SURVIVAL OF PLANT PATHOGENS

Aim: To acquaint the students with survival of plant pathogens

Survival

To continue the infection chain, most of the plant pathogens have developed some efficient means of survival through the unfavourable part of the year. So that with the onset of the favourable season its infection may be renewed. Chief sources of survival of plant pathogens are:

- Infected living hosts
- Infected or contaminated planting organs
- Infected crop residues
- Resting structures
- Soil

Infected living hosts

- Infected plants are the most important sources/reservoir of inoculum for plant diseases.
- Bacteria, fungal spores and spore producing structures such as pycnidia, acervuli etc. may survive the unfavorable season in the infected twigs and branches of perennial plants, e.g., *Erwinia amylovora* in apple, *Xanthomonas campestris* pv. *citri* in citrus causing canker.
- When the favourable season returns, the resting bodies come out of their dormant state, become active and produce primary inoculum.
- Some crops like rice, chillies, brinjal or brassicas are grown throughout the year and provide continuity to the pathogens infecting them year after year.
- Also, the volunteer or self sown plants growing outside the fields get infected during the off-season and may act as a good source of inoculum to the new crop, e.g., *Puccinia graminis* on wheat, *Helminthosporium oryzae* and *Pyricularia oryzae* on rice or *Alternaria solani* on chillies.

Subsidiary hosts

- Many plant pathogens have a wide host range and attack different related or unrelated plant species grown in different situations and different season. These are called subsidiary hosts. These include:

  a) Collateral hosts

  b) Alternate hosts

  c) Wild hosts of the same family

  d) Weed hosts.

Collateral hosts

- Fungal pathogens like *Alternaria solani* and *A. brassicicola* mostly attack members of *Solanaceae* and *Brassicae* family, respectively, which are their collateral hosts.

Alternate hosts

- *Puccinia graminis tritici* which causes stem rust of wheat attacks and survives on barberry (*Barberis vulgaris),* the only other species it affects other than wheat.
- Such transfer of inoculum is obligatory and essential for completing the life cycle. So barberry called the alternate host.
- Similarly, *Cronartium ribicola* which causes blister rust of the white pine also attacks wild or cultivated currant or gooseberry plants as its alternate host,
- Cedar is an alternate host of *Gymnosporangium juniperi-virginianae* causing cedar- apple rust.
- Both *Rhizoctonia solani* and *Sclerotium roilfsii* have very wide host range spread over many families. As a result the inoculum of these pathogens is available almost throughout the year for infecting the same or different host species.

Alternative hosts

Such transfer of inoculum from one host species to another is not compulsory. There are called **alternative hosts.**

- Cereal rusts can infect their wild hosts and survive the winter crop periods in such hosts and also some self sown wheat plants at higher altitudes.
- Powdery mildew fungus *Erysiphe cichoracearum* and viral pathogens of cucurbits also survive the inter-crop period in wild cucurbits when their normal crop host is absent.
- Important rice pathogens, *Helminthosporium oryzae* and *Pyricularia oryzae* can survive through their weed hosts like *Leersia heaxandra, Echinochloa colonum,* and *Setaria intermediata* and *Digitaria marginata* y or some others.

Vectors as hosts

- Among fungi and bacteria, which are transmitted by insects, some over winter within the body of their vectors, e.g., *Ceratocystis fagacearum* (oak wilt) survives in nitidulid beetles, *Xanthomonas campestris* pv. *stewartii* (maize wilt) in flea beetles and rice stunt virus in leaf hoppers.

Infected seed or planting material

- Infected or contaminated seeds and other planting material may carry the inoculum of fungal, bacterial, viral or nematode pathogens through the inter-crop period or the unfavourable season.
- Some attack the floral organs and enter in to the ovary and others infect the seed through the seed coat.
- Some infect the embryo and others the tissue beneath the seed coat and remain there in a dormant state without causing any damage to the seed and affecting their germinability.
- *Ustilago tritici* and *Alternaria triticina* (in wheat), *Alternaria brasscicola* (in brassicas) survive in/on the seed.
- *Phytophthroa infestans* (causing late blight of potato), *Peronospora destructor* (downy mildew of onion), *Pythium aphanidermatum* (rhizome rot of ginger), red rot

of sugarcane, leaf roll and mild mosaic viruses of potatoes survive in the planting material like tubers, bulbs, rhizomes etc of the respective crops.

