SRS INSTITUTE OF AGRICULTURE AND TECHNOLOGY

(Affiliated to Tamil Nadu Agricultural University)

PAT 302 DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT – II (2+1)

PRACTICAL MANUAL CUM RECORD

B.Sc. (Hons.) Agriculture

COURSE TEACHER

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CERTIFICATE

Certified that this is a bonafide record of work done by the student Mr./Ms._____(ID. No._____) of III B.Sc.(Hons.) Agriculture for the course, **PAT 302 – Diseases of Field and Horticultural Crops and their Management - II (2+1)** during VI semester of the academic year 2023 – 2024.

COURSE ASSOCIATE **COURSE TEACHER**

EXTERNAL EXAMINER

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Ex.No.1. **DISEASES OF WHEAT**

Date:

1. Black Rust / Stem Rust

Symptoms

On wheat

- Initially, brick red colored elliptical blisters or pustules, known as uredia, develop on the stem, leaf and leaf sheath.
- The epidermis covering the pustules is later ruptured irregularly exposing a powdery mass of brick red-colored uredospores.
- At the end of the crop season, the pustules turn black as the fungus produces teliospores.

On barberry

- On the upper side of leaf, a few minute, orange-colored bodies, the spermagonia, are formed bearing a small droplet of liquid or nectar.
- Beneath the spermagonia, groups of orange-yellow cuplike aecia appear.
- The infected host tissue is frequently swollen.

Pathogen: *Puccinia graminis* f. sp. *tritici*

- The fungus produces well branched, dikaryotic, intercellular mycelium and haustoria. It is an obligate biotroph, macrocyclic and heteroecious.
- On wheat, the fungus produces uredial, Telial and basidial stages and on alternate host Barberry, it produces pycnial and aecial stages
- The urediospores are produced repeatedly from the same mycelium or from the urediospores by clonal multiplication.
- Thus urediospores are called repeating spores and are considered as asexual spores.The uredospores are brown, oval, one celled, pedicellate, with four equatorial germpores.
- The teleutospores (teliospores) are dark or chestnut brown, two-celled, pedicellate, smooth walled and pointed apex.
- The basidiospores are unicellular, round and uninucleate. Basidiospores infect barberry plant.
- The pycnia are produced on the upper surface of the barberry leaf. They are flask-shaped and ostiolate.
- The aecia are produced on the lower surface of barberry leaf.

2. Brown rust / orange rust / leaf rust

Symptoms:

- Small circular to oval shaped, orange to brown colored pustules (representing the formation of uredia) are scattered on both the upper and the lower leaf surfaces.
- *Thalictrum* and *Isopyron* species are alternate hosts

Pathogen: *Puccinia triticina* (formerly *P. recondita)*

- Characters are the same as described in *P. graminis tritici*. But the differentiating feature is teleutospores that are two celled, with a rounded and thickened apex

3. Yellow rust / stripe rust

Symptoms:

- Yellow-colored pustules are produced between veins on leaf and arranged in linear rows and hence it is called stripe rust.
- The pustules consist of uredosori exposing a large number of uredospores.
- Alternate host –*Berberis* spp. and *Mahonia*

Pathogen: *Puccinia striiformis* f. sp. *tritici*

- Characters are the same as described in *P. graminis tritici*. But the differentiating feature is teleutospores which are two celled, thick walled and flattened at the top.

4. Loose Smut

Symptoms:

- Disease is seen in the ear head stage. Diseased ear heads emerge out of the boot leaf earlier than healthy ones.
- Usually all spikelets are affected and transformed into a mass of black powdery spores. Each spikelet is covered by a thin silvery membrane, which breaks while the earhead emerges.
- The powdery mass of spores is blown off by wind or removed by rain leaving behind only the central rachis.

Pathogen: *Ustilago nuda tritici*

- It produces unicellular pale, olive-brown, spherical to oval, minute, echinulated smut spores (chlamydospores) in the affected earheads.

5. Powdery Mildew

Symptoms:

- A greyish white powdery growth appears on the upper surface of the leaf, leaf sheath and inflorescence.
- With advancement of the disease, several black dots representing the cleistothecia formation on the affected plant parts

Pathogen: *Blumaria graminis* var. *tritici*

- Thallus is filamentous, hyaline, septate mycelium. Mycelia are epiphytics (ectoparasites) on the surface of the leaves and pathogens absorbs the nutrients by producing haustoria from the superficial mycelium into the epidermal cells.
- Asexual spore is conidium. Conidiophore is short, club shaped, unbranched, non-septate and hyaline. Conidia are barrel shaped, single celled, hyaline, produced in chain.
- Sexual fruiting body is chasmothecium contains ascus and ascospores (sexual spores) are produced.

6. Flag Smut

Symptoms:

- The fungus attacks leaf, stem and earheads. Symptoms appear anytime from seedling stage to the ear formation.
- Greyish black linear sori occur on the leaf blade and leaf sheath.
- The sorus contains black powdery mass of spores. Infected plants are stunted in growth and bear twisted leaves, that droop down giving flagging symptom.

Pathogen: *Urocystis agropyri*

- The spores are aggregated into balls consisting of a dark fertile entre, surrounded by a ring of lighter coloured sterile cells.
- Each spore ball contains 1 to 6 number of brown, globose, smooth walled spores (called smut spores/teliospores).
- Each smut spore germinates into promycelium which produces 2-6 cylindrical basidiospores terminally.
- Basidiospore germinates to produce primary mycelium. Opposite mating type primary mycelia fuse and form dikaryotic secondary mycelium that become systemic.
- Dikaryotic mycelium later forms black stripes of smut sori.

7. Rough bunt/ Common bunt/stinking bunt/hill bunt

Symptoms

- Symptoms evident only at heading stage though it infects the seedlings (systemic infection).
- Infected plants are shorter and produce smutted grains that emit a fishy stink smell. Hence the disease is called stinking smut.
- This stinking/foul smell is due to a volatile compound called trimethylamine produced by the fungus.
- The smut sori in the smutted grains are covered with membrane made up of host tissue and the teliospores from the sori are released only at the time of thrashing.

Pathogen: *Tilletia caries/ T. laevis*

- *Tilletia caries* produces rough walled teliopsores and *T. laevis* produces smooth walled teliospores.
- Upon germination, teliospores germinate to produce non- septate promycelium (holobasdium type) which again produce 8-16 cylindrical basidiospores formed terminally.
- Basidiospores of opposite mating type fuse in situ, forming characteristic H shaped structures leading to the formation of dikaryotic hyphae.
- A short dikaryotic hypha infects the host or it forms a cresecent shaped binucleate secondary sporidium which again germinate to produce dikaryotic hypha.

8. Karnal bunt/partial bunt

Symptoms

- The symptom occurs at the time of earhead formation.
- Few grains are smutted and that too these grains are partially (that is why, it is called as partial bunt) converted into black powdery mass of smut sorus.
- Embryo is not affected and such grains can germinate.

Pathogen: *Tilletia indica* (Syn: *Neovossia indica)*

- Teliospores are dark brown, spherical to oval shaped. Spores germinate to form a short stout non-septate promycelium at the apex of which several filiform basidiospores are formed.

9. Ergot

Symptoms

- The first symptoms appear as creamy droplets of a sticky liquid exuding from young florets of infected heads (Honey dew).
- The droplets are soon replaced by a hard, horn-shaped, purplish-black sclerotia or ergots that grow in place of the kernel (kernal is replaced by sclerotia)

Pathogen: *Claviceps purpurea*

- It is a biotroph, non-systemic with high organ specificity that is it infects only the ovary of the cereals and entire ovary is converted into sclerotia in place of normal seed development from the ovary.
- The pathogen infects the florets, grows through the stylar tube to the base of the ovary where it ramifies the entire ovary tissue and depends on the living host plant tissue (biotroph).
- The fungus produces conidia on asexual fruiting body- sporodochia.
- The sexual spores are ascospores that are produced in perithecium. The fungi survives in the form of sclerotia

10. Fusarium head blight / scab

Symptoms

- Generally, *Fusarium* spp infect root and cause vascular infection. But *F.graminearum* infects mainly inflorescence and damages the grains. Similarly, *F.verticillioides* also infects the wheat ear head. Both these two species of *Fusarium* mainly infects the inflorescence and root infection is uncommon.
- Premature bleaching of one or more spikelets or the entire immature wheat ear head is the common symptom. The bleaching can start anywhere on the ear head and spread until the entire ear head is bleached.
- Bleached spikelets are sterile or contain shriveled and/or discolored seed. During humid conditions, white or pink fungal growth with orange spore masses may be seen on bleached spikelets.
- Blue-black colored perithecia are formed, giving the ear head a scabbed appearance, hence

the name scab.

- *F. graminearum* produces a toxin, deoxynivalenol (DON, vomitoxin), a serious mycotoxin

Pathogen: *Fusarium graminearum (Gibberella zeae)*

- Thallus is hyaline, septate, filamentous mycelium.
- During asexual reproduction, it produces macro conidia and chlamydospores. It does not produce micro conidia.
- During sexual reproduction, it produces sexual fruiting body perithecia and ascospores

11. Tundu / Yellow Ear Rot

Symptoms:

- The characteristic symptom of the disease is the formation of yellow slime on the stem and inflorescence.
- It dries up to form sticky yellow layers and cause curling and twisting of the spikes.
- Galls formed by the nematodes replace most of the grains in the ear head.

Causal organisms: *Rathayibacter tritici*

- The bacterium is rod shaped, pleomorphic and frequently exhibit club shaped swellings, Gram positive and motile by a polar flagellum
- Nematode, *Anguina tritici*, is the vector of the bacterium *Rathayibacter*.

Minor diseases

1. **Tan spot – *Pyrenophora tritici-repentis***

- Tan colored and dimond shaped spots surrounded with yellow halo are formed on the leaf.
- When plant matures, the fungus invades the straw and produce black colored raised fruiting bodies called pseudothecia are formed.

2. **Take all disease -*Gaeumannomyces graminis* var. *tritici***

- Take-all first becomes apparent near the time when the seed head emerges.
- The leaves are yellow and plants may be stunted.
- The disease usually occurs in circular patches although it also can be fairly uniform throughout a field.
- The most diagnostic field symptom is prematurely-ripe tillers

3. **Foot Rot -** *Pythium graminicolum* and *P. arrhenomanes*

Symptoms:

- The disease mainly occurs in seedlings and roots and rootlets become brown in colour.
- Seedlings become pale green and have stunted growth.
- The collar region becomes discoloured and soft
- The leaf sheaths turn blackish brown and split into shreds.

Ex. No.2. **DISEASES OF CHICKPEA, LENTIL, SUNFLOWER AND MUSTARD**

Date:

DISEASES OF CHICKPEA

1. Wilt

Symptoms

- The disease occurs at two stages of crop growth, seedling stage and flowering stage.
- The main symptoms on seedlings are yellowing and drying of leaves, drooping of petioles and rachis, withering of plants.
- In the case of adult plants drooping of leaves is observed initially in upper part of plant, and soon observed in entire plant.
- Vascular browning is conspicuously seen on the stem and root portion

Pathogen: ***Fusarium oxysporum fsp ciceri***

- The fungus produces hyaline to light brown, septate and profusely branched hyphae.
- Micro conidia are oval to cylindrical, hyaline, single celled, normally arise on short conidiophores.
- Macro conidia which borne on branched conidiophores, are thin walled, 3 to 5septate, fusoid and pointed at both ends.
- Chlamydospores are rough walled or smooth, terminal or intercalary, may be formed singly or in chains.

2. Ascochyta blight

Symptoms

- All above ground parts of the plant are infected. On leaf, the lesions are round or elongated, bearing irregularly depressed brown spot and surrounded by a brownish red margin.
- Similar spots may appear on the stem and pods. The spots on the stem and pods have pycnidia arranged in concentric circles as minute block dots.
- When the lesions girdle the stem, the portion above the point of attack rapidly dies. If the main stem is girdles at the collar region, the whole plant dies.

Pathogen: ***Ascochyta rabiei***

- The fungus produces hyaline to brown and septate mycelium.
- Pycnidia are spherical to sub-globose with a prominent ostiole.
- Pycnidiospores are hyaline, oval to oblong, straight or slightly curved and single celled, occasionally bicelled.

3. Rust

Symptoms

- Infection appears as small oval, brown, powdery lesions on both the surface, especially more on lower surface or leaf.
- The lesions, which are uredosori, cover the entire leaf surface. Late in the season, dark teliosori appear on the leaves.
- The rust pustules may appear on petioles, stems and pods. The pycnial and aecial stages are unknown

Pathogen: *Uromyces ciceris-arietini*

- The uredospores are spherical, brownish yellow in colour, loosey echinulated with 4-8 germ pores.
- Teliospores are round to oval, brown, single celled with unthickened apex and the walls are rough, brown and warty.

