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PLANT PATHOLOGY: THE STUDY OF PLANT DISEASES

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ABSTRACT

Plant Pathology is a branch of agricultural science that deals with the study of fungi, bacteria, viruses, nematodes, and other microbes that cause diseases of plants. Plants diseases and disorders make plant to suffer, either kill or reduce their ability to survive/ reproduce. Any abnormal condition that alters the appearance or function of a plant is called plant disease. The term 'Pathology' is derived from two Greek words 'pathos' and 'logos', 'Pathos' means suffering and 'logos' Means to study/ knowledge. Therefore Pathology means "study of suffering". Thus the Plant Pathology or Phytopathology is the branch of biology that deals with the study of suffering plants. It is both science of learning and understanding the nature of disease and art of diagnosing and controlling the disease. This paper is a modest attempt to study the impact of Plant Diseases.

KEYWORDS: *Pathogen, Plant Disease, Plant Pathology, Microorganisms.*

INTRODUCTION

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.

CONCEPT OF PLANT DISEASE

The normal physiological functions of plants are disturbed when they are affected by pathogenic living organisms or by some environmental factors. Initially plants react to the disease causing agents, particularly in the site of infection. Later, the reaction becomes more widespread and histological changes take place. Such changes are expressed as different types of symptoms of the disease which can be visualized macroscopically. As a result of the disease, plant growth in reduced, deformed or even the plant dies. When a plant is suffering, we call it diseased, i.e. it is at 'dis-ease'. Disease is a condition that occurs in consequence of abnormal changes in the form, physiology, integrity or behaviour of the plant. According to American Phytopathological Society (Phytopathology 30:361-368, 1940), disease is a deviation from normal functioning of physiological processes of sufficient duration or intensity to cause disturbance or cessation of vital activities. The British Mycological Society (Trans. Brit. Mycol. Soc. 33:154-160, 1950) defined the disease as a harmful deviation from the normal functioning of process. Recently, Encyclopedia Britannica (2002) forwarded a simplified definition of plant disease. A plant is diseased when it is continuously disturbed by some causal agent that results in abnormal physiological process that disrupts the plants normal structure, growth, function or other activities. This interference with one or more plant's essential physiological or biochemical systems elicites characteristic pathological conditions or symptoms.

IMPACT OF PLANT DISEASES ON MANKIND

Plant diseases have impacted man's ability to grow plants for food, shelter, and clothing since he began to cultivate plants. Drawings and carvings of early civilizations in Central America depict corn plants with drooping ears and poor root systems. Crop failures for ancient man and through the middle ages were common, and plant diseases were often attributed to displeasure of various deities. The Roman god Robigus was thought to be responsible for a good wheat harvest and Romans prayed to him to prevent their wheat crop from being blasted with fire (rust). In more modern times (since 1800), plant diseases have destroyed military plans of monarchs; changed cultures; caused mass migrations of people to avoid starvation; resulted in loss of major components of forest communities; and bankrupted thousands of planters, companies, and banks.

DIAGNOSIS OF PLANT DISEASES

Rapid and accurate diagnosis of disease is necessary before proper control measures can be suggested. It is the first step in the study of any disease. Diagnosis is largely based on characteristic symptoms expressed by the diseased plant. Identification of the pathogen is also essential to diagnosis. Three steps involved in diagnosis include careful observation and classification of the facts, evaluation of the facts, and a logical decision as to the cause.

VARIABLE FACTORS AFFECTING DIAGNOSIS

A skilled diagnostician must know the normal appearance of an affected plant species, its local air and soil environment, the cultural conditions under which it is growing, the pathogens described for the area, and the disease-developing potential of the pathogen. Diagnosis is best done in the presence of the growing plant. Disease is suspected when, for example, part or all of a plant begins to die. Disease also is indicated when blossoms, leaves, stems, roots, or other plant parts appear abnormal—i.e., misshapen, curled, discoloured, overdeveloped, or underdeveloped. Diseased plants also often fail to respond normally to fertilizing, watering, pruning, insect and mite control, or other recommended practices.

