CULTURAL METHODS OF PLANT DISEASE MANAGEMENT

Aim: To acquaint the students with cultural methods of plant disease management Host

Eradication

When a plant pathogen enters into new area despite quarantine, a plant disease epidemic may occur. All the host plants infected by pathogen may have to be removed and burnt to prevent such epidemics. This eliminates the pathogen and prevents greater losses from the spread of pathogen to additional plants.

Eradication of the crop/main host

- This type of eradication of pathogen was done in Florida and other southern states for control of bacterial canker of citrus in 1915, where more than three million trees had to be destroyed.
- Another outbreak of citrus canker occurred in Florida in 1984, and by 1992; and the disease was apparently brought under control through painful destruction of nursery and orchard trees in the United States.
- Host eradication is also carried out routinely in many nurseries, greenhouses, and fields to prevent spread of numerous diseases by eliminating infected plants that provide a ready source of inoculum within this crop.
- However, attempts to eradicate certain diseases like fire blight of apple and pear caused by the bacterium *Erwinia amylovora* and plum pox virus of stone fruits in the United States, and coffee rust in several South American countries to eradicate them have not been successful.

Eradication of the wild/volunteer host plants

- Certain pathogens of annual crops, e.g., *Cucumber mosaic virus* overwinters only or mainly in perennial wild plants.
- Eradication of host in which the pathogen overwinters is sometimes enough to eliminate completely or to reduce drastically the amount of inoculum that can cause infection in the following season.
- In some crops like potatoes, the pathogens overwinter in the infected tubers.

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- These tubers produce infected plants in the spring that allow pathogen to come on aboveground parts from where it can spread further by insects, rain and wind.
- Eradication of such volunteer plants of a crop helps greatly to reduce the inoculum of these pathogens.

Eradication of alternate hosts

- Some pathogens require alternate hosts to complete their life cycle, e.g., *Puccinia graminis tritici* requires wheat and barberry, and *Cronartium ribicola* requires pine and currants.
- Eradication of wild or economically less important alternate host interrupts the life cycle of pathogen and leads to the control of the disease.

Crop Rotation

- Soil borne pathogens that infect plants of one or a few species or even families of plants can sometimes be reduced in the soil by planting non-host crops for 3 or 4 years.
- Crop rotation can reduce population of pathogens (e.g., *Verticillium*).

Fallowing

The field is tilled and left fallow for a year or part of year in some cases.

- During fallowing, pathogen debris and inoculum are destroyed by microorganism with little or no replacement.
- In areas with hot summer, fallowing allows greater heating and drying of the soil, which leads to a marked reduction of nematodes and some other pathogens.
- Other cropping systems utilize herbicides, reduced tillage and fallowing.
- In such systems, certain diseases, e.g. stalk rot of grain sorghum and corn, caused by *Fusarium moniliforme* have been reduced dramatically.
- In other diseases, such as Septoria leaf blotch of wheat and barley scab were increased.

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Sanitation

Sanitation consists of all activities aimed at eliminating or reducing the amount of inoculum present in a plant, field or a warehouse and at preventing the spread of the pathogen to other healthy plants and plant products.

- Ploughing under infected plants after harvest, such as leftover infected fruit, tubers or leaves, helps cover the inoculum with soil and speed up its disintegration and concurrent destruction of most pathogens carried in or on them.
- Removing the infected leaves of house or garden plants helps remove or reduce the inoculum.
- Infected crop debris of grasses and rice crops is destroyed by burning in some parts of world, which reduces or eliminates the surface inoculum of several pathogens.
- By washing their hands before handling certain kinds of plants, such as tomatoes, workers who smoke may reduce the spread of *Tobacco mosaic virus*.
- Disinfecting the knives used to cut propagative stock, such as potato tuber and disinfecting pruning shears between trees reduce the spread of pathogen through such tools.
- Washing the soil of farm equipment before moving it from one field to another may also help in preventing the spread of pathogens present in the soil.

Practices for Creating Conditions Unfavourable to the Pathogen

- Stored product should be aerated properly to hasten the drying of their surface and inhibit germination and infection by any fungal or bacterial pathogens present on them.
- The appropriate choice of fertilizers or soil amendments may also lead to change in the soil pH, which may unfavourably influence the development of pathogen.
- In the production of many crops, particularly containerized stock, using decomposed tree bark in the planting medium has resulted in the successful control of diseases caused by several soil borne pathogens, e.g. *Phytophthora, Pythium* and *Thielaviopsis* causing root rots , *Rhizoctonia* causing damping off and crown rot, *Fusarium* causing wilt, and nematode diseases of several crops.