4. Dry root rot

Symptoms

- The pathogen is seed-borne and primarily causes seedling blight and collar rot in the initial stages. The grown up plants also show symptoms after flowering stage.
- The infected plants show drooping of leaves and death occurs in patches.
- The bark of the lower stem and roots shreds and are associated with a large number of sclerotia.
- Dark coloured, minute pycnidia also develop on the lower portion of the stem.

Pathogen: *Rhizoctonia bataticola*

- The fungus produces a large number of black, rounds to irregular shaped sclerotia.
- The pycnidia are dark brown to black with an ostiole and contain numerous single celled, thin walled, hyaline and elliptical pycnidiospores.

5.* Wet root rot: *Rhizoctonia Solani

Symptoms:

- The infected seedling slowly turn yellow and petioles and leaflets show drooping symptoms that leads to complete drying of the plant.
- The stem near the collar region shows rotting symptom.

Pathogen:

- The hyphae of the fungus are dark brown, filamentous and septate with constrictions.
- The sclerotia are brown and irregular in shape.
- The fungus has its sexual stage. *Thanephorus cucumeris*, which produces 2-4 basidiospores in terminal clusters on a short called hypha.

6. Collar rot

Symptoms

- It comes in the early stages i.e up to six weeks from sowing. Drying plants whose foliage turns slightly yellow before death, scattered in the field is an indication of the disease. Seedlings become chlorotic.
- The joint of stem and root turns soft slightly contracts and begins to decay.
- Infected parts turn brown white. Black dots, like mustard in shape known as sclerotia are seen appearing on the white infected plant parts.

Pathogen: *Sclerotium rolfsii*

- Fungus produces white cottony radiating mycelia with mustard seed like sclerotia on the infected plant parts

7. Stunt disease

Symptoms

- Affected plants are stunted and bushy with short internodes.
- The leaflets are smaller with yellow, orange or brown discoloration. Stem also shows brown discoloration. The plants dry prematurely.
- If survive, a very few small pods are formed. Phloem browning in the collar region is the most characteristic symptom of the stunt, leaving xylem normal.

Pathogen: Chlorotic stunt virus

- The virus is transmitted by *Aphis craccivora*

DISEASES OF LENTIL

1. Fusarium Wilt

Symptoms:

- It usually occurs near or at the reproductive stages (flowering to pod-filling) of crop growth.
- Symptoms include the drooping and wilting of the uppermost leaflets and discolouration of the vascular system. Plants become completely yellow and die.
- When the plants are affected during the mid- to late-pod filling stages, seeds are often shriveled

Pathogen: *Fusarium oxysporum* f.sp. *lentis*

- The fungus produces hyaline to light brown, septate and profusely branched hyphae.
- Micro conidia are oval to cylindrical, hyaline, single celled, normally arise on short conidiophores.
- Macro conidia which borne on branched conidiophores, are thin walled, 3 to 5septate, fusoid and pointed at both ends.
- Chlamydospores are roughwalled or smooth, terminal or intercalary, may be formed singly or in chains

2. Ascochyta blight

Symptoms

- The symptoms of the disease include lesions on leaves, petioles, stems and pods.
- The irregularly shaped lesions on leaves, petioles and stem are tan and darker brown on pods and seeds.
- Black pycnidia are visible in the centre ofmature/older lesions. In severe infection, lesions can girdle the stem, leading to breakage and subsequent death of all tissues above the lesion.
- Heavily infected seeds are shriveled and discoloured with whitish mycelium and pycnidia

Pathogen: ***Ascochvta lentis***

- The asexual stage is characterized by the production of pycnidia in the lesions on infected plants, the pycnidia release conidia which are cylindrical, straight or rarely curved, round at the ends with a median septum.
- The teleomorph *(Didvmella lentis)* was observed for the first time on over wintered lentil straw which produced fertile pseudothecia and viable ascospores.

3. Rust

Symptoms

- Rust starts with the formation of yellowish-white pycnia and aecial cups on the lower surface of leaflets and on pods, singly or in small groups in a circular form.
- Later, brown uredial pustules emerge on either surface of leaflets, stem and pods. Pustules are oval to circular. They may coalesce to form larger pustules.
- The telia, which are formed late in the season, are dark brown to black, elongated and present mainly on branches and stems.
- In severe infections leaves are shed and plants dry prematurely and the affected plant dries without forming any seeds in pods or with small shriveled seeds.

Pathogen: *Uromyces viciae-fabae*

- It is an autoecious fungus, completing its life cycle on lentil.
- The aecia of are formed usually in groups surrounding the pycnia or sometimes scattered, cupulate. The aeciospores are spheroidal, wall hyaline, verrucose.
- Uredia are amphigenous and on the petioles and stems, scattered, cinnamon color. Uredospores are ellipsoidal with very finely echinulations.
- Telia are like the uredia but black and larger. Teliospores are ellipsoidal chestnut brown colored , and smooth

DISEASES OF SUNFLOWER

1. Root rot or charcoal rot

Symptoms

- The pathogen is seed-borne and primarily causes seedling blight and collar rot in the initial stages.
- The grown up plants also show symptoms after flowering stage. The infected plants show drooping of leaves and death occurs in patches.
- The bark of the lower stem and roots shreds and are associated with a large number of sclerotia.
- Dark coloured, minute pycnidia also develop on the lower portion of the stem.

Pathogen: *Rhizoctonia bataticola* (Pycnidial stage*: Macrophomina phaseolina*)

- The fungus produces a large number of black, round to irregular shaped sclerotia.
- The pycnidia are dark brown to black with an ostiole and contain numerous single celled, thin walled, hyaline and elliptical pycnidiospores.

2. Leaf blight

Symptoms

- The pathogen produces brown spots on the leaves, but the spots can also be seen on the stem, sepals and petals.
- The lesions on the leaves are dark brown with pale margin surrounded by a yellow halo.
- The spots later enlarge in size with concentric rings and become irregular in shape.
- Several spots coalesce to show bigger irregular lesions leading to drying and defoliation.

Pathogen: *Alternaria helianthi*

- The pathogen produces cylindrical conidiophores, which are pale grey-yellow coloured, straight or curved, geniculate, simple or branched, septate and bear single conidium.
- Conidia are cylindrical to long ellipsoid, straight or slightly curved, pale grey-yellow to pale brown, 1 to 2 septate with longitudinal septa.

3. Downy Mildew

Symptom

- First symptoms are yellowing of the first pair of true leaves.
- Sunflower plants carrying systemic infection are severely stunted and leaves are entirely chlorotic.
- Affected plants bear abnormally thick, downward curled leaves showing prominent yellow and green mottling.
- The stem becomes brittle. Small angular greenish yellow lesions may appear on leaves as a result of secondary infection. Fungal growth is visible at lower surface.

Pathogen: *Plasmopara halstedii*

- Obligate biotroph produces intercellular mycelium with haustoria.
- During asexual reproduction, it produces right angle branched sporangiophore with hyaline, oval shaped, thin walled sporangia.
- During sexual reproduction, the fungus produces oospores with long dormancy

4. Rust

Symptoms:

- Small, reddish brown pustules (uredia) covered with rusty dust appear on the lower surface of bottom leaves.
- Infection later spreads to other leaves and even to the green parts of the head.
- In severe infection, when numerous pustules appear on leaves, they become yellow and dry.
- The black coloured telia are also seen among uredia on the lower surface.
- The disease is autoecious rust. The pycnial and aecial stages occur on volunteer crops grown during off-season.

Pathogen: *Puccinia helianthi*

- The uredospores are round or elliptical, dark cinnamon-brown in colour and minutely echinulated with 2 equatorial germpores.
- Teliospores are elliptical or oblong, two celled, smooth walled and cheshnut brown in colour with a long, colourless pedicel.

5. Head rot/ Capitulum rot

Symptoms

- The affected heads show water soaked lesions on the lower surface, which later turn brown
- The discoloration may extend to stalk from head. The affected portions of the head become soft and pulpy and insects are also seen associated with the putrified tissues.
- The larvae and insects which attack the head pave way for the entry of the fungus which attacks the inner part of the head and the developing seeds.
- The seeds are converted into a black powdery mass. The head finally withers and droops down with heavy fungal mycelial nets.

Pathogen: *Rhizopus sp*.

- Pathogen produces dark brown or black coloured, non-septate hyphae.
- It produces many aerial stolens and rhizoids. Sproangia are globose and black in colour with a central columella.
- The sporangiospores are aplanate, dark coloured and ovoid.

6. Powdery mildew

Symptoms

- The disease produces white powdery growth on the leavesWhite to grey mildew on the upper surface of older leaves.
- As plant matures black pin head sized are visible in white mildew areas.
- The affected leaves more luster, curl, become chlorotic and die.

Pathogen: *Golovinomyces cichoracearum*

- The fungus produces ectophytic, branched, septate mycelium.
- During asexual reproduction, it produces hyaline, cylindrical, thin walled, single celled conidia in chain on a short club shaped conidiophores

7. Basal rot

Symptoms

- Initial symptoms of the disease appear 40 days sowing.
- The infected plants can be identified by their sickly appearance. Plants dry up due to the disease infestation.
- The lower portion of stem is covered with white or brownish white fungal colonies. In extreme cases the plants wilts and dies.
- Dark brown lesions appear on the base of the stem near ground level, leading to withering. Large numbers of sclerotia are seen.

Pathogen: *Sclerotium rolfsii*

- It is a necrotrophic fungal pathogen produces hyaline, septate, branched radiating mycelium.
- It produces numerous small brown colored mustard seed like sclerotia with high degree of dormancy

8. Necrosis -Tobacco streak virus (TSV)

Symptoms:

- mosaic on leaves that leads to extensive necrosis of leaf lamina, petiole, stem, floral calyx and complete death of seedlings
- Early infection either kills the plant or causes severe stunting with malformed head filled with chaffy
- seeds Necrosis at bud formation stage makes the capitulum to bend and twist Complete failure of seed setting and maturation.

Pathogen: Tobacco streak virus

- It is an *Ilarvirus* with 25-28 nm, tripartite genome encapzidated separately.
- Virus spreads through thrips *Frankliniella schultzii*.

DISEASES OF MUSTARD

1. Alternaria blight

Symptoms

- The disease attacks on the lower leaves as small circular brown necrotic spots which slowly increase in size.
- Many concentric spots coalesce to cover large patches showing blightening and defoliation in severe cases.
- Circular to linear, dark brown lesions also develop on stems and pods, which are elongated at later stage.
- Infected pods produce small, discolored and shriveled seeds.

Pathogen: *Alternaria brassicola* and *Alternaria brassicae*

- It is a necrotrophic fungal pathogen produced conidia formed in chains or solitary.
- The conidia are typically ovoid to obclavate, often beaked, pale brown to brown, multi-celled and muriform.

2. White rust

Symptoms

- Both local and systemic infections are observed.
- In case of local infection, white creamy yellow raised pustules appear on the leaves which later coalesce to form patches.
- In systemic infection and during humid weather, mixed infection of white rust and downy mildew cause swelling and distortion of the stem and floral parts due to hypertrophy and hyperplasia and develop "stag head" structure

Pathogen: *Albugo candida (Cystopus candidus)*

- The mycelium is intercellular that produces knob like haustoria in the host cells.
- The pathogen produces endogenous sporangia in chain.
- The sporangia germinate directly to produce mycelium and indirectly by producing zoospores.
- The pathogen perpetuates through the ornamented reticulate oospores lying in the diseased plant debris.

3. Downy Mildew

- Light green or slightly chlorotic lesions that become yellow or necrotic after sporulation.
- Lesions are angular and variable in size, but are often bounded by large veins.
- The bottom sides of leaves develop a fluffy or downy appearance from sporulation during cool, moist conditions.
- Old lesions become necrotic and translucent after invasion by secondary saprophytes.
- Seedlings may be killed or develop dark brown vascular systems from severe infections, but older plants are rarely killed.

Pathogen: ***Peronospora brassicae***

- It is an obligate parasite that produces intercellular mycelia with large finger shapedbranched haustoria,
- Numerous erect dichotomously branched sporangiophores with pointed sterigmata which bears hyaline, thin walled , spherical to oval shaped sporangia.
- The sporangia directly germinate and produces mycelium
- Under unfavourable condition , it produces thick walled dormant resting oospores

4. Powdery mildew

Symptoms

- Symptoms appear as dirty white, circular, floury patches on either sides of the leaves.
- Under favourable environmental conditions, entire leaves, stems, floral parts and pods are affected. The whole leaf may be covered with powdery mass

Pathogen: *Erysiphe cruciferarum*

- Mycelium of the fungus appears as small radiating and diffuses colonies of superficial white on the surface of the leaf.
- The conidia are singly produced (not in chains) and are ovoid to cylindrical in shape.
- The asci and ascospores are produced in chasmothecium.

