Plant Disease - various control measures

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Introduction:

Plant disease may be defined simply as a malfunctioning process in the plant as a whole or any part of it caused by any of the several factors. The study of plant disease is called Phytopathology or Plant pathology.

According to G. N. Agrios (1978), plant pathology is the study of-

a. The living entites and the environmental conditions that cause diseases in plants.
b. The mechanisms by which these factors produce disease in plants.
c. The interaction between the disease-causing agents and the diseased plants.
d. The methods of preventing disease, alleviating the damage it causes, or controlling a disease either before or after it develops in a plant.

Plant diseases are caused by physical, chemical or biological factors of the environment. Disease caused by biotic agents such as viruses, bacteria, fungi, nematodes etc. Disease caused by physical or chemical factors such as air pollution, water, frost, nutrition, etc. many plant diseases result from multiple factors, some of which are biotic (internal) and other abiotic (external); the role of each factor is determined by the environment.

The purpose of plant pathology is developing control for all plant disease. The object is also to save the yield which is destroyed by plant disease and to make it available to the cultivators and to the hungry and ill-clothed people of the world.

Principles of Plant Disease Control:

Study of plant pathology to acquire information on system, caused and mechanisms of development of plant disease in no doubt interesting and scientifically justified; the solution of control problem is the ultimate purpose of the plant pathology.

Depending upon the types of pathogen, the host and either interaction, control methods vary from one disease to another. Therefore control measures for the disease of a particular plant or plant population are to be planned according to the nature of the pathogen, its mode of perennation and method of spread.

The various control measures may be divided as- (a) Regulatory, (b) Cultural, (c) Biological, (d) Physical and (e) Chemical depending on the nature of the agents employed to control the disease.

A. ***Regulatory methods:*** These methods are employed in order to prevent the import and spread of pathogens into the country or individual states. Regulatory control measure is implemented by means of quarantines and inspections of plants in the field or warehouse and often by eradication of some host plants.
   - **Quarantines and inspections**- There are lost evidences to indicate that many of the plant pathogens have been introduced unknowingly from one country to the other where such pathogens did not exist before. Plant quarantines are steps taken by a country or state through legislation to prevent the entry of foreign plant pathogens present in diseased planting materials into the country. In order to keep out foreign plant pathogens and to protect the countries farms, gardens, forests, etc., the quarantine measures prohibit or restrict entry into country or state from foreign countries. Several voluntary inspection system of plant materials for planting are also introduced in different countries or states, for the purpose of controlling the entry or disease producing pathogens.

B. ***Cultural methods:*** Under this, the 'control is achieved through the activities of man and through the genetic or cultural manipulation of plants, but without the use of any biological, physical or chemical agents.' Some of the objects of these methods are to eliminate the

pathogen from the plant or form the area in which the plants grow, while other objects are to increase the resistance of the host to the pathogen or to create conditions unfavorable to the pathogen and also to obtain pathogen-free propagative materials from infected plants.

- **Host eradication**- When a pathogen has been introduced in a new area inspite of quarantine or quarantines have not been established in time to prevent such introduction or to prevent the introduction of new pathogens from diseased host plants, all the host plants should be removed and burned - this measure also results in elimination of the pathogen that host plants carry and in prevention of greater losser from the spread of the pathogen to more plants, host eradication to prevent the spread of many diseases is also carried out in fields, nurseries, greenhouse, etc. through elimination of the ready source of inoculums within the crop.
- **Crop rotation**- It is obvious that continuous cropping in a particular field provides the opportunity for perpetuation and intensification of pathogenic organisms. Soil pathogens attacking plants of one species can be often eliminated from the soil by planting crops, belonging to other species not attacked by the pathogen, for 3 or 4 years.
- **Sanitation**- This practice includes all measures aimed at eliminating or reducing the amount of inoculum present in a plant, field or warehouse and at preventing the spread of the pathogen to other healthy plans and plant products.
- **Improvement of growing conditions of plants**- It has been observed that the vigour of the plant often help to increase the resistance against pathogen attack.
- **Creating unfavourable conditions to the pathogen**- Proper aeration of stored plant products dries up their surface rapidly and inhibits the germination and infection by bacterial and fungal pathogens present on them.
- **Tissue culture**- Control of the vascular diseases of some ornamental plant propagating by cuttings may be done through tissue culture of the meristem tips, because those pathogens are

unable to reach the apical meristems until very late stages of the disease free cuttings for creating new healthy plants.

C. ***Biological methods:*** Plant disease may be controlled biologically by selecting and breeding plants for resistance to particular pathogens or by using some other micro-organisms which are either antagonistic to the pathogens itself.

- **Breeding and use of resistant varieties**- The best methods of controlling plant disease would be by means of resistant varieties. If plant varieties resistant to disease could be found or developed, then all crop-losses resulting from disease could be avoided. A few plants among the diseased remain virtually unaffected by the pathogen those survivor plants probably remain healthy because of their resistance characters; if such plants are propagated asexually and continue to be resistant to pathogen for several years, they may become the stoke plants for the development of resistant varieties.
- **Cross protection and interference**- The term cross protection is used specifically for the protection of a plant by a mild strain of a virus from infection by a strain of the same virus which causes much more severe symptoms.
- **Hyperparasitism**- This is the control of pathogenic micro-organisms with other micro-organisms or viruses which parasitise or antagonize the pathogens- bacteriophyages, mycoparasites; nematophagous fungi, etc. are the best example of Hyperparasitism.
- **Control through trap crops and antagonistic plants**- Some plants which are not susceptible to few sedentary plant-parasitic nematodes produce exudates which stimulate the hatching of eggs of those nematodes- the larvae remain within those plants but are unable to develop into adults and lay eggs and they die finally; such type of plants are called trap crops.