Conditions other than infection with a pathogen, however, may produce similar or identical symptoms. Some of these have been described, but numerous other conditions must be considered as well when plants are adversely affected. For example, an affected plant may not be adapted to the area in which it is growing. It may not be able to withstand the extremes in soil moisture, temperature, wind, light, or humidity of the local situation. Damage to plants may be caused by insects, mites, rodents, pets, or humans. The soil may be poorly drained, gravelly, or overly sandy; it may be covering buried debris such as boards, cement blocks, bricks, or mortar; or it may be too dry or otherwise unfavourable for good plant growth. Problems also are caused by high winds, hail, lightning, blowing sand, a heavy load of snow or ice, flooding, fire, ice-removal chemicals, mechanical injury by garden tools or machinery, and fumes from weed-killing chemicals, trash burners, nearby industrial plants, or motor vehicles. The affected plant may have received treatment different from nearby healthy ones—watering, fertilizing, pest control, pruning, or depth of planting, for example. If different species or kinds of plants in the same area have similar symptoms, the chances are that a pathogen is not involved. Most infectious diseases are highly specific for individual or closely related plant species, and similar symptoms on unrelated plants are usually an indication of some environmental factor rather than a disease-causing organism.

Examination of leaves is usually considered to be the best starting point in diagnosis. The colour, size, shape, and margins of spots and blights (lesions) are often associated with a particular fungus or bacterium. Many fungi produce "signs" of disease, such as mold growth or fruiting bodies that appear as dark specks in the dead area. Early stages of bacterial infections that develop on leaves or fruits during humid weather often appear as dark and water-soaked spots with a distinct margin and sometimes a halo—a lighter-coloured ring around the spot.

Low winter temperatures and late spring or early fall freezes cause blasting (sudden death) of leaf and flower buds or sudden blighting (discoloration and death) of tender foliage. Insect-injured leaves usually show evidence of feeding, such as holes, discoloration, stippling, blotching, downward curling, or other deformations. Scorching of leaf margins and between the veins is common following hot, dry, windy weather. Similar symptoms are produced by an excess of water, an imbalance of essential nutrients, an excess of soluble salts, changes in the soil water table or soil grade, gas or fume injury, and root injury or disease. Viral diseases, such as mosaics and yellows, are sometimes confused with injury by a hormone-type weed killer, unbalanced nutrition, and soil that is excessively alkaline or acid. Nearby plant species are often examined to see if similar symptoms are evident on several different types of plants.

Examination of stems, shoots, branches, and trunk follows a thorough leaf examination. Sunken, swollen, or discoloured areas in the fleshy stem or bark may indicate canker infection by a fungus or bacterium or injury caused by excessively high or low temperatures, hail, tools, equipment, vehicles, or girdling wires.

Fruiting bodies of fungi in or on such areas often indicate secondary infection. Accurate identification of signs as belonging to a pathogenic organism or a secondary or saprophytic one is difficult. Tissues directly infected by pathogenic fungi or bacteria normally show a gradual change in colour or consistency. Injuries, in comparison, are usually well defined with an abrupt change from healthy to affected tissue.

Holes and sawdustlike debris are evidence of boring insects that usually invade woody plants in a low state of vigour. Other borer indications include wilting and dieback (progressive death of shoots that begins at tip and works downward). These symptoms also are produced by fungi and bacteria that invade water- and food-conducting vascular tissue.

Symptoms of wilt-inducing microorganisms include dark streaks in sapwood of wilted branches when the wood is cut through at an angle. Abnormal suckers or water sprouts on trees can indicate careless pruning, extremes in temperature or water supply, structural injury, or disease.

Galls, which are unsightly overgrowths on stem, branch, or trunk, may indicate crown gall, insect injury, water imbalance between plant and soil, or other factors. Crown gall is infectious and develops as rough, roundish galls at wounds, resulting from grafting, pruning, or cultivating.