5. Club root

Symptom

- Affected plants remain stunted.
- Tiny nodules to large club shaped outgrowths develop in the root system.
- Leaves turn pale green or yellow followed by wilting and under severe conditions the plants die.

Pathogen: ***Plasmodiophora brassicae***

- It is an obligate parasite belongs to protozoa.
- The vegetative thallus is plasmodium. It follows a special form of nuclear division i.e., cruciform division.
- It produces zoospores during asexual reproduction and resting spores during sexual reproduction.

6.Sclerotinia stem rot

Symptom

- Elongated water soaked lesions appear on stem near to the crown region, covered with cottony mycelial growth later on.
- Plant looks like whitish from distance at internodes or base.
- Premature ripening and shredding of stem, wilting and drying.
- Brown to black sclerotial bodies may also be seen on the infected plant parts.

Pathogen: *Sclerotinia sclerotiarum*

- Mycelium of the fungus is hyaline, septate, branched and radiating on infected parts.
- The fungus produces hard, irregular, flattened sclerotia during asexual reproduction.
- The sclerotia germinate and produce apothecia with asci and ascospores

7. Bacterial blight/ black rot

Symptoms

- The leaf tissue turns yellow and chlorosis reach towards the centre of the leaf and form V shaped area with base of V towards the midrib. The veins show brown to black discoloration.
- Dark coloured streaks are formed on the stem from the ground level and gradually these streaks enlarge and girdle the stem.
- Stem become hollow due to internal rotting.
- Midrib cracking of lower leaves, browning of veins and withering is observed.
- In severe cases, the vesicular bundles of the stem also turn brown and the plant collapses.

Pathogen: *Xanthomonas campestris pv campestris*

- It is a gram negative, rod shaped, soil bone bacterium with single polar flagellum.
- It produces yellow pigment xanthomonadin

8. Parasitic weed: Broomrape: *Orobanche aegyptiaca* L.(Orobanchaceae)

- Broomrape is an annual total root parasites lacking chlorophyll, upto 1 m tall.
- Usually parasitize solanaceae and fabaceae hosts reducing crop yield severely.
- Seeds germinate in response to host root exudates and the seedlings must come in contact with host root immediately after germination.
- Some species may produce flowers within a week of emergence from the soil.
- Seeds of orobanche are irregular wedge shaped oblong, tiny dust like 0.2 to 0.5 mm long black to brown coloured.

Ex. No.3 **DISEASES OF COTTON AND SUGARCANE**

Date:

DISEASES OF COTTON

1. Fusarial wilt

Symptoms

- First symptoms on young seedlings are yellowing and browning of cotyledons, followed by brown ring on the petiole.
- Finally wilting & drying of the seedling occur. Infection at later stages includes lossof turgidity, yellowing, drooping and wilting, starting from older leaves.
- Browning or blackening of vascular tissues occur on the stem and spreads upwardsand downwards. Infected plants stunted with fewer bolls

Pathogen: ***Fusarium oxysporum f.sp vasinfectum***

- The fungus produces three types of spores. Macroconidia are 1 to 5 septate, hyaline, thin walled, falcate with tapering ends.
- The microconidia are hyaline, thin walled, spherical or elliptical, single or two celled.
- Chlamydospores are dark coloured and thick walled.
- The fungus also produces a vivotoxin, Fusaric acid which is partially responsible for wilting of the plants.

2. Verticilium wilt

Symptoms

- If affects the crop in square and boll formation stages.
- Bronzing of veins followed by interveinal chlorosis, yellowing and scorching of leaves.
- It exhibits drying of leaf margins and areas between veins known as Tiger stripe symptom.
- Affected plants remain barren showing pinkish discolouration in stem and wood.
- It may produce smaller bolls

Pathogen: ***Verticillium dahliae***

- The fungus produces hyaline, septate mycelium and two types of spores.
- The conidia are single celled, hyaline, spherical to oval, borne singly on verticillate conidiophores.
- The micro sclerotia are globose to oblong, measuring 48-120 X 26-45um.

3. Root rot

Symptoms

- Germinating seedling shows black lesions on hypocotyls, girdling of stem and death of seedling
- Affected basal stem becomes dark with bark shredding and scloretial bodies in the shredded bark
- The entire root system gets rotted, plants dried & can be easily pulled out

Pathogen: *Rhizoctonia bataticola*

- The fungal hyphae are septate and fairly thick and produce black, irregular minute sclerotic with mycelia attachment.

4. **Anthracnose : *Colletotrichum capsici***

- Small reddish circular spots on the cotyledons of the seedlings
- Collar region shows lesions leading to wilting and drying. In matured plants stem splitting and shredding of bark
- In bolls, water soaked reddish brown spots known as boll spotting leading to premature bursting and drying

Pathogen: *Colletotrichum capsici*

- The pathogen forms large number of acervuli on the infected parts.
- The conidiophores are slightly curved, short, and club shaped
- The conidia are hyaline and falcate, borne single on the conidiophores.
- Numerous black coloured and thick walled setae are also produced in acervulus.

5. Grey or Areolate mildew

- Irregular to angular pale translucent lesions on lower surface, bound by veinlets and grey powdery growth
- Light green specks on upper surface
- In severe cases whitish grey powdery growth on upper surface. Affected leaves dry up inward turn yellow and fall prematurely

Pathogen: *Ramularia areola*

- The fungus produces endophytic, septate mycelium. Conidiophores are short, hyaline and branched at the base. Conidia are borne singly or in chains at the tips of conidiophores.
- The conidia are hyaline, irregularly oblong with pointed ends, sometimes rounded to flattened ends, unicellular or 1-3 septate.
- The perfect stage of the fungus produces perithecia containing many asci. The ascospores are hyaline and usually two celled.

6. **Boll rot**

- Brown or black dots covering entire bolls
- Rotting may be internal or external
- Bolls do not open and fall prematurely

Pathogen: *Fusarium moniliforme*; *Aspergillus flavus*

Fusarium moniliforme

- Mycelium - septate, hyaline, Conidiophore- slender, short, hyaline, simple, stout or branched irregularly.
- Two types of conidia – macroconidia (several celled, slightly curved or bent, pointed at the both the ends, sickle shaped), microconidia (1 or 2 celled, ovoid, single or in chains, hyaline) and also Chlamydospores : terminal or intercalary, produced singly or in chains by the mycelial hyphae or macroconidia.

Aspergillus flavus

- Mycelium*:* highly branched, septate. Conidiophore: characteristic symmetric or asymmetric broom like fashion.
- The first generation branches are called primary branches or rammi, on which whorls of second generation branches called metulae are produced.
- Each metula ultimately bears bottled shaped phialides which bears conidia in chains in basipetal succession. Conidia: globose, hyaline.

7. **Leaf blight**

- It affects all stages of crop. Initially, produces small, brown irregular to round spots with a central necrotic lesions which on coalesce form large blighted areas
- The affected leaves brittle and fall off. Symptoms are also in stems, bracts and bolls in severe cases

Pathogen: *Alternaria macrospora*

- The fungus produces dark brown, short, 1-8 septate, irregularly bent conidiophores with a single conidium at the apex.
- The conidia are obclavate, light to dark brown in colour with 3-9 transverse septa and 4 longitudinal septa, with a prominent long beak.

8. **Bacterial blight**

- Water soaked, circular or irregular lesions on cotyledons which spread to petiole and stem and finally withering and death of seedling known as Seedling blight
- The infection of veins and veinlets shows blackening with crinkled and twisted leaves and bacterial oozing
- Black lesions on stem and branches, premature drooping off of the leaves resulting in die back known as Black arm. It also affects the bolls causing boll rot

Pathogen: ***Xanthomonas campestris p.v malvacearum***

- The bacterium is a short rod with a single polar flagellum. It is gram negative, non-spore forming and measures 1.0-1.2 X 0.7-0.9 μm.
- The bacterium is aerobic, capsule forming and produces yellow colonies in culture medium.

9. Stenosis (or) Small leaf:

- Affected plants stunted, produces smaller leaves in clusters due to profuse vegetative growth
- Leaves disfigured and flower with abortive ovary
- Premature dropping of flower buds and bolls
- Root system poorly developed
- Basal stem with short branches bearing small and cluster of deformed leaves

Pathogen: ***Candidatus Phytoplasma***

- Phytoplasma is found in the sieve cells of infected plants.
- Two types of bodies are noticed, spherical bodies of 300-400 nm diameter and filamentous bodies of 30-53 mm diameter.

10. Cotton leaf curl

Symptoms

- Leaves of infected cotton curl upward and bear leaf-like enations on the underside along with vein thickening.
- Plants infected early in the season are stunted and yield is reduced drastically.
- This virus devastated the Pakistan cotton industry in early 1990s where it caused an estimated yield reduction of 30-35%.

Pathogen: Cotton Leaf curl virus

- Cotton leaf curl virus (CLCuV) is a plant pathogenic virus species of the family *Geminiviridae*. It is a DNA virus.
- Vector: White fly *Bamisia tabaci*

DISEASES OF SUGARCANE

1. Red rot : *Colletotrichum falcatum*

Symptoms

- Drooping, withering, and finally yellowing of the 3rd or 4th upper leaves in the crown followed by wilting of the entire crown.
- Dark-reddish zones having tendency to elongate rapidly turning blood-red enclosed by dark margins.Reddening of internal tissue with white cross bands.
- Shrivelling of canes with black specks. Infected cane gives sour smell

Pathogen: *Colletotrichum falcatum*

- The fungus produces thin, hyaline, septate, profusely branched hyphae containing oil droplets.
- The fungus produces black, minute velvetty acervuli with long, rigid bristlelike, septate pointed setae on the surface of rind, leaf midrib and sometimes in the pith region.
- Conidiophores are closely packed inside the acervulus, which are short, hyaline and single celled. The conidia are single celled, hyaline, falcate, granular and guttulate.
- perfect stage of the fungus produces large number of globose and dark brown to black perithecia with a papillate ostiole. Asci are clavate, unitunicate and eight spored.
- Large number of hyaline, septate, filiform paraphyses is also present among asci. Ascospores are ellipsoid or fusoid, hyaline, straight or slightly curved and unicellular

2. Smut

Symptoms

- It is a Culmiculous smut.The central shoot converted into long whip like dusty black structure
- Whip covered by white papery membrane, in maturity membrane ruptures and liberates smut spores (Teliospores)
- Mummified arrows

Pathogen: *Ustilago scitaminea*

- The fungal hyphae are primarily intercellular and produce tiny black teliospores.
- The thin membrane which covers the smut whip represents the host epidermis.
- The smut spores are light brown in colour, spherical and echinulate.
- Smut spores germinate to produce 3-4 celled, hyaline promycelium and produce 3-4 sporidia which are hyaline and oval shaped with pointed ends.

3. Sett rot or Pineapple disease

Symptoms

- Affected tissues are reddish colour later turns black
- Internal cavities formed due to rotting of internal tissues
- Affected setts produce sweet pine apple odour
- Infection reduced the germination of setts which results in the gap in the field

Pathogen: *Ceratocystis paradoxa*

- Conidia : micro conidia (young-hyaline, maturity-black, thin walled, cylindrical form, endogenously produce chain of conidia) and macro conidia (exogenously produced chain of conidia ,spherical , elliptical, truncate or pyriform , hyaline to olive green or black color.
- Perithecia are gregarious and flask shaped with a long narrow beak. Asci are clavate and the ascospores are convex to elliptical.

4. Rust

Symptoms

- Minute, elongated, yellow spots (uredia) appear on lower surface of young leaves. Later the pustules appear on upper surface also. The pustules turn brown on maturity.
- Late in the season, dark brown to black telia appear on the lower surface of leaves. In severe cases, the uredia also appear on the leaf sheath and the entire foliage looks brownish from a distance.
- The disease affects cane yield and reduces juice quality.

Pathogen: *Puccinia erianthi*

- The mycelium is hyaline, branched and septate. P.kuehnii produces ovoid or pear shaped, single celled uredospores with apical thickening and golden yellow in colour.
- Teliospores are produced in abundance, which are pale to brick colour, two celled, smooth walled and slightly constricted at septum.
- Occurrence of pycnial and aecial stages and the role of alternate host are unknown.

5. Pokkah Boeng

Symptoms

- Development of disease symptom in four phases was observed namely chlorotic phases I and II, top rot and knife cut phase
- Appearance of chlorotic patches towards the base of the young leaves
- In acute cases disease shows distortion of stalk with external and internal cut like lesions and rotting of apical part of stalk.
- Under field conditions, the disease may develop many variations from the general symptoms, but the final result is usually a malformed or damaged top and stalk.
- The base of affected leaves is often narrower as compared to normal leaves.
- Knife cut symptoms of the disease were reported in varieties some varieties.