D. ***Physical methods:*** Various types of radiation and temperature are the physical agents that are used in controlling plant disease.

- **Control by heat treatment**- Following types of heat treatment (high temperature) are is use:

a. Soil sterilization by heat- This practice is usually done in seed beds, cold farms, greenhouse, etc. by the heat carried in live steam or hot water.
b. Hot water treatment of propagative- Hot water treatment of seeds, bulbs, nursery, stocks, etc. is usually done to kill plant pathogens which may be present on the inside and outside of those organs.
c. Elimination of viruses from plants by heat- Heat treatment in controlling virus disease is one of the most successful and widely used therapeutic methods.
d. Hot air treatment of storage plant organs- This treatment of storage organs often removes the excess moisture from their surfaces and hastens healing of wounds thereby preventing their infection by some weak pathogens.

- **Control by refrigeration**- This is the widely used measure of controlling post-harvest disease of fleshy plant product. Temperatures at or slightly above the freezing point do not kill the pathogen present on or in the tissues but inhibit or greatly retard the growth and activities of such pathogens hence the spread of existing infection and the initiation of new infection are prevented.

E. ***Chemical methods:*** The use of chemical compounds toxin to pathogens is the most common means in controlling plant diseases in the field, in the greenhouse and also storage. Most of the chemical are used to control diseases of foliage and other aerial plant parts; some chemical are used to disinfect and protect seeds, tubers, bulbs, etc. from infection; some are used to disinfect soli, others to disinfect warehouses, to protect fruits and vegetables from infection, to treat wounds, etc. Insecticides are used to control insect vector of some pathogens.

- **Methods of plant disease control with chemical**-
  a. Foliage sprays and dusts- Chemical are usually applied as sprays or dusts on the foliage of plants to control fungal and bacterial disease. Most of the fungicides and bactericides are protectant in their action- hence they must be sprayed or dusted on the plant surface before the arrival or the

establishment of the pathogens there. Spore of pathogens require moisture before their germination- hence sprays or dusts seem to be most effective when those are applied before, during or after every rain, especially during the period or possibility of infection.

b. Treatment of seeds and other propagative stocks- Seeds, tubers, bulbs, roots, etc. are generally treated with various chemicals to prevent their decry after planting by controlling pathogens carried on them or present in the soil. Chemicals may be applied on seeds and other propagative materials like tubers, bulbs, corms, roots, etc. as dusts or as thick water suspensions mixed with those materials, or they can be soaked in water solution of the chemical and then dried.

c. Soil treatment- Soil, in which trees, ornamentals, vegetables, etc. are planted in often treated i.e. fumigated with volatile chemicals to control fungi, bacteria and nematodes. This treatment is done several days or weeks before planting.

d. Treatment of tree wounds- Accidental cuts and wounds mode on the bark of branches and trunks during pruning or wounds resulting during the removal of infections by fungi and bacteria must be protected from drying and also from becoming gateway of entry of new pathogens.

e. Control of post harvest diseases- Many fruits and vegetables are subjected to fungal attack in storage after their harvest. A number of fungicide chemical are used for control of such post harvest diseases.

f. Disinfection of warehouses- To avoid infection of stored products by pathogens, the storage rooms are cleaned thoroughly and the debris left over there from previous years is removed and burned.

g. Control of insect vector- This is very important especially when the pathogen is introduced or disseminated by insect vector. Application of insecticides to control viruses, and fungal and bacterial spores carried by insects is very successful method.

- ***Types of chemicals used to control plant diseases***- Various chemical have been used now a days for crop protection as fumigants, soil treatments, dusts, sprays, pests, paints and systemic.
  - ***a.*** Copper compounds- Bordeaux mixture is the most commonly and widely used copper fungicide all over the world. This fungicide controls many bacterial and fungal leaf spots, blights, anthracnoses, cankers, downy mildews, etc.
  - ***b.*** Sulphur compounds- Numerous inorganic and organic sulphur compounds have been used as good fungicide to control a variety of diseases. The organic sulphur compounds comprise the most modern fungicides. They include thiram, ferbam, ziram, nabam, zineb, etc. there are all derivatives of dithiocarbamic acid.
  - ***c.*** Mercury compounds – Inorganic mercury compounds $HgCl_2$ known as corrosive sublimate or dichloride of mercury and Hg_2Cl_2 known as calomel are used for soaking the seeds, rhizomes and corms of many vegetables and flowers to control some bacterial and fungal diseases.
  - ***d.*** Quinones – Chloranil and dichlone, these two quinone compounds are usually used commercially as fungicides.
  - ***e.*** Benzene compounds – Being toxin to micro-organisms, benzene compounds are used commercially as fungicides. Daconil 2787, a broad spectrum fungicide is effective against leaf spots, blights, fruit spots and rots, certain powdery mildews, etc.
  - ***f.*** Heterocyclic compounds – It includes some heterogeneous group of fungicides, of which the best one is captan. Captan is sold as captan, orthocide, etc. it's a very good and effective fungicide for control of leaf spots, blights, fruit rots, etc.
  - ***g.*** Other organic fungicides – There are some chemically diverse compounds acting as good fungicides for some diseases. Polyram is a foliar and seed protectant fungicide, it also controls rusts, downy mildews, leaf spots, blights of various plants.

h. Antibiotics – Many antibiotics such as streptomycin, tetracyclines, cycloheximide, griseofulvin, etc. are the most important to control plant diseases. These are the products of one micro-organism and toxin to other micro-organism. These antibiotics act on the pathogen or on the host directly or they act after undergoing transformation within the host.