a dynamic mechanism set in to defend the host.

AGGRESIVENESS

This is the capability of the pathogen or the virus to infect a host pathogen. The term is used particularly in a gradual sense and is measured by the degree of infection. However, the degree of infection is also determined by the susceptibility or resistance of the host.

SUSCEPTIBILITY

This is the inability of the host to prevent the development of the parasite thus not defending itself against infection by a pathogenic organism or virus.

VIRULENCE

Virulence is the observed capacity of a pathogen to infect certain genotypes of a host plant.. In reference to genotypes which cannot be infected, the term avirulence is used.

The term pathogenicity indicates in general the disease generating capacity of biotical and abiotical factors.

A parasite is not regarded to be a pathogen if it lacks virulence.

VULNERABILITY

This is the inability of the host to defend itself against infection by parasite or infestation by phytophages.

MAIN CATEGORIES OF PLANT DISEASES

As to the cause of the malfunctioning of processes in plants, a distinction can be made between infections and non-infections diseases.

INFECTIOUS DISEASE: are caused by pathogenic organisms. Pathogens include parasitic fungi, bacteria and protozoan as well as mycoplasmas and viruses.

NON INFECTIOUS DISEASES: are malfunctioning caused by hereditary and genetic defect. Abiotic factor causing diseases include adverse soil conditions, deficiency or excess of certain nutrients, adverse meteorological conditions, environmental pollution and industrial contaminant.

ESTABLISHMENT OF PLANT DISEASES

In order to establish the host – pathogen relationship, the pathogen must first arrive at the surface of host then followed by the penetration of the host, then development of the organ like a germ – tube of a geminating spore usually during this stage, there are no visible symptoms and the period referred to as membation stage which may in turn lead to the on ward recognition of the first symptom as the host gets infected. The relationship may not reach or pass the membation stage of the host since plants put up effective resistance either by protection or defense. .

For a conclusion to be made about the causative agent of a particular disease, some steps need to be taken and this is because though an organ may be present or in association with the lesion, it does not necessary mean that is caused the disease because there could be the secondary invader. In 1884, Koch laid down some conditions to be fulfilled before an organism can be confirmed as the causative organ.

KOCH POSTULATE

1. The organism must be consistently associated with the lesion of the disease.

2. The organism must be isolated and grown in pure culture, free from all other organism

3. The organism from pure culture must be inoculated on to healthy plants of the same species from which it was originally isolated and must reproduce the same disease as was originally observed.

4. The organism must be re-isolated and re-inoculated and must once again reproduce the

original disease. In case of an obligate pathogen, inoculation is unto a healthy host

PLANT DISEASE DIAGNOSIS

The diagnosis of pathogen diseases is one of the most important and useful technique to be learnt in pathogen pathology. To diagnose a plant disease successfully, the characteristics of the organism that caused the disease or symptoms and signs associated with

the major type of diseases and the test to confirm the organism and the basic for classification of that pathogen needs to be understood. Plant disease diagnosis is designed to recognize the primary disease causing agent. The majority of pathogen disease can be diagnosed by a relatively straight forward procedure, an evaluation of background information and a macroscopic and often microscopic examination of the diseased pathogen. However, some diseases can only be diagnosed currently through the use of sophisticated tools such as an serology.

STEPS IN DISEASE DIAGNOSIS

1. Obtain background, information on hoot and disease
2. Obtain a good sample of diseased plant.
3. Examine pathogen and describe symptoms and signs of disease.
4. Obtain literature describing diseases for the host.
5. Identify disease by accompanying your description of disease with published descriptions.

PESTICIDES

Pesticides have played and will continue to play a great note in increasing agricultural production and in securing the supply of food and fibres needed by the people of the world. It is essential that the reasons for using pesticides and the consequences of mis-using them be carefully analyed in order to obtain maximum benefit from their application while at the same time, preventing their possible hazardous effect on non target organism and the environment.

ADVANTAGES OF CHEMICDAL CONTROL

1. It in an effective and reliable means for controlling pests and diseases and preventing losses in fields and in storing.

2 They offer protection against many diseases

3. Most pesticides demonstrate fast activities by which serious infection and outbreaks can be limited or possibly controlled.

4. Chemical control is effective under very diverse ecological condition and it is less dependent on scale of the operation than the various form of cultural and biological control.

DISADVANTAGES OF CHEMICAL CONTROL

1. Many pesticides cause the development of resistance in organism
2. Pesticide having a persistent activity may destroy the natural enemy complex.
3. Improper application of pesticides may cause unwanted or hazardous effect with regards to specific sensitivity of the target organism and natural enemies,
4. Cost of pesticide is rising steadily.
5. The inherent toxicity of pesticides and the long persistence cause environmental contamination.

INTEGRATED PEST MANAGEMENT (IPM)

IPM has been defined as a pest management system that in the context of the associated environment to the population dynamics of the past species, utilizes all suitable technique and methods in as compactable a manner as possible and maintains the pest population at levels below those causing economic injury.

ECONOMICALLY IMPORTANT CROP

Cocoa is one of the most important cash crop grown by farmers in central and West Africa.

ECONOMIC IMPORTANCE OF COCOA

It is a perenmial crop which may yield for up to 30years and all the part of the plant have one use or the other but the most important of them is the fruit (pod). Cocoa has been used as sources of chocolate and various chocolate based product. The cocoa powder is used in making cakes biscuits, bread, bournvita, ice cream e.t.c. The cocoa bean also serves as a source of wine. The fruit wall is fibrous and is used in soap making. The leaves of cocoa are locally used for wrapping fruit and when they drop from the tree, they serve as a good organic manure. The stem is locally used for firewood.

DISEASES OF COCOA

(1) Black pod (fungi)

This has been the primary fungal disease affecting cocoa production worldwide since the 1920's.A detailed study of the taxonomy of the species of phytopthora affecting cocoa proposed 3 species *Phytopthora palmivora*, *Phytopthora megakarya* and a third species, tentatively identified as *Phytopthora capsici*. This latter species closely resembles black pepper fungus *Phytopthora capsici* but it might prove to be a new specie.

Phytopthora palmivora has a worldwide distribution on cocoa *Phytopthora megakarya* is confined to several countries of West Africa and *Phytopthora capsici* to South America, central America and the west indies.

The major economic loss is from infection of the pod. Economic loss arises from infection during the 2 months prior to ripening. Pods infected and this stage can be a total loss because the fungus can easily pass from the pod husk to the coat of bean in a developing green pod.

CONTROL MEASURES.

CHEMICAL CONTROL OF BLACK POD.

Chemical control of black pod by spraying copper fungicide is a well established control of black pod.

CULTURAL PRACTICES

Cultural control forms an important part for Phytopthora pod rot management in Cameroon. This method is based on the reduction of relative humidity and the quantity of the inoculum in Cocoa farms. Achieving this objective in Cameroon include regular weeding, pruning of cocoa trees, sanitation and shade management in cocoa farms.