- The apical leaves may also show pronounced wrinkling and twisting depending upon the susceptibility of varieties and existing climatic conditions also malformed or damaged top and stalk due to this disease.

Pathogen: - *Fusarium moniliformae*

- Asexual reproduction -Macro and micro conidia are produced.
- Micro conidia are hyaline, single celled and oval.
- Macro conidia are slightly sickle shaped, and two to five celled.
- The fungus produces the phytotoxin, fusaric acid, which is non-host specific.

6.Gummosis

Symptoms

- Leaves – longitudinal streaks or strips, strips are pale yellow later brown color changed.
- Canes- it are stunted with short internodes , bushy appearance
- Nodal region vascular system – dull yellow bacterial ooze comes out from the cut end of through cracks of the canes, vascular bundles are deep red colour

Pathogen: *Xanthomonas campestris* pv *vasculorum*

- The bacterium is a short rod, 1.0-1.5x0.4-0.5µ, motile single polar flagellum, gram – ve, non- spore, non-capsule, and non-acid-fast.

6. Red stripe

- Chlorotic lesions carrying dark red stripes, several of them coalesce to cover large areas of the leaf blade and to cause the wilting and drying of the leaves.
- The growing tips are yellow and later reddish with dark brown stripes.rotting are comes from tip to downwards dark red discolouration of tissue.

Pathogen: *Pseudomonas rubrilineans*

- Short rod 0.7-1.5x0.4-0.7µ, it is motile single polar flagellum, it is gram negative, non-acid , non-capsular , and produce small glistening, buff to yellow colonies on medium.

7. Sugarcane Mosaic

- Chlorotic stripe alternate with normal green in young leaf and leaf sheath
- Plant stunted and chlorotic

Pathogen: *Potato Virus Y*

- Sugarcane mosaic virus is rod shaped, measuring 650-770 X 12-15µm. It belongs to Potato Virus Y group. In India atleast six strains, viz., A, B, C, D, E, and F have been identified. Strain B is the most common which produces a mild mottle of the leaf.

8. Grassy shoot

- Clumps stunted, thin with short internodes having aerial roots

- Leaves pale yellow to chlorotic thin and narrow
- Plants appear bushy – appears grass like
- Buds papery and abnormally elongated

Pathogen: ***Candidatus Phytoplasma***

- Phytoplasma is found in the sieve cells of infected plants. Two types of bodies are noticed, spherical bodies of 300-400 nm diameter and filamentous bodies of 30-53 mm diameter.

9. **Phanerogamic parasite :** ***Striga euphrasioides***

- Partial root parasite, growing up from the roots to form a leafy shoots.
- The parasite cans synthesis carbohydrates through the green chlorophyll pigments in the leaves but its other nutrients it depends on host root.
- It is usually controlled by pulling out the shoots before flowering and seed set.

Ex. No.4 **DISEASES OF MANGO AND SAPOTA**

Date

DISEASES OF MANGO

1. MALFORMATION

Symptoms

Bunchy top phase

- Formation of bunch of thickened small shootlets.
- Shootlets are short and stunted.
- Gives bunchy top appearance

Vegetative malformation

- Excessive vegetative branches. Swollen with short internodes.
- Seedlings give a bunchy top appearance.

Floral malformation

- Malformed head dries as black mass.
- Persist in the tree for long time.
- Primary axis and vegetative branches are transformed into vegetative branches shortened and resemble witches broom.
- The affected inflorescence are of three types viz., heavy , medium and light

Pathogen: ***Fusarium moniliforme* var. *subglutinans***

- The Pathogen produces microconidia, macroconidia and chlamydospores.
- Microconidia are 1 or 2 celled, oval, fusiform. Macroconidia are 2 or 3 celled, septate, falcate and tapered at the end.

2. POWDERY MILDEW

Symptoms

- Powdery growth covers the stalks of the panicle, flowers, tender fruits and leaves.
- Affected fruits and flowers fall prematurely.

Pathogen: *Oidium mangiferae*

- Mycelium is hyaline, branched, septate. It produces haustoria inside the epidermal cells.
- It also produces short conidiophore and conidia.
- Conidia are borne singly (or) rarely in chains.

3. ANTHRACNOSE:

Symptoms

- The varieties Neelam and Malgoa are highly susceptible
- Black or dark coloured circular spots on leaves with shot holes.
- Die back symptom on young twigs and inflorescence
- Flower stalk infected, flowers wither and shed. Tender fruits turn black and fall off.
- Black circular or irregular sunken spots on fruits

Pathogen: *Gloeosporium gloeosporiodes*

- The Pathogen produces acervuli which appear as pinkish dots.
- Conidia are borne on hyaline conidiophores.
- Conidia are straight (or) cylindrical (or) oval, hyaline with 2 oil drops and non-septate with round ends

4. DIE BACK

Symptoms

- Prevailing in abandoned gardens
- Dying of twigs from tip downwards
- Leaves turn brown and upward rolling. Leaves fall off
- Internal browning of wood tissue and cracks appear on branches which exude gum.
- Base of pedicel of fruit darkens. Circular black patch appears which turn fruit completely black. Pulp becomes brown and soft.

Pathogen: *Lasiodiplodia theobromae*

- Pycnidial fungi inside the pycnidia, conidiogenous cells produce hyaline thin walled pycnidiospores which become brown, thick walled, two celled with longitudinal striations.

5. SOOTY MOULD

Symptoms

- Black encrustation formed on flowers, leaves ,stem and fruit
- Mycelium superficial and lives on the sugary secretion of the sucking pests like hoppers, jassids, aphids and mealy bugs.
- Photosynthetic activity of plant is reduced

Pathogen: *Capnodium mangiferae*

- Fungus produces 5 types of conidia such as1. Torula 2. Trichothecium 3. Coniothecium 4. Brachysporium 5. Ascospores from Pseudothecia

6. GREY BLIGHT

Symptoms

- Brown spots develop at the margin and tip of the leaf lamina and distributed irregularly on the entire leaf.
- Black dots appear at the centre of the ashy grey spots represent the acervuli.

Pathogen: *Pestalotiopsis mangiferae*

- Conidia are 5-celled, clavate / fusiform. Top and bottom cells are hyaline and middle 3 cells are dark coloured.
- Appendages are seen at the top portion.

7. Red rust

Symptoms

- Spots are greenish grey in colour and velvety in texture with feathery margin.
- Later they turn reddish brown.
- Algal spots on fruits reduce the quality and marketability

Pathogen: *Cephaleuros virescens*

- The algae produce sporangia on sporangiophore.
- 5-8 sporangia are formed on each vesicle.
- Sporangia produce numerous quarter flagellate zoospores.

8. Bacterial leaf spot

Symptoms

- Leaf lesions consist of black, raised, angular areas, restricted by the veins and frequently surrounded by a yellow margin.
- Elongated stem cankers occur on the bark and can cause terminal dieback. Fruit lesions consist of individual or multiple star-shaped cracks, often appearing with anthracnose lesions in a tearstain pattern.
- The bacterial lesions do not expand as the fruit ripen.
- In young trees the disease can cause dieback of branches.

Pathogen: *Xanthomonas axonopodis pv. mangiferae*

- It is a gram negative, rod shaped bacterium with single polar flagellum.
- Commonly multiplied by binary fission

9. **GIANT MISTLETOE: Partial stem parasite – Loranthus** *(Dendrophthoe spp.)*

- The flowering plant parasitizes slender branches of the host tree by means of bulged haustoria.
- It derives nutrients and water from the host and makes the host branches to die.
- The severely attacked trees are weakened and their productivity is lowered.

DISEASES OF SAPOTA

1. Flat limb

Symptoms

- Branches of the affected trees become flat and twisted with severe bunching of leaves which become small, thin and yellow.
- The affected branches bear small, dry, hard and shrivelled fruits and these affected branches give rise to normal branches during summer months.

Pathogen: ***Botryodiplodia theobromae***

- The fungus produces pycnidia.
- Young conidia are hyaline thin walled and single celled.
- Matured conidia are dark brown in colour, 2 celled.

2. Sooty mould

Symptoms

- Black encrustation formed on flowers, leaves ,stem and fruit
- Mycelium superficial and lives on the sugary secretion of the sucking pests like hoppers, jassids, aphids and mealy bugs.
- Photosynthetic activity is reduced which results in reduced fruit set and fruit fall

Pathogen: *Capnodium mangiferae*

- Fungus produces 5 types of conidia such as 1. Torula 2. Trichothecium 3. Coniothecium 4. Brachysporium 5. Ascospores from Pseudothecia

3. Leaf spot

Symptoms

- Small circular pink to dark brown spots with whitish centre appear on leaves at the time of maturity
- Premature leaf fall resulting in yield reduction.
- Maximum incidence of the disease is observed in the months of October to December

Pathogen: ***Phaeophleospora indica***

- Sub epidermal dark walled cup shaped pycnidia which contains brown, verrucose, cylindrical conidiophores
- Conidia are cylindrical, brown smooth walled single to multi septate

4. Grey blight

- Numerous small reddish brown pecks on lamina
- Greyish centre with reddish margin
- In the centre black fruiting bodies seen

Pathogen: ***Pestalotiopsis versicolor***

- Conidia are 5-celled, clavate / fusiform.
- Top and bottom cells are hyaline and middle 3 cells are dark coloured with appendages

Ex.No:5 **DISEASES OF CITRUS AND GRAPEVINE**

Date:

DISEASES OF CITRUS

1. Foot rot/ Gummosis/ Leaf fall

Symptoms

- Sap oozing from small cracks in the infected bark, giving the tree a bleeding
- Profuse exudation of gum from the bark of the trunk
- The bark stays firm, dries, and eventually cracks and sloughs off appearance
- Lesions spread around the circumference of the trunk, slowly girdling the tree.
- Decline may occur rapidly within a year

Pathogen: ***Phytophthora palmivora***

- Hyaline coenocytic mycelium.
- Sporangiophores are slender sympodially branched which bears elliptical non-papillate sporangia with slight apical thickening with kidney shaped, biflagellate zoospores.
- Sexual spore is oospore

2.Scab / Verucosis

Symptoms

- Sour orange, rough lemon and tangerine are highly susceptible

On Twigs, petioles or newly emerging shoot apices

- Tangerine cultivar of citrus is highly susceptible.
- Light brown, raised, circular scabs appear on young stems or green twigs.

On Leaves

- Light brown pustules or scabs develop on young leaves, and are sometimes visible on both upper and lower surfaces. Distortion and malformation of leaves.

On Fruits

- Light brown, raised, rounded, warty scabs appear on the rind of young fruits.
- Scab will be pink to light brown during disease initiation and from grey to black later in the season.

Pathogen: ***Elsinoe fawcettii***

- **Asexual stage:** *Sphaceloma fawcettii*
- Conidia are produced on acervuli on the surface of lesions on leaves or fruit with larger, spindle-shaped hyaline single celled conidia with minute droplets/oil globules at the end.
- **Sexual stage:** *Elsinoe fawcettii*
- Produce pseudothecium with ascus and ascospores which are hyaline to yellow, 1 to 3 septate and elliptical.

3. Anthracnose / Die back

Symptoms

- Dark brown circular spots with grey brown centre and acervuli are arranged in concentric circle on leaf lamina
- Branches wither from tip to downwards.
- Acervuli appear as black dots on dead twigs and fruits.
- Initially reddish brown spots develop on fruits and later turn to brown colour circular and sunken spots.

Pathogen: ***Gloeosporium gloeosporioides***

- Hyaline, septate and branched conidiophore on which cylindrical, single celled, hyaline and thin walled conidia with large number of oil globules are produced.

4. Powdery mildew

Symptoms

- White powdery patches of fungal growth on upper surface of young leaf.
- In severe cases covers the entire leaf, petiole and stem.
- Yellowing, crinkling and defoliation of leaf
- Young fruits are affected and drop off.

Pathogen: *Acremonium (Oidium) tingitaninum*

- Mycelium is ectophytic, hyaline and branched
- Hyaline club shaped conidiophore with chain of barrel shaped conidia arranged in basipetal succession.
- Sexual fruiting body is chasmothecium which bears asci and ascospores.