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Polyethylene Traps and Mulches

- Many plant viruses, such as cucumber mosaic virus are brought into crops such as peppers, by airborne aphid vectors.
- When vertical, sticky, yellow polyethylene sheets are erected along edges of susceptible crop fields, a considerable number of aphids are attracted to and stick to them.
- If reflectant aluminum or black, whitish-grey or coloured polyethylene sheets are used as mulches between the plants or rows in the field, incoming aphids, thrips and possibly other insect vectors are repelled and misled away from the field.
- Reflectant mulches, however, cease to function as soon as the crop canopy covers them.

Practices for Evading or Avoidance of the Pathogen

For several plant diseases, control depends on attempts to evade pathogens.

- Bean anthracnose, caused by the fungus *Colletotrichum lindemuthianum,* and the bacterial blight of bean caused by bacteria *Xanthomonas phaseoli* and *Pseudomonas phaseolicola* are transmitted through the seed. Therefore, they can be successfully controlled by using disease free seed and seed treatments.
- In many cases, the susceptible crop is planted at a great enough distance from field containing infected plants so that the pathogen would not infect the crop.
- Crop isolation is practiced mostly with perennial plants, such as peach orchards isolated from choke cherry shrubs or trees infected with X disease phytoplasma.
- Various activities which evade the pathogens include:

  i) Using vigorous seed
  ii) Selecting proper dates and proper sites
  iii) Maintaining proper distances between fields and between rows and plants
  iv) Planting windbreaks or trap crops
  v) Planting in well drained soil
  vi) Using proper insect and weed control

Such practices increase the chances that the host will remain free of pathogen or at least that it will go through its most susceptible stage before the pathogen reaches the host.

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Use of Pathogen Free Seed and Propagative Material

- Seed may carry internally one or a few fungi such as those causing anthracnose and smuts, certain bacteria causing bacterial wilts, spots and blights and certain viruses (*Tobacco ring spot virus* in soybean, *Bean common mosaic virus*, *Lettuce mosaic virus*, *Barley stripe mosaic virus*, *Squash mosaic virus and Prunus nectroic ring virus*). Such diseases cn be controlled effectively by producing and using disease free seed.
- True seed, however, is invaded by relatively few pathogens, although several may contaminate its surface.
- All types of pathogen can be carried in or on propagating material.
- When a pathogen is excluded from the propagating material of the host, it is often possible to grow the host free of that pathogen for the rest of its life, e.g., woody plants, generally affected by non-vectored viruses.

Production of pathogen free vegetative propagating material

- Vegetative propagating material free of pathogens that are distributed systemically throughout the plant is obtained from mother plant that had been tested and shown to be free of particular pathogen or pathogens.
- To ensure continuous production of pathogen free buds, grafts, cuttings, rootstocks and runners of trees, vines, and other perennials; the mother plant is indexed for the particular pathogen at regular intervals.
- For certain crops, such as potato, complex certification programmmes have been evolved to produce pathogen free seed potatoes.
- For the seed to be certified the plants must show disease level no higher than those allowed by particular state.
- Sometimes it is impossible to find even a single plant of variety that is free of particular pathogen, especially of viruses. In that case, one or few healthy plants are initially obtained by meristematic tissue culture which most viruses do not invade.

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Practices for the Exclusion of Pathogens from Plant Surfaces by Epidermal Coatings

- The plants are sprayed with compounds that form a continuous film or membrane on the plant surface for controlling diseases of aboveground parts of plant and inhibit contact of pathogen with the host and penetration of host.
- Water emulsion of dodecyl alcohol forms a high quality of lipid membrane. The membrane allows diffusion of oxygen and carbon dioxide but not of water. The membrane is not easily washed by rain and remains intact for about 15 days.
- Kaolin based films have also proved effective in protecting apple shoot from becoming infected by the bacterial disease fire blight, and apple fruit from powdery mildew. It also protects grapevine from Pierce disease caused by *Xylella fastidiosa* by interfering with its transmission by the vector.