Wood-decay fungi also enter unprotected wounds, resulting in discoloured, water-soaked, spongy, stringy, crumbly, or hard rots of living and dead wood. External evidence of wood-decay fungi are clusters of mushrooms (or toadstools) and hoof- or shelf-shaped fungal fruiting structures, called conks, punks, or brackets.

Aboveground symptoms of many root problems look alike. They include stunting of leaf and twig growth, poor foliage colour, gradual or sudden decline in vigour and productivity, shoot wilting and dieback, and even rapid death of the plant. The causes include infectious root and crown rot; nematode, insect, or rodent feeding; low temperature or lightning injury; household gas injury; poor soil type or drainage; change in soil grade; or massive removal of roots in digging utility trenches and construction.

Abnormal root growth is revealed by comparison with healthy roots. Some nematodes, such as root knot (Meloidogyne species), produce small to large galls in roots; other species cause affected roots to become discoloured, stubby, excessively branched, and decayed. Bacterial and fungal root rots commonly follow feeding by nematodes, insects, and rodents.

Diagnosis of a disease complex, one with two or more causes, is usually difficult and requires separation and identification of the individual causes.

SYMPTOMS

The variety of symptoms, the internal and external expressions of disease, that result from any disease form the symptom complex, which, together with the accompanying signs, makes up the syndrome of the disease.

Generalized symptoms may be classified as local or systemic, primary or secondary, and microscopic or macroscopic. Local symptoms are physiological or structural changes within a limited area of host tissue, such as leaf spots, galls, and cankers. Systemic symptoms are those involving the reaction of a greater part or all of the plant, such as wilting, yellowing, and dwarfing. Primary symptoms are the direct result of pathogen activity on invaded tissues (e.g., swollen "clubs" in clubroot of cabbage and "galls" formed by feeding of the root knot nematode). Secondary symptoms result from the physiological effects of disease on distant tissues and uninvaded organs (e.g., wilting and drooping of cabbage leaves in hot weather resulting from clubroot or root knot). Microscopic disease symptoms are expressions of disease in cell structure or cell arrangement seen under a microscope. Macroscopic symptoms are expressions of disease that can be seen with the unaided eye. Specific macroscopic symptoms are classified under one of four major categories: prenecrotic, necrotic, hypoplastic, and hyperplastic or hypertrophic. These categories reflect abnormal effects on host cells, tissues, and organs that can be seen without a hand lens or microscope.

SIGNS

Besides symptoms, the diagnostician recognizes signs characteristic of specific diseases. Signs are either structures formed by the pathogen or the result of interaction between pathogen and host—e.g., ooze of fire blight bacteria, slime flux from wetwood of elm, odour of tissues affected with bacterial soft rot.

TECHNOLOGICAL ADVANCES IN THE IDENTIFICATION OF PATHOGENIC AGENTS

Developments in microscopy, serology and immunology, molecular biology, and laboratory instrumentation have resulted in many new and sophisticated laboratory procedures for the identification of plant pathogens, particularly bacteria, viruses, and viroids. The techniques of traditional scanning microscopy and transmission electron microscopy have been applied to immunosorbent electron microscopy, in which the specimen is subject to an antigen-antibody reaction before observation and scanning tunneling microscopy, which provides information about the surface of a specimen by constructing a three-dimensional image.

Serological tests have been made more specific and convenient to perform since the discovery of a technique to produce large quantities of monoclonal antibodies, which bind to only one specific antigen. The sensitivity of antigen-antibody detection has been significantly increased by a radioimmunoassay (RIA) procedure. In this procedure a "known" antigen is overlayed on a plastic plate to which antigen molecules adhere. A solution of antibody is applied to the same plate; if the antibody is specific to the antigen, it will combine with it. This is followed by the application of radioactively labeled anti-antibody, which is allowed to react and then washed off.