5. Sooty mould

Symptoms

- Black encrustation formed on flowers, leaves ,stem and fruit
- Mycelium superficial and lives on the sugary secretion of the sucking pests lik hoppers, jassids, aphids and mealy bugs.
- Photosynthetic ability reduced which results in reduced fruit set and fruit fall

Pathogen: *Capnodium citri*

- The fungus produces 5 types of conidia such as 1. Torula 2. Trichothecium 3. Coniothecium 4. Brachysporium 5. Ascospores from Pseudothecia

6. Canker

Symptoms

Lime is highly susceptible while sweet orange is highly resistant

Leaf canker

- Circular brown colour corky cankerous growth with yellow halo on both the surface of the leaves

Stem canker

- Irregular corky lesions appear on the petiole, twigs and young stem leads to die back symptom
- Girdling of stem and partial or complete drying of seedlings

Fruit canker

- Corky cankerous out growth seen on the fruits without yellow halo and reduces market value.

Pathogen: *Xanthomonas axonopodis* pv.*citri*

- Gram negative rod shaped bacteria , motile with single polar flagellum

7. Citrus Greening /Huanglongbing (HLB)

Symptoms

- Stunting of leaves, sparse foliation, twig die back, green fruits with a yellow patches on the rind
- Chlorosis of leaves resemble to Zn deficiency
- Twigs become upright position with smaller leaves
- Fruits are small lopsided with curved columella
- Sun exposed side of the fruits developed full orange colour, other side remain dull olive green in colour .Fruits low in juice with high soluble solid and acidity
- Seeds are poorly developed, dark coloured and aborted

Pathogen: *Candidatus Liberibacter asiaticus*

- It is a phloem limited fastidious bacterium transmitted by Asian citrus psyllid, *Diaphorina citri*

8. TRISTEZA /QUICK DECLINE

Symptoms

- Vein flecking in large number on leaves,
- Stunting of trees, stem pitting, root decay, dieback of twigs,
- Yield is reduced and fruits are very small.

Pathogen: Citrus tristeza virus

- Flexuous thread like rod shaped RNA virus and located in phloem vessels of the root stock.
- Vector: Black citrus aphid-*Toxoptera citricidus / T.auranti*

5. GIANT MISTLETOE: *Loranthus* *(Dendrophthoe spp.)*

- The flowering plant parasitizes slender branches of the host tree by means of bulged haustoria.
- It derives nutrients and water from the host and makes the host branches to die.
- The severely attacked trees are weakened and their productivity is lowered.

DISEASES OF GRAPES

1. Downy mildew

Symptoms

- Small translucent, pale yellow oily spots on upper surface and downy growth on the corresponding lower surface.
- Severe infection leads to development of necrotic lesions and finally resulting in defoliation
- Infected leaves, shoots and tendrils are covered with whitish growth. Flowers and berries affected
- Affected berries leathery and wrinkled and become mummified without cracking.

Pathogen: *Plasmopara viticola*

- Hyphae are coenocytic, thin walled and hyaline.
- Sporangiophores produced in clusters branched at right angles.
- At the apex of each branch, 2-3 sterigmata arises which borne thin walled, lemon shaped papillate sporangia containing zoospores.
- Zoospores are reniform or kidney shaped, biflagellate with tinsel and whiplash type flagella.
- Sexual or resting spores are called oospores which are brown and thick walled.

2. Powdery mildew

Symptoms

- White powdery patches on the upper surface of the leaf. Leaves discoloured and malformed.
- Powdery growth on the stem, tendrils, flowers, young fruit bunches and berries.
- Stem turns grey and finally dark
- Flowers wither and dry up
- Powdery growth on the berries leads to cracking of berries

Pathogen: *Erysiphe* (*Uncinula) necator*

- Mycelium ectophytic, slender, branched and septate.
- Conidiophores are short, erect and bear a chain of 3 or 4 oval shaped conidia.
- Chasmothecia are black and contain 8 to 12 ovoid asci. Each ascus contains 4 – 6 oval shaped ascospores.

3. Anthracnose / Birds Eye Spot

- Small, circular or irregular dark brown spots with shot hole
- Red spots on berry – circular, sunken and ashy grey – surrounded by dark margin (like birds eye)
- Girdling of the stem

Pathogen: *Elsinoe ampelina*

- Asexual stage: Conidia are hyaline, single celled, oblong or ovoid.
- Sexual stage: Pseudothecia with several asci. Each ascus contains 8 ascospores with 4 celled.

4. RUST:

Symptoms

- Heteroecious rust and the spermogonial and aecial infection appeared on the alternate host, *Meliosma myriantha*.
- Yellowish to brownish rusty pustules appear on the lower surface of the leaves which contains yellowish-orange masses of uredospores.
- The telia are crust-like and orange-brown initially, but become dark brown or almost black.
- Heavy infection causes early senescence and dropping of the leaves.

Pathogen: ***Phakopsora euvitis***

- It is an obligate parasite.
- Uredosori are minute, subepidermical, becoming erumpent, surrounded by cylindrical paraphyses and Urediniospores are yellow, elliptical and pedicellate.
- Telia are subepidermical and teliospores irregularly arranged in 3-4 layers, oblong to cylindrical in shape.

5. Fan leaf

Symptoms

- Virus diseases Vines become stunted or less vigorous than the normal.
- Leaves are variously and severely distorted, asymmetrical, cupped and puckered and exhibit acute dentations. Chlorotic mottling may sometimes accompany foliar deformations.
- Canes are also malformed, showing abnormal branching with shortened internodes.
- Bunches are reduced in number and size, ripen irregularly and have shot berries and poor berry setting.

Pathogen: Grapevine fan leaf NEPO virus (GFLV)

- It is an icosahedral shaped RNA virus
- Vector: Dagger Nematode -*Xiphinema index*

Ex.No:6 **DISEASES OF JACK FRUIT, PINE APPLE, BER, APPLE, PEACH,**

Date: **PLUM, STRAWBERRY**

DISEASES OF JACK FRUIT

1. Pink disease

Symptoms

- Affects young branches and pinkish out growth are seen on the surface
- Further penetrates bark and grows inside and subsequently enters cortex
- Due to interuption of flow nutrients, leaves become yellow
- Leaf crinckle and shedds and twigs get dried. Pink encrustation is seen on the lower shaded area.

Pathogen: ***Pellicularia salmonicolor***

- The mycelium of fungus in the culture appear as hyaline, septate, branched, with rapidly spreading hyphae and produce pink-salmon colour when exposed to shaded natural light.
- The hyphae consist of thickening or swellings at some places called dolipore septa along with prominent clamp connection.
- Conidia of Corticium salmonicolor appeared as small hyaline oval or irregular in shape

2. Rhizopus fruit rot

Symptoms

- In young fruit rots begins in the stalk and covered by the mycelium.
- The fruits are mummified and drop down.

Pathogen: ***Rhizopus atrocarpi***

- Coloured, coenocytic mycelium with rhizoids and tuft of sporangiophore with sporangia.
- Aplanospores are sticky in nature.

DISEASES OF PINEAPPLE

1. Heart rot

Symptoms

- Yellowing of leaves which later in to above brown coloured, yellowish white area at base of leaves with brown margin
- Fruit development is arrested and entire plant wilts from the tip downward
- The fruits exhibits spongy texture
- When the plant is pulled out the roots appear dark and in the process of decaying.

Pathogen: ***Phytophthora parasitica / P. cinnamomi***

- Hyaline coenocytic mycelium.
- Sporangiophores are slender sympodially branched which bears elliptical non-papillate sporangia with slight apical thickening with kidney shaped, biflagellate zoospores.
- Sexual spore is oospore.

DISEASES OF BER

1. Powdery mildew

Symptoms

- The disease appears by the end of October and prevails up to April.
- The disease first appears on young leaves in the form of white floury patches and later spreads to the young shoots and developing fruits.
- With the passage of time, the infected area becomes slightly raised and rough.
- The in-fected fruit often becomes malformed and may shed from the tree.

Pathogen: *Oidium erysiphoides* f. sp. *zizyphi*

- Hyaline club shaped conidiophore with chain of barrel shaped conidia arranged in basipetal succession.
- Sexual fruiting body chasmothecium which bears asci and ascospores.

2. Black leaf spot

Symptoms:

- Sooty tuft like circular to irregular black spot de-velop on leaf surface.
- When infection ad-vances, it covers a large area on the lower sur-face of the leaves and corresponding upper surface shows brownish discoloration

Pathogen: *Isariopsis indica* var. *zizyphi*

- Fungus produces synnemata consists of loose conidiophores which bears dark to ale one or two celled often curved conidia at the top.

3. Anthracnose

Symptoms:

- Irregular, rough or corky reddish brown spots with yellowish margin, having the size of 2 to 3 mm in diameter.
- The spots generally appear on the upper surface of leaves and are not restricted by veins.
- Initially these spots were isolated but at later stage they may coalesced to form large patches on the infected leaves.
- On the fruit surface symptoms were small, circular to roughly circular; brown to black colored spots with depressed sporulating zone at the center.
- Size of spots quickly enlarges during color change of fruit peel from green to yellow and on each fruit usually 3-4 spots were recorded.

Pathogen: *Colletotrichum gloeosporioides*

- Mycelium septate.
- Conidiophore bears the conidia which are falcate, hyaline unicellular with narrow ends. Acervuli and setae present

4. Rust

Symptoms

- The disease first appeared on the lower surface of leaves as small, irregular, reddish brown uredo-pustules which later advances to cover the whole surface of leaves.
- The infected leaves finally shed off from the tree
- Autocious rust.

Pathogen: *Phakopsora zizyphi-vulgaris*

- Uredosori with peripheral incurved Paraphyses.
- Uredia hypophyllous, scattered, reddish brown, subepidermal, erumpent, paraphysate, paraphyses invariably marginal incurved, thickened
- Urediospores borne on long stalks, obovate or elliptic, narrowed towards the base, echinulate above, the lower one-third smooth, germpores 2-3, cinnamon brown.

DISEASES OF APPLE

1. Scab

Symptoms

- Symptom appears on leaves and fruits.
- On lower side of the leaf lesion appear as olivaceous spots which turn dark brown to black and become velvety.
- On young foliage, the spots have a radiating appearance with a feathery edge.
- On older leaves the lesions are more definite in outline.
- The lesion may form a convex surface with corresponding concave area on the opposite side.
- In severe infection leaf blade curved, dwarfed and distorted.
- Fruits show small, rough, black circular lesions.
- The centre of the spots become corky and on mature fruits, yellow halo is seen around the lesions.

Pathogen: *Venturia inaequalis*

- Septate, branched and coloured mycelium.
- Conidiophores are brown, rarely septate.
- Conidia are generally unicellular / bicellular, truncate at base and pointed at tip and brown coloured.
- Ascocarp is Pseudothecium which consists of numerous asci with boat shaped bicelled ascospores with unequal in size.

2. Powdery mildew

Symptom

- Small patches of white powdery growth appear on upper side of leaves.
- In severe case the symptom appear on both the sides.
- Twigs are also infected. Affected leaves fall off in severe infection.
- Fruit buds are also affected and deformed or remain small.

Pathogen: *Podosphaera leucotricha*

- Ectophytic, with saccate haustoria.
- Conidiophores arise on leaves and young shoots bears long chain of hyaline, oval shaped single celled conidia with fibrosin bodies.
- Chasmothecium consists of ascus which in turn possesses ascospores.

3. Soft rot

Symptom

- Young spots starts from stem end of the fruit as light brown watery rot. As the fruit ripens area of the rotting increases,
- Skin becomes wrinkled.
- A peculiar musty odour is emitted
- Under humid condition a bluish green sporulating growth appears.
- Infection take place by wounds in the skin caused by insects and during handing in storage and transport

Pathogen: *Penicillium expansum*

- Branched conidiophore bears green or bluish green mass of elliptical conidia in chain.
- Primary and secondary spread through wind borne conidia

4. **Bitter rot – *Glomerella cingulata***

Symptom

- Faint, light brown discolouration beneath the skin develops.
- The discolouration expands in a cone shape.
- The circular, rough lesions become depressed. The lesions increased and cover entire areas of fruits.
- Tiny black dots appear beneath the cuticle which gives rise to acervuli
- Pink masses of spores are found arranged in defined rings.

5. Fire blight

Symptom

- The initial symptom usually occurs on leaves, which become water soaked, then shrivel turn brownish to black in colour and fall or remain hanging in tree.
- The symptom spread to twigs. Terminal twigs wilt from tip to downward and forming a very typical "shepherd's crook" symptom
- Fruits become water soaked, turn brown, shrivel and finally become black.
- Oozing may be seen in the affected area.

Pathogen: *Erwinia amylovora*

- Rod shaped, motile, peritrichous bacteria.
- Each bacterial cell is enclosed in a capsule.
- Bacterium from infected plant parts served as primary inoculum and secondary spread is through irrigation water, insects and rain splash.

