# PATHOLOGY

### History

Historical perspectives of forest/plant diseases; Major epidemics and their social impacts, Key contributors; Importance of tree/plant diseases; Common pathological terms.

### **Concept of tree disease**

What is a disease; Causes of diseases; Classification of diseases; Types of diseases; Disease triangle; Disease cycle; Parasitism; Pathogenicity; Events in disease development.

**Pathogens:** Fungi, oomycetes, bacteria, viruses, viroids, phytoplasma, spiroplasma, phanerogamic plant parasites and nematodes and their characteristics. Common survival and dispersal methods.

## Abiotic disorders

**Disease diagnoses:** Symptoms and signs, Microscopy and micrometry, Molecular tools in pathogen detection including serology (ELISA) and DNA-based tools (DNA barcoding, LAMP, Next Generation Sequencing, etc).

**Disease epidemiology:** Disease cycles (monocyclic vs. polycyclic); Environmental influences (including climate change leading to shifts in pathogen distribution and increased susceptibility due to stress; Vector (insects, human activities, etc.), Disease forecasting; Remote sensing and GIS applications.

**Disease resistance and host defence mechanisms:** Structural, biochemical and genetic resistance; Systemic acquired resistance (SAR) and induced systemic resistance (ISR); Hypersensitive response; Breeding trees for disease-resistance; Gene for Gene hypothesis; Enzymes and toxins, Disease resistant genes; Hypovirulence, Cross protection.

**Forest disease management:** Principles of disease management, Cultural (silvicultural practices, sanitation, etc.); Chemical (fungicides, antibiotics, etc.), Biological (antagonistic microbes, PGPR, *Trichoderma*, mycorrhizae, etc.); Quarantine and regulatory measures including timber import/ export; Integrated Disease Management (IDM) approaches; Genome editing.

**Seed diseases:** Internal and external seed borne diseases, for eg., seed rot fungi (*Aspergillus, Penicillium*, etc.)

### Nursery diseases: Damping off (Pythium, Phytophthora, Rhizoctonia,

Fusarium, etc.); Leaf spot and blight (Alternaria, Colletotrichum spp.); Powdery
mildew (Erysiphe, Podosphaera, Golovinomyces, etc.); Wilt Disease (Fusarium,
Verticillium.); Root rot (Phytophthora, Fusarium, etc.); Bacterial wilt (Ralstonia solanacearum); Root-knot nematodes (Meloidogyne sp.)

Foliar diseases: Powdery and downy mildew; Leaf spot and blight; Rust; Wilt; Viral diseases.

### Stem and bark diseases: Canker, Heart rot (Ganoderma, Fomes, etc.); Stem canker

(Botryosphaeria, Nectria, Cryphonectria parasitica, etc.); Pink disease (Erythricium salmonicolor); Charcoal rot (Macrophomina phaseolina); Bacterial wilt (Ralstonia solanacearum); Sandal spike disease (Phytoplasma); Bamboo blight (Fusarium moniliforme, Sarocladium oryzae); Mistletoe (Himalayan dwarf mistletoe) Dendrophthoe falcata, Loranthus, etc.); Dodder (Cuscuta).

Root diseases: Root rots- (*Ganoderma., Armillaria mellea, Phytophthora*, etc.); Root-knot nematodes (*Meloidogyne* spp.), Pine wilt nematode. Shisham wilt.

**Rot, decay and stain**: White root rot (*Rigidoporus microporus*); Brown cubical rot (*Laetiporus sulphureus*), bacterial soft rot, sap stain (*Ceratocystis*)

**Emerging diseases:** Neem dieback, Poplar dieback, Sudden Oak Death (*Phytophthora ramorum*); Dieback (*Diplodia, Botryosphaeria*, etc.); Sooty mold (*Capnodium* sp.)

**Tools in forest pathology:** Bioinformatics, PCR, qRT PCR, NGS, NCBI, GenBank, EMBL, culture collections and pathogen databases.