The radioactivity that remains on the plate is a measure of the amount of antibody that combined with the known fixed antigen. Another highly sensitive immunoassay is the enzyme-linked immunosorbent assay (ELISA). In principle this assay is similar to the RIA except that an enzyme system, instead of radioactivity, is used as an indicator of an antigen-antibody combination.

New analytic methods in molecular biology have made genetic studies for the characterization and identification of bacteria more practical. The DNA hybridization technique is an example. A strand of DNA from a known species (the probe) is radioactively labeled and "mixed" with DNA from an unidentified species. If the probe and the unknown DNA are from identical species, they will have complementary DNA sequences that enable them to bind to one another. Bound to DNA from the unknown species, the probe acts as a marker and identifies the bacteria.

The growing demand for quick identification of microorganisms has resulted in the development of instrumentation for automated technology that allows a large number of tests to be performed on many specimens in a short period of time. The results are read automatically and analyzed by a computer program to identify the pathogens.

MEASURES OF DISEASE CONTROL

Successful disease control requires thorough knowledge of the causal agent and the disease cycle, host-pathogen interactions in relation to environmental factors, and cost. Disease control starts with the best variety, seed, or planting stock available and continues throughout the life of the plant. For harvested crops, disease control extends through transport, storage, and marketing. Relatively few diseases are controlled by a single method; the majority require several approaches. These often need to be integrated into a broad program of biological, cultural, and chemical methods to control as many different pests—including insects, mites, rodents, and weeds—on a given crop as possible.

Most control measures are directed against inoculum of the pathogen and involve the principles of exclusion and avoidance, eradication, protection, host resistance and selection, and therapy.

Plant pathology, the study of plant diseases and their causes, is crucial for several reasons:

1. **Food Security**: Plant diseases can significantly impact crop yields. Understanding and managing these diseases is essential for ensuring sufficient food production to meet the needs of a growing global population.
2. **Economic Impact**: Crop losses due to diseases can lead to substantial economic losses for farmers and the agricultural industry. Effective disease management can improve profitability and sustainability in agriculture.
3. **Biodiversity Conservation**: Plant pathogens can threaten biodiversity by impacting native plant species and disrupting ecosystems. Studying plant pathology helps in developing strategies to protect endangered species and maintain ecological balance.
4. **Sustainable Agriculture**: Knowledge of plant diseases contributes to the development of sustainable agricultural practices. This includes integrated pest management (IPM) strategies that reduce reliance on chemical pesticides, promoting healthier ecosystems.
5. **Research and Innovation**: Plant pathology drives research in areas such as genetics, microbiology, and biotechnology. Innovations in disease-resistant crop varieties can lead to more resilient agricultural systems.
6. **Climate Change Adaptation**: As climate change affects plant health and disease patterns, understanding these dynamics helps in developing adaptive strategies for agriculture.
7. **Public Health**: Some plant pathogens can affect human health directly (e.g., mycotoxins from fungal infections) or indirectly through food supply chains. Monitoring and managing plant diseases is important for public health safety.

CONCLUSION:

In summary, plant pathology plays a vital role in agricultural productivity, economic stability, environmental conservation, and public health, making it a critical field of study in addressing global challenges.

REFERENCE

1. http://www.jnkvv.org/PDF/04042020185331SKT.pdf
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-pathology#:~:text=Plant%20pathology%20is%20a%20science,parasitic%20microorganisms%20that%20cause%20disease.

3. https://agri-bsc.kkwagh.edu.in/uploads/department_course/PATH-_121_FUNDAMENTALS_OF_PLANT_PATHOLOGY.pdf
4. https://agritech.tnau.ac.in/pdf/Plant%20Pathology_%20Concepts%20and%20Laboratory%20Exercises_240131_100459.pdf
5. https://www.britannica.com/science/plant-disease/Symptoms
6. https://www.quora.com/What-is-the-importance-of-plant-pathology