- Pathogens surviving in or on the seed or vegetative planting material are already in contact with the potential host plants and are not exposed to the vagaries of the environment.
- When the seeds germinate, the pathogens also become active, resume their growth or infect the seedlings at the earliest opportunity.
- Some other pathogens which enter through the seed coat and do not affect the embryo are *Septoria apicola* in celery, *Colletotrichum* in chillies, *Pseudomonas phaseolicola* in bean and *Clavibacter michiganese* in tomato.
- Seeds may also get contaminated with the pathogen during threshing and storage. For example, covered smut of barely (*Ustilago hordei*), grain smut of jowar (*S. sorghi*), bunt of wheat (*Tilletia caries* and *T. foetida*) or fruit rot of chillies (*Colletotrichum capsici*).
- Longevity of fungal spores carried externally on seed varies considerably for different pathogens depending upon storage conditions.
- While thin walled spores perish early, those with thick walls survive longer.

Crop Residue

- Crop residue consisting of infected plant parts (leaves, stems, fruits etc.), roots and stubbles help in the survival of plant pathogens are a major source of primary inoculum for the next crop to be grown there.
- Examples are *Colletotrichum falcatum* in sugarcane, *Cercosporidium personatum* in groundnut, *Alternaria brassicae* in crucifers, *Ascochyta pisi* in pea, *Xanthomonas campestris* pv. *campestris* in cabbage, *Xanthomonas campestris* pv. *oryzae* in rice, bean mosaic virus in bean and barley mosaic virus in barely.

Soil

- Soil is the ultimate resting place for most of the plant pathogens and one of the major source of primary inoculum for fungal, bacterial or nematode pathogens.
- Most pathogens come back to soil after completing parasitic existence on the host plants. Some of them survive in soil as free living saprophytes and also reproduce and complete their life cycles.

- Others just survive there showing only limited growth and no reproduction. Those that attack aerial organs of the hosts mostly survive the inter crop period or adverse climates through resistant propagules.
- Garrett (1950) distinguished behavior of soil borne fungal pathogens and grouped them as soil inhabiting and soil invading fungi.
- **Soil inhabiting fungi** were characterized by their ability to survive indefinitely in soil as saprophytes and to complete their life cycles there, e.g., *Pythium, Phytophthora, Rhizoctonia* sp., *Sclerotium rolfsii* and *Fusarium solani.* They are mostly primitive, less specialized parasites.
- **Soil invading fungi** also known as **root inhabiting fungi** were characterized by an extended parasitic phase on living host plants, mostly restricted to host roots and a declining saprophytic phase in soil after death of the host plant.
- The root inhabiting fungi with characteristic local distribution in soil are: *Gaeumannomyces graminis, Fomes annosus, Phymatotrichum omnivorum* and *Armillariella mellea.*
- Vascular pathogens including *Verticillium albo-atrum* represent the intermediate group. They are no doubt somewhat specialized in their parasitic habits but can survive also in soil saprophytically for a few years. Their ability to form perennating structures like chlamydospores (in *Fusarium oxysporum*) or micro sclerotia (*Verticillium albo-atrum*) may have a contributory role in this respect.

Resting structures

- Many soil borne fungal pathogens survive effectively in soil through adverse circumstances by forming resting structures.
- Basically, the resting structures are of two types:

  i) resting spores of sexual or asexual origin
  ii) resting organs made of vegetative hyphae.

  - Thick-walled chlamydospores help in the survival of many fungi as *Pythium* spp., *Fusarium solani* and *F. oxysporum.*
  - Resting spores of *Plasmodiophora brassicae* also act in perennation. The conidia of *Diplocarpon rosae* also participate in the act of survival.

- Smut spores some times also called as chlamydospores also function in survival of some rust, and smut and bunt fungi, termed respectively as teleutospores, smut spores and bunt spores.
- Some fungi form sclerotia which are black hardened structures made up of aggregations of vegetative hyphae and are able to survive through extremely unfavourable conditions.
- *Sclerotium rolfsii*, *Rhizoctonia* spp. and *Phymatotrichum omnivorum* are some of the common fungal pathogens with an important role for sclerotia in their survival.