DISEASES OF PEACH

1. Peach leaf curl

Symptom

- It attacks the leaves, causing curling and blister formation.
- The leaves start turning yellowish or reddish and fall off prematurely.
- The infected portion develops a pink or reddish bronze colour.
- Growth of the tree is affected with a reduction of yield.

Pathogen: *Taphrina deformans*

- Intercellular mycelium devoid of ascocarp.
- Naked asci are produced individually and bear eight ascospores.
- Ascospores undergo budding division before released from Ascus.
- Ascospores as well as budded conidia from ascospores served as inoculum

2. Powdery mildew

Symptoms

- Small superficial white powdery mass on leaves appear.
- All the parts like leaves, twigs and fruits are infected with this fungus.
- Fruits may turn pinkish and finally dark brown in colour.

Pathogen: *Sphaerotheca pannosa*

- Ectophytic, with saccate haustoria.
- Conidiophores arise on leaves and young shoots bears long chain of hyaline, oval shaped single celled conidia with fibrosin bodies.
- Chasmothecium consists of ascus which in turn possesses ascospores.
- Primary spread is through air borne ascospores and secondary spread is through air borne conidia

DISEASES OF PLUM

1. Pocket plum or Bladder plum gall

Symptoms

- Gall appears on the developing fruit form elongated, flattened, hollow, stone-less
- The surface of the gall becomes corrugate and coated with the fungus, showing as a white bloom of ascospores
- The totally inedible fruits shrivel and most fall

Pathogen: *Taphrina pruni*

- Intercellular mycelium devoid of ascocarp.
- Naked asci are produced individually and bear eight ascospores.
- Ascospores undergo budding division before released from Ascus.
- Ascospores as well as budded conidia from ascospores served as inoculum

DISEASES OF STRAWBERRY

1. Leaf Spot

Symptoms

- Symptoms of leaf spot first appear as circular, deep purple spots on the upper leaf surface.
- These spots enlarge and the centers turn grayish to white on older leaves and light brown on young leaves.
- A definite reddish purple to rusty brown border surrounds the spots.
- On fruit, superficial black spots may form under moist weather conditions. The spots form on ripe berries around groups of seeds.
- The spots are about ¼ inch in diameter, and there are usually only one or two spots per fruit. However, some fruits may be more severely infected.

Pathogen: *Mycosphaerella fragariae*

- The fungus overwinters as sclerotia in the soil
- The fungus infects the plant and produces more spores in spots on the upper and lower leaf surface that spread the disease during early summer
- Conidia are produced on clusters of short conidiophores on underside of the diseased area
- Perithecia are formed in autumn at the edge of the leaf spot where the fungus winters
- New conidia are produced in spring with most infection taking place through stomata

2. Leaf Scorch

Symptoms

- Leaf scorch consists of numerous small, irregular, purplish spots or "blotches" that develop on the upper surface of leaves.
- The centers of the blotches become brownish.
- Blotches may coalesce until they nearly cover the leaflet, which then appears purplish to reddish to brown.

Pathogen: *Diplocarpon earliana*

- Conidia in abundance, often with conidiophores attached. T
- hese conidiophores are at most 3 to l0 μ long and 3 to 4μ in diameter. The conidia are hyaline, asymmetri cally two-celled with the upper cell larger and beaked, curved, con stricted at the septa, guttulate
- The asci are fasciculate, oblong, taper bluntly at thickened apex, the ascopores and hyaline, elliptical and two celled.

3. Leaf Blight

Symptoms

- One to several circular reddish-purple spots on a leaflet.
- Spots enlarge to V-shaped lesions with a light brown inner zone and dark brown outer zone.
- Lesions follow major veins progressing inward. The whole leaflet may turn brown.
- In severe cases, stolons, fruit trusses and petioles may become infected which may girdle and kill the stem.

Pathogen: *Phomopsis obscurans*

- The fungus overwinters as mycelium or fruiting structures on the old leaves that remain attached to the plant.
- The pycnidia of *P. obscurans* are produced on the upper surface of leaves and are immersed, black, globose and have short protruding ostiolar necks.
- Conidia are hyaline, unicellular and fusiform.
- Each conidium has two to three guttulae with one guttula at each end of the spore. The conidia are borne on hyaline conidiophores that are vertically to irregularly branched and measure up to 85 µm long.
- Conidia are exuded in mass as tendrils or globules and usually have a pale amber color

4. Angular leaf spot

Symptoms:

- On leaves, 1-4 mm, angular, shiny, water-soaked spots appear surrounded by the smallest veins.
- In the early stage the spots are only visible on the lower surface and appear translucent against the light.
- They enlarge, coalesce and after about 2 weeks are also visible on the upper surface as water-soaked, angular spots, which become reddish-brown in colour.
- They have a shiny appearance and are usually covered by bacterial exudate which when dry turns brown and appears as gum-like scales.
- Spots coalesce more frequently along the primary and secondary veins.
- The dead tissues tear and break off, and the diseased leaf may assume a ragged appearance.

Pathogen: *Xanthomonas fragariae*

- *Xanthomonas fragariae* is a gram negative, aerobic, rod-shaped
- Colonies of *X. fragariae* usually are mucoid, convex, and yellow when grown on yeast dextrose calcium carbonate (YDC) media or sucrose peptone agar (SPA).
- All members of the genus *Xanthomonas* are catalase positive and oxidase negative

Ex.No.7. **DISEASES OF CUCURBITS**

Date:

1. Fusarium wilt of watermelon

Symptoms:

- On young seedlings, a hypocotyl rot and damping-off may occur.
- In older plants, there is marginal yellowing progressing to a general yellowing of the older leaves, and wilting of one or more runners.
- In some cases, sudden collapse occurs without any yellowing of the foliage. On stems near the crown of the plant, a linear, necrotic lesion may develop, extending up the plant and usually on one side of the vine.
- One runner on a plant may wilt and collapse, with the rest of the runners remaining healthy. A gummy, red exudate may ooze from these lesions
- Vascular discoloration should be evident and is very diagnostic
- Mature plants often wilt severely (collapse) late in the season because of the fruit load stress.

Pathogen: ***Fusarium oxysporum f.sp. niveum***

- Produces micro conidia, macro conidia, and chlamydospores
- Primary spread is through soil borne chlamydospores and secondary spread is through water borne conidia

2. Root rot

Symptoms

- Yellowing of leaves, stunted, poor fruit set
- Root affected – sunken darkened lesions on fleshy roots
- Crown girdled

Pathogen: ***Pythium aphanidermatum , Phytophthora sp.***

- *Pythium* produces coenocytic mycelium with sporangiophore bearing irregular shaped sporangia
- The sporangia put forth vesicle which bears the zoospores
- *Phytophthora* produces coenocytic mycelium with sporangiphore bearing papillate sporangia which bears the zoospores.

3. Anthracnose

Symptoms

- On leaves: small yellow spots, turn brown
- Attack stem and fruit
- On stem, sunken lesions are formed
- On fruits: circular, black, sunken spot. Infected portion bears acervuli.

Pathogen: ***Colletotrichum lagenarium***

- Mycelium hyaline , septate and branched
- Conidiophore bears the conidia which are falcate, hyaline unicellular with narrow ends.

- Acervuli and setae present
- Primary spread is through ascospores from plant debris and secondary spread is through wind borne conidia

4. Downy mildew

Symptoms

- Downy growth on the lower surface of leaf.
- Small purplish brown spots appear initially on the under surface of leaves

Pathogen: *Pseudoperonospora cubensis*

- The sporangiophores are dichotomously branched at acute angles and taper into gracefully curved pointed tips on which sporangia are borne
- Primary spread is through soil borne oospores and secondary spread is through zoospores

5. Powdery mildew

Symptoms

- Upper surface small white or greyish superficial spots later entire leaves covered by fungal growth.
- Defoliation occurs.
- Fruits are small and yield reduced.

Pathogen: *Golovinomyces cichoracearum*

- Conidia are single celled, hyaline barrel-shaped and in long chains.
- Chasmothecium are globose and dark with hyaline to dark brown myceloid appendages.
- Asci are pedicellate, and ovate. Ascospores are single celled, hyaline oval to sub cylindrical.
- Primary spread is through ascospores from infected plant debris and secondary spread is through wind borne conidia

6. Bacterial wilt

Symptoms

- Leaves become dull green and wilts rapidly. Finally plant collapse.
- On fruits: Water soaked tissue appear, glistening exudations appear

Pathogen: *Erwinia tracheiphila*

- Gram negative bacteria with peritrichous flagella

Vector: Striped Cucumber beetle: *Acalymma vittatum;* Spotted cucumber beetle: *Diabrotica undecimpunctata howardi*

7. Cucumber mosaic

Symptoms

- Susceptible stage: 6 weeks old crop
- Yellow mottling and leaf distortion
- Plant dwarfed – inter nodes shortened

- Gives a bushy growth, leaves close to the ground in a rosette like clump
- Fruits become mottled and slowly spread to entire fruit. Fruit becomes light yellowish green, intermingled with spots of a much darker green colour.
- Produce distorted fruit with irregular green areas and later becomes white which is called as white pickle.

Pathogen: **Cucumber mosaic virus**

- CMV is the type species of the genus *Cucumovirus* in the family *Bromoviridae*. It is a RNA virus
- Transmitted by aphids species *Myzus persicae* and *Aphis gossypii*

Ex.No.8. DISEASES OF POTATO, PEAS, BEET ROOT, RADISH

Date:

DISEASES OF POTATO

1. Black scurf and stem canker

Symptoms

Sprout injury:

- Dark brown lesion on cortical and vascular tissue. Sprout killed

Stem canker and wilt:

- Reddish brown lesions or cankers on stem resulting in girdling .Disease spreads to petiole and leaflets.
- Xylem vessels affected resulting in stem rot and wilting
- White crust around the haulm at ground level

Black scurf:

- Chocolate coloured specks on the surface of the tubers
- Black sclerotia formed on tubers
- Russeting of tubers
- Browning of internal tissues causing hard dry rot

Pathogen: *Rhizoctonia solani*

- Septate mycelium with a constriction at branch.
- Sclerotia are irregular brown to black.
- Perfect stage: *Thanatephorus cucumeris. B*asidia with basidiospores are produced
- Primary spread is through the infected tubers and secondary spread is through sclerotia

4. Wart / Black wart

Symptoms

- Small white soft, pulpy wart on the eyes. resembles cauliflower
- Wart later turns black
- In severe cases during wet season the auxillary bud or the leaf is transformed into greenish yellow outgrowth resembling cocks comb.

Pathogen: *Synchytrium endobioticum*

- Obligate parasite, endobiotic (inside the cell) produces zoospores which develops into prosorus
- Primary spread is through resting spores present in soil and infected tubers, while secondary spread is through zoozpores

3. Early blight

Leaf symptom:

- Brown spots becomes angular with or without concentric rings
- Spots enlarge to form necrotic areas
- Leaves dry and hangs along the stem

Tuber symptom

- Dark brown circular or irregular slightly sunken spot .
- Internal tissues become brown and corky.

Pathogen: ***Alternaria solani***

- Hyphae septate, branched, dark coloured
- Conidiophores are short and dark in colour,
- Conidia are beaked, obclavate, formed singly, olive brown, muriform with both horizontal and vertical septation.
- Primary spread is through dormant mycelium in plant debris and Tuber, while secondary spread is through conidia

4. Late blight:

Leaf symptom

- Brownish to purplish black water soaked lesions on upper surface
- White mildew growth appears on lower surface.
- Spreads from leaf to petiole and then to stem
- Stem breaks and plant topples.

Tuber symptom

- Purplish discolouration of the skin followed by dry rot

Pathogen: ***Phytophthora infestans***

- *Phytophthora* produces coenocytic mycelium with sporangiophore bearing papillate sporangia which bears the zoospores.
- Primary spread is through oospore, dormant mycelium in plant debris and Tuber, while, secondary spread is through zoospores produced in sporangia

5. Soft rot:

Symptoms

- Water soaked areas around the lenticels
- Internal tissue decay and becomes brown and later black
- Affected tissues become soft and a reddish or black demarcation seen between healthy and affected tissues.
- Affected tissues become slimy and emit sulphurous odour.

Pathogen: ***Pectobacterium carotovorum*** **pv** ***carotovorum***

- Gram negative bacteria with peritrichous flagella

- Primary spread is through soil borne bacterium and bacteria in plant debris and Tuber, while secondary spread is through water born bacteria

6. Common scab:

Symptoms

- Rough, corky lesions, which may range from small and raised to deeply pitted.
- Initially, infections appear as small tan to reddish-brown spots on the tuber surface.
- Pitted scab can be as deep as one half inch into the tuber.
- Tubers with russetted scab can have large areas superficially covered with corky tissue.

Pathogen: *Streptomyces scabies*

- Streptomyces scabies is filamentous, gram positive bacteria spore and toxin producing bacteria.
- The toxin that causes the common scab symptoms is called thaxtomin.
- It disrupts the development of cell walls and results in scab lesions.
- Primary spread is through soil borne bacteria and infected plant debris while, secondary spread is through water borne bacteria

7. Mild mosaic/ mosaic/ Latent mosaic: Potato virus X

- Interveinal mottling with slight dwarfing or with deformed leaves
- Plants bushy and pale
- Mainly transmitted by tubers and mechanically through zoospores of Synchytrium endobioticum

8. Severe mosaic/ Vein banding: Potato Virus Y

- Leaf crinkle, roll upwards, form cup like structure. Plant stunted, and gives rosette appearance.
- Mottling of interveinal and veinal areas.
- Chlorotic streaks become necrotic and kill leaf. Streaks on stem.
- Transmission: Through infected tuber, Aphid (*Myzus persicae*) and mechanical means

9. Leaf roll:Potato leaf roll virus

- Tip and margins of leaves roll upwards
- Midrib takes the shape of spoon and later into funnel
- Leaflets brittle ,become yellow and then brown
- Necrosis of phloem
- Transmission: By Green peach aphid : *Myzus persicae* and infected tubers

DISEASES OF PEAS

1. Wilt

- Yellowing and drooping of leaves
- Stunting of plants
- Brown to black discolouration of xylem

Pathogen: *Fusarium oxysporum* f.sp. *pisi*

- Fungus has hyaline , septate , branched mycelia
- Produces micro conidia, macro conidia, and chlamydospores

2. Anthracnose

Symptoms

- Brown irregular spots with light centre and dark margin on the leaf and stem
- Brown circular suncken spots on the pods leads to pod rot
- Seeds become discoloured and shriveled

Pathogen: *Colletotrichum pisi*

- Pathogen produces conidia single celled; hyaline slightly curved with oil globule. Asexual fruiting body is acervuli.
- Primary spread is through dormant mycelium and ascospores from infected debris and secondary spread is through wind borne conidia

3. Rust

Symptoms

- Yellow spots having aecia in round or elongated clusters
- Pustules develop which are powdery and orange brown in appearance
- Drying of leaves

Pathogen: *Uromyces fabae*

- Uredospores: Single celled, brown coloured with echinulations. Teliospores: Single celled, brown with thickened apex
- Primary spread through teliospores and secondary spread through uredospores

4. Powdery mildew

Symptoms

- White powdery patches on the upper surface of the leaves.
- Drying of leaves
- This disease can delay the maturity
- Affect the flavor of the processed peas

Pathogen: *Erysiphe polygoni*

- Septate mycelium producing oidium type of conidia and conidiophores.
- Sexual fruiting body: Chasmothecium with many asci and ascospores

DISEASES OF BEET ROOT

1. Leaf Spot

Symptoms

- Numerous small circular spots appear on the leaf surface. The spots increase in size, becoming brownish or purplish in color.
- Individual spots are usually circular but several may coalesce into larger areas of dead tissue. The spots dry up giving a shot-hole appearance to the leaves.
- In case of severe infection spots cover the entire leaf surface resulting in pre-mature death and dropping of the leaves.
- As leaves die, the crown becomes cone-shaped with a rosette of dead leaves at the base.
- Defoliation occurs throughout the growing season resulting in reduction in root size and yield. Older leaves are mostly affected.

Pathogen: *Cercospora beticola*

- Conidia (spores) are needle-shaped (2-3 x 36-107 µm), colorless, and have several cross-walls (septations).
- Conidial morphology varies greatly with environmental conditions.
- Host plants include many weed species such as lambsquarters, pigweed, mallow, and bindweed.
- Economic hosts include tablebeet, sugar beet, Swiss chard, spinach, and most wild *Beta* species.

2. Downy Mildew

Symptoms

- Appear as irregular greasy greyish areas on the leaves. Under moist conditions, these areas expand rapidly and a white powdery growth appears on the lower surface of the affected leaves.
- Affected leaf dries and shrivels quickly. Flower shoots on infected plants become stunted and distorted.
- The entire inflorescence has a compact appearance and excessive leaf development may give an appearance witches broom.

Pathogen: *Perenospora schachtti*

- The fungus survives on the crop residues in the soil and is also carried by the seed.
- Mycelium coenocytic and intercellular with finger-like branched haustoria in the host cells.
- sporangiophores branching obscurely dichotomous tapering to a blunt point, angle of branching a right angle or less.
- Sporangia are ellipsoid, pale brown to violet and sexual spores are Oospores

3. Bacterial blight

Symptoms

- The infected leaves show irregular to circular shaped spots with tan to dark brown centers and dark black borders.
- In some instance symptoms also appear on the edges of the leaves which initially may appear water-soaked and later turn yellow and then necrotic.
- These spots may join together between the veins an the dried area falls off, which gives a ragged appearance

Pathogen: ***Pseudomonas syringae pv. aptata***

- The bacteria spread mainly by splashing rainfall, mechanical and insect injuries.
- The pathogen also infects other crops like bean, eggplant, lettuce, and pepper.

4. Mosaic

Symptoms

- Appear as conspicuous mottling with chlorotic, zonate ring spots on the leaf surface.
- When these ring spots develop their center are usually green.
- Virus infected plants remain stunted and may lose some leaves.

Pathogen:

- Spinach mosaic virus, sugarbeet mosaic virus (BtMV). It is a *Potyvirus* in the family *Potyviridae*.
- Vector(s) are *Myzus persicae, Aphis fabae*
- Virus is transmitted in a non-persistent manner.

5. Curly-top

- External symptoms of curly top virus infection may appear in leaves, stems, flowers, fruits, or roots of infected plants.
- Generally, mottling is absent, but infected plant parts may become distorted through curling, twisting, rolling, stunting, etc.
- Leaves become thickened and leathery
- Some of the most pronounced symptoms resulting from curly top virus attacks are internal and non-observable with the unaided eye.
- Such internal symptoms consist of death of the food conducting vessels, as well as of extreme variations from the normal in numbers and sizes of cells composing the plant tissues

Pathogen: ***Beet curly top virus (BCTV)***

- Caused by *Beet curly top virus (BCTV), Beet severe curly top virus (BSCTV, Beet mild curly top virus (BMCTV)*
- Transmitted by beet leaf hoppers *Circulifer tenellus*.

6. Beet Yellows

Symptoms:

- Yellow spots on the young leaves in the initial stages of infection.
- As the disease progresses, the leaves exhibit irregular yellow patches alternating with normal green colour of the leaves.
- The older leaves of infected plants become chlorotic, noticeably thickened, leathery and brittle.
- The foliage becomes abnormally red or yellow and often dies.

Pathogen: *Beet Western Yellows Virus (BWYV)*

- The virus is transmitted by aphids (green peach aphids and black bean aphids). It has an extensive host range

DISEASES OF RADISH

1. Alternaria Blight

Symptoms

- The pathogen affects leaves, stem, pods and seeds.
- Symptoms of the disease first appear on the leaves of seed stem in the form of small, yellowish, slightly raised lesions.
- Lesions appear later on the stems and seed pods.
- Infection spreads rapidly during rainy weather, and the entire pod may be so infected that the styler end becomes black and shrivelled.
- The fungus penetrates in pod tissues, ultimately infecting the seeds. The infected seed fails to germinate.

Pathogen: *Alternaria raphani*

- Conidia are light brown to medium brown in colour, smooth or minutely rough, sometimes verruculose, beakless and apically bluntly conical when juvenile, many have a long beak at maturity, the transition from spore body to beak is gradually tapering;
- conidium body 40-120 x 12-20 f-L111 on host, with 5- 14 transverse septa and several longitudinal or oblique septa; the beak filifonn, colourless or pale, septate, often once branched (bifurcate)

2. White Rust

Symptoms

- Disease attacks the leaves and flowering shoots.
- Affected flowering shoots get deformed and bear only malformed flowers.
- White powdery substance in patches is observed on the under surface of the leaves.

Pathogen: *Albugo candida*

- When liberated, the sporangia inside the pustules are spread by wind, rain, and insects.
- After landing on a susceptible plant, each sporangium gives rise to about six zoospores which, under suitable conditions of moisture and light, form germ tubes which invade the plant's tissues.
- Zoospores are naked (wall-less), kidney-shaped and bi-flagellate. Both flagella are inserted laterally.
- Thick-walled sexual spores, called oospores are produced which germinate, producing either vesicles inside the plant tissue, exit tubes with vesicles at the tip, or germ tubes.

3. Downy mildew

Symptoms

- The disease is characterized by the appearance of the purplish brown spots on the under surface of the leaves.
- These spots may remain small or enlarge considerably.
- The upper surface of the leaf above the lesion is tan to yellow.

- Downy growth usually appears on the under surface of these lesions.

Pathogen: *Peronospora parasitica*

- Mycelia are intercellular in host tissues and no intracellular hyphae are observed; the pathogen entering leaf cells forming haustoria.
- Under humid conditions, erect, dichotomously-branched conidiophores are formed. These are generally about 350 µm long, bearing sub-elliptical sporangia 17–22×14–15 µm, and emerge through stomata on the lower surfaces of infected leaves.
- Oospores may be found in infected leaves, sepals, flower buds and stems.

4. Black rot

Symptoms

- It effects almost all the cruciferous plants all over the world. It is a seed-borne disease.
- The plant may be affected at any time during its growth from the youngest seedling until it matures.
- On young seedlings, the cotylcdons are affected at the margins which show blackening and such cotyledons die.
- Later, infection of leaves occurs through water pores at the margins. The infected tissues I turn yellow and the chlorosis occurs.
- The veins show a brown or black discolouration.

Pathogen: *Xanthomonas compestrispv compestris*

- *X. campestris* is a rod-shaped Gram-negative bacteria characterized by its two cell walls and yellow pigment.
- It has a filamentous structure called hypersensitive response and pathogenicity (Hrp) pili that is attached to type III protein secretion system implementing the ability to transfer bacterial proteins to the plant and also motility in water

5. Radish mosaic

Symptoms:

- First appear as small, circular to irregular chlorotic lesion in between and adjacent to the veins.
- Little or no leaf distortion is noticed, and stunting or abnormal leaf formation rarely occurs.
- Severe yield loss in susceptible cultivars of radish is caused due to this viral disease.

Pathogen: Radish enation mosaic virus, radish mosaic comovirus

- Virus is transmitted by arthropods, by insects of the order **Coleoptera**; *Phyllotreta* ssp., *Epitrix hirtipennis* and *Diabrotica undecimpunctata*

Ex.No.9. DISEASES OF CASSAVA, COLACASIA AND YAM

Date:

DISEASES OF CASSAVA

1. Tuber rot

Symptoms

- Yellowing of leaves from the middle portion resulting in drooping
- Water-soaked brown to black lesions on tubers which coalesce further and spread over the entire tubers.
- Infected tubers emit a foul smell

Pathogen: *Phytophthora palmivora*

- Mycelium is hyaline, Coenocytic and branched. Asexual spore is Zoospores and Sexual spore is Oospores
- Primary spread is through soil borne Oospores and secondary spread is through wind and water borne zoospores

3. Brown leaf spot

Symptoms

- Spots appear on both sides of leaf
- On upper surface the spots appear brown with distinct dark border.
- On lower surface lesions have less distinct margin with grey centre due to the production of condiophores and conidia.
- The lesions become angular as they are limited by the veins. Leaves dry and drop.

Pathogen: *Cercospora henningsii*

- Sexual stage – *Mycosphaerella manihotis*.
- Geniculate conidiophores bears pale olivaceous both ends blunt 2 to 8 septate conidia.
- Black perithecia bears asci with 8 ascospores.
- Primary spread is through soil borne ascospres and secondary spread is through wind borne conidia

4. Indian cassava mosaic

Symptoms

- Mosaic disease with chlorotic areas.
- Leaves distorted, reduced in size ,misshapen and twisted with bright yellow area separated by normal green tissue.
- Plants stunted with reduced leaf canopy and stem girth.
- Heavy reduction in yield and tuber splitting

Pathogen: Indian Cassava Mosaic Virus (ICMV)

- DNA virus present in pairs as Geminate particles
- Vector : White fly –*Bemisia tabaci*

DISEASES OF COLACASIA

1. Phytophthora leaf blight

Symptoms

- The early stages of the disease are characterized by small circular water-soaked lesions, generally dark brown or purple.
- A clear amber fluid exudes from the center of the lesion.
- This liquid turns bright yellow or dark purple when it dries. The lesions rapidly enlarge and take on a zonate appearance.
- After initial establishment lesion development is rapid until the leaf is entirely colonized and collapses.

Pathogen: *Phytophthora colocasiae*

- *Phytophthora* produces coenocytic mycelium with sporangiphore bearing papillate sporangia which bears the zoospores.
- Primary spread is through oospore, dormant mycelium in plant debris and secondary spread is through zoospores produced in sporangia

2. Pythium rot

Symptoms

- The normally firm flesh of the corm is transformed into a soft, mushy, often malodorous mass.
- In wetland culture, the root system is destroyed except for a small fringe near the apex of the corm.
- The plants become stunted, with leaf stalks shortened and leaf blades curled and crinkled, yellowish and spotted.

Pathogen : *Pythium aphanidermatum*

- Coenocytic mycelium ,produces sporangiospore bearing irregular shaped sporangia which bears the vesicle. Inside the vesicle the zoospores are produced.
- Primary spread is through soil borne oospores and secondary spread is through water borne zoospores

3. MOSAIC

Symptoms:

- Plants generally become asymptomatic three to four months after initial symptom expression.
- The foliar symptoms include a dispersed and veinal mosaic pattern on the leaves.
- Leaf distortion is generally mild to moderate.

Pathogen: *Dasheen Mosaic virus*

- It is a stylet-borne virus carried by aphids *Myzus persicae.*

DISEASES OF YAM

1. Anthracnose

Symptoms

- Symptoms appeared at first as small dark brown or black lesion on the leaves, petioles and stems.
- The lesion is often surrounded by a chlorotic halo enlarged and coalesces, resulting in extensive necrosis of the leaves and die-back of the stem

Pathogen: *Colletotrichum gloeosporioides*

- Pathogen produces conidia single celled, hyaline slightly curved with oil globule.
- Asexual fruiting body is acervuli
- Primary spread is through dormant mycelium and ascospores from infected debris and secondary spread is through wind borne conidia

2. Dry rot

Symptoms:

- Symptoms though vary with varying coloration depending on the invading Pathogen, the infected tissues become hard and dry.
- The infected tubers first turned grey and then black, such tubers become pulverulent, breaking into small dry particles.

Pathogen: *Botryodiplodia theobromae*

- Inside the pycnidia, conidiogenous cells produce hyaline thin walled pycnidiospores which become brown, thick walled, two celled with longitudinal striations.
- Primary and Secondary spread is through air borne conidia

3. Collar rot:

- Collar rot is commonly found in two to three months old plants.
- The collar region is get rot which leads to death of the plants.
- In severe cases leaf become brownish and dry leads to death of the plant.

Pathogen: *Sclerotium rolfsii* and *Rhizoctonia solani*

- The fungus overwinters as a sclerotium, which is a dense mass of hyphae with a hard outer shell.
- Mustard like sclerotia is produced by *S. rolfsii* and spongy sclerotia are produced by *R.solani.*

Ex. No.10 FIELD VISIT/ EXPOSURE VISIT TO HILLY FRUITS/ VEGETABLES AND PLANTATION CROPS / MUSHROOM UNIT

Date:

Ex. No. 11 **DISEASES OF CHILIES, TURMERIC AND GINGER**

DATE:

DISEASES OF CHILLIES

1. DAMPING OFF

Symptoms

- Pre-emergence damping off: seed rotting poor germination
- Post-emergence damping off: girdling of stem, toppling down of seedling

Pathogen: ***Pythium aphanidermatum***

- *Pythium* produces coenocytic mycelium with sporangiophore bearing irregular shaped sporangia.
- The sporangia put forth vesicle which bears the zoospores
- Sexual spore is oospore

2. POWDERY MILDEW

Symptoms

- Infects the lower leaf surface as small, whitish powdery-like colonies.
- The upper surface of the foliage develops yellow spots. As the disease develops, the older colonies of the fungus may turn a dirty white color with age.
- The severely affected leaves turn yellow, then brown and fall off. Chlorotic and necrotic spots of the leaves, branch die-back, and dwarfing were the main symptoms, which were followed by pod drop.
- Generally, the older leaves are affected first and the disease gradually moves up the plant.
- Crop yields and fruit quality may be reduced through loss of foliage.

Pathogen: ***Leveillula taurica*** **(asexual stage** ***Oidiopsis sicula*****)**

- The mycelium is endophytic bears condiophore and conidia (oidiopsis type)
- Formation of conidia singly (Pseudoidium type) on long lengthy conidiophore
- The size and shape of conidia mainly ellipsoid–ovoid
- Sexual spores are ascospores from chasmothecium

- **3. CERCOSPORA LEAF SPOT**

Symptoms

- Small circular brown spots light centre surrounded by dark band
- Spots on petiole, branches, peduncle
- Leaves wither and drop

Pathogen: ***Cercospora capsici***

- Conidiophores bears conidia which are sub hyaline to coloured, obculate
- Sexual spore is ascospores from pseudothecia

3. DIE-BACK AND FRUIT ROT / ANTHRACNOSE

Symptoms

- **Die-back:** Necrosis of twigs from tip backwards causing die back of the branches.
- Twigs -Brown, straw coloured lesions having large number of acervuli
- **Fruit rot:** Small black circular spots on skin of ripe fruits
- Fruit turns straw coloured, numerous black acervuli formed in concentric rings
- Seeds covered with fungal hyphae, turn rusty, lose pungency
- Diseased fruits shrivel and dry up

Pathogen: *Colletotrichum capsici*

- Mycelium septate. Conidiophore bears the conidia which are falcate, hyaline unicellular with narrow ends.
- Acervuli and setae present

4. BACTERIAL LEAF SPOT

Symptoms

On Leaf

- Small, circular or irregular, dark brown or black greasy spots on leaf
- Petioles and stems also affected
- Cankerous growth and wilting of branches

On Fruits

- Round raised water soaked spots with a pale yellow border
- Bacterial ooze

Pathogen: *Xanthomonas vesicatoria*

- Bacteria monotrichous, gram negative, rod shaped bacteria
- Mode of spread is by irrigation water and rain splash

5. CHILLI MOSAIC VIRUS

Symptoms

- Mottling of yellow and green colour of leaves
- Margins curled inside
- Leaves develop depression, raised areas and puckering in the leaf blade
- Stunted plants with few flowers

Pathogen: Cucumber mosaic virus

- It is a RNA virus
- Transmission is by *Aphis gossypii*, *A. craccivora*

6. LEAF CURL VIRUS

Symptoms

- Folded upward like a boat like structure
- Curling of leaves; Leaves small, internodes shortened; Plants distorted, stunted, unproductive

- Fruits small deformed

Pathogen: Chilli leaf curl virus

- It is a Gemini virus having DNA as nuclear material
- Vector is white fly *Bemisia tabaci*

DISEASES OF TURMERIC

1. RHIZOME AND ROOT ROT

Symptoms

- Basal portion of shoot watery and soft.
- Root system reduced, Rhizome decay becomes brown and soft.
- Leaves exhibit gradual drying.
- Appearance of diseases in patches.

Pathogen: *Pythium aphanidermatum*

- Inter and Intra cellular mycelium. Zoospores are reniform, biflagellate, oogonia are spherical, antheredia is often curved.
- Oospores are spherical with smooth wall.

2. LEAF SPOT

Symptoms:

- Brown spots on upper surface of leaf.
- Centre greyish white, thin with numerous black dot like acervuli arranged in concentric rings. Yellow halo around spots.
- In severe cases leaves dry up and field presents a scorched appearance.

Pathogen : *Colletotrichum capsici*

- It produces acervuli which is rounded or irregular in shape. Conidiophores are simple, septate.
- Conidia are cylindrical, non-septate with oil globules.

3. LEAF BLOTCH

Symptoms

- Spots on both side of leaf.
- Infected leaf reddish brown appearance.
- The functional area of leaf reduced.

Pathogen: *Taphrina maculans*

- Obligate parasite.
- Septate, subcuticular, hyaline, intercellular and branched mycelium which does not produce ascocarp (naked asci).
- Asci are produced individually which bears eight ascospores.

DISEASES OF GINGER

1. RHIZOME ROT/ SOFT ROT

Symptoms

- Basal portion of the plants shows a water soaked brown colour and becomes soft.
- Leaves pale and yellowing of leaves.
- Withering and drying of leaves.
- Shoot easily pulled out.
- Tissues rot and fibrovascular strands lie isolated.
- Roots rot and become soft.

Pathogen : *Pythium aphanidermatum*

- Inter and Intra cellular mycelium.
- Zoospores are reniform, biflagellate, oogonia are spherical, antheredia is often curved
- Oospores are spherical with smooth wall.

2. LEAF SPOT

Symptoms

- Brown spots on upper surface of leaf.
- Centre grayish white, thin with numerous black dot like acervuli arranged in concentric rings. Yellow halo around spots.
- Severe cases leaves dry up and field presents a scorched appearance.

Pathogen: *Colletotrichum zingiberis*

- It produces acervuli which is rounded or irregular in shape. Conidiophores are simple, septate.
- Conidia are cylindrical, non-septate with oil globules.

Ex.No.12
DATE:

DISEASE OF CORIANDER, CARDAMOM, BLACK PEPPER AND VANNILA

DISEASES OF CORIANDER

1. STEM GALL / TUMOUR

Symptoms:

- Tumour like swelling on leaf vein, leaf stalks, peduncles, stem and fruits.
- The elongated swelling gives a hanging appearance to the leaves.

Pathogen: ***Protomyces macrosporus***

- Mycelium septate .Scattered cells in the hyphae swell and form globose bodies which later develop into chlamydospores.
- Chlamydospores germinate and form sporangium which releases ephemeral zoospores.
- Primary spread is by Ascospores and secondary spread by Budded conidia from ascospores

2. WILT

Symptoms:

- Wilting is sudden
- Drooping of terminal portion ,withering and drying of leaves
- Leaves become pinkish yellow to yellow and sterility is noticed

Pathogen: ***Fusarium oxysporum fsp. corianderii***

- Soil borne fungus with hyaline septate mycelium
- Produces microconidia, macroconidia, and chlamydospores

3. POWDERY MILDEW

Symptoms

- White circular patches of powdery growth covers the leaf surface
- Affected leaves became distorted and dries up.

Pathogen: ***Erysiphe polygoni***

- Ectophytic mycelium , septate produces conidiophore which bears chain of conidia
- Mycelium hyaline and septate. Conidiophores bear chain of conidia
- Sexual spores are ascospores from chasmothecium

DISEASES OF CARDAMOM

1. DAMPING OFF /RHIZOME ROT /CLUMP ROT

Symptoms

- Pale yellow young foliage.
- Rotting of rhizomes.
- Shoots become very brittle and later collapse

Pathogen: ***Pythium vexans***

- Inter and Intra cellular mycelium. Zoospores are reniform, biflagellate,
- Oogonia are spherical, antheredia is often curved.
- Oospores are spherical with smooth wall.

2. AZHUKAL DISEASE /CAPSULE ROT

Symptoms:

- Large, irregular water soaked dirty black colour lesions appear on mature leaves.
- The leaves shred and get attached to the pseudostem
- Grayish patch of irregular brownish margin seen on the base of the leaf sheath.
- The basal portion of the pseudo stem breaks.
- Small light brown lesions develop on the tender fruits which fall prematurely.
- Blackish discolouration on the fruit wall.
- The tips of the inflorescence rot.

Pathogen: ***Phytophthora nicotianae var. nicotianae***

- Inter cellular mycelium with haustoria.
- Zoospores are reniform, biflagellate, oogonia are spherical,
- Antheredia is amphigynous and often curved.
- Oospores are spherical with smooth wall.

3. CHENTHAL DISEASES / LEAF BLIGHT

Symptoms

- Appearance of elongated water soaked lesions and leathery in appearance.
- In advanced stages, lesions are brown to dark with yellow halo.
- Withering and wilting of pseudo stem
- Drying of inflorescence tip to downward and presents a burnt appearance.

Pathogen: ***Colletotrichum gloeosporides***

- It produces acervuli which is rounded or irregular in shape. Conidiophores are simple, septate.
- Conidia are cylindrical, non-septate with oil globules.
- Sexual spore is ascospores

4. MOSAIC/ KATTE DISEASE

Symptoms:

- Thin chlorotic flecks on youngest leaves of stem which develop into pale green stripes running from midrib to leaf margin parallel to veins
- All leaves emerging subsequently have stripes; symptoms then spread to all tillers

Pathogen: Cardamom mosaic virus

- It is a RNA virus belongs to Poty virus group
- Vector is aphid *Pentalonia nigronervosa* fsp *.caladii*

D I S E A S E S O F BLACK PEPPER

1. Foot rot / Quick wilt

Symptoms

- On the upper surface black coloured water soaked lesions appear.
- Later spots enlarge in size and cover the entire leaf surface and produces concentric lesions.
- Pathogen affects the young branches and causes drying of branches