



Principles of Plant Disease Management in Agriculture

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A plant disease is usually defined as abnormal growth and dysfunction of a plant. Diseases are the result of some disturbance in the normal life procedure of the plant. Disease may be the result of living and non-living causes. Biotic diseases are caused by living organism, for example, fungi, bacteria, and viruses. Abiotic diseases are caused by non-living environmental conditions, for example, soil compaction, wind, frost, soil salt damage, and girdling roots. Plant diseases are of great economic value in crop production. Plant disease is the deviation from the standard state of health of the plant, resulting in the reduction of farm yield and crop failure in severe cases.

Information on etiology, symptoms, pathogenesis and epidemiology of plant diseases are intellectually interesting and scientifically justified but most important of all they are useful as they help in formulation of methods developed for successful management of disease and thereby increasing the quantity and improving the quality of plant and plant products. Practices of disease management vary considerably from one disease to another depending upon the type of pathogen, the host and the biotic and abiotic factors involved. Contrary to management of human and animal diseases where every individual is attended, the plants are generally treated as populations and measures used as preventive rather than curative. Methods for plant diseases control were first classified by Whetzel (1929) into exclusion, eradication, protection and immunization. Further advances in plant pathology leading to development of newer methods. Two more principles - avoidance and therapy were created (NAS, 1968).

Avoidance: It involves avoiding disease by planting at time when, or in areas where inoculum is absent or ineffective due to environmental conditions. The major aim is to enable the host to avoid contact with the pathogen or to ensure that the susceptible stage of the plant does not coincide with favourable conditions for the pathogen. The main practices under avoidance are choice of geographical area, selection of the field, choice of sowing/ planting time, selection of seed and planting material, short duration / disease escaping varieties and modification of agronomic/cultural practices. The potato cultivation at high altitude is relatively free from viruses; as prevailing environmental conditions do not permit the buildup of vector populations. Similarly, early planting of potato or wheat, in Indo Gangetic plains may escape late blight or stem rust damage respectively.

Exclusion: It means preventing the inoculum from entering or establishing in a field or area where it does not exist. Seed certification, crop inspection, eradication of inoculum and / or insect vectors, and quarantine measures are some of the means of preventing the spread for pathogens.

Eradication: The process of reducing, inactivating, eliminating or destroying inoculums at the source, either from a region or from an individual plant in which it is already established is termed as eradication. Eradication involves eliminating the pathogen from infested areas; the magnitude of the operation involved may vary considerably. One of the most extensive eradication operations carried out so far was to get rid of the citrus canker (*Xanthomonas axonopodis*) in the USA during 1927- 35. As many as 4 million citrus trees were cut and burnt at a cost of about 2.5 million dollars to eradicate the pathogen. The practices invariably employed to achieve eradication of inoculums include eradication of alternate and / or collateral hosts, crop rotations, field sanitations, heat or chemical treatments of plant materials or soil, biological control etc.

Protection: The protection of infection courts against the inoculums of many fast spreading infectious pathogen, brought by wind from neighbouring fields or any other distant place of survival. Principles of avoidance, exclusion and eradication may not be sufficient to prevent the contact of host with pathogen, thus development of the disease is imminent. Measures are necessary to protect host plants from invading inoculums. It can be achieved by creating toxic barrier between the plant surface and the inoculums. Methods employed to achieve such results are chemical sprays, dusts, modification of environment, and modification of host nutrition.

Host resistance: It utilizes in-built mechanism to resist various activities of pathogen. The infection or subsequent damage by pathogen can be rendered ineffective through genetic manipulation or by chemotherapy. The host resistance can also be induced by use of certain biotic and abiotic factors. The discovery of Mendelian laws of inheritance and developments in plant breeding techniques have helped in developing crop varieties resistant to specific pathogen or group of pathogens. The classical breeding techniques include selection, mutation and hybridization. Use of biotechnological tools such as tissue culture, genetic engineering and protoplast fusion are being used to develop resistant cultivars of various economically important crops.

Therapy: It is the treatment of infected host plant, which is attempted in case of economically important horticulture plants. As a principle of plant disease control, it provides an opportunity to cure or rejuvenate the diseased host plant by use of physical or chemical agents. The first five of these principles are mainly preventive (prophylactic) and constitute the major components of plant disease management. They are applied to the population of plants before infection takes place. Therapy is a curative procedure and is applied to individuals after infection has taken place. Under the concept of disease management these principles have been classified into following five categories:

1. Management of physical environment (cultural control)
2. Management of associated micro biota (biological antagonism)
3. Management of host genes (host resistance)
4. Management with chemicals (Chemical control)
5. Management with therapy (Physical, chemical etc.)

The six principles that characterize the modern concept of plant disease management should be viewed from three stand point

1. Reduction in the initial inoculums or the rate of disease development.
2. Management of the pathogen population, the cure or induce defense of the suspect or modify the environment as it influences disease and
3. Interruption of dispersal, survival or the course of disease development.

Integrated disease management: The term Integrated pest management was originally designed for management of insect pest but it is equally applicable to plant diseases also. IPM

is an ecosystem- based strategy that focuses on long term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, and modification of cultural practices and use of resistant varieties. Management of pathogen involves the practices directed to exclude, reduce or eradicate inoculums. Management of the host involves the practices directed to improve plant vigour and induce resistance through nutrition, introduction of genetic resistance through breeding and providing need based protection by chemical means. Management of environment involves the practices that modify the environment which is not favorable to pathogen or disease development and does not predispose host to attack.

Plant Quarantine: Plant Quarantine refers to the holding of plants in isolation until they are believed to be healthy. Now, broader meaning of the plant quarantine covers all aspects of the regulation of the movement of living plants, living plant parts/plant products between politically defined territories or ecologically distinct parts of them. Intermediate quarantine and post entry quarantine are used respectively to denote the detention of plants in isolation for inspection during or after arrival at their final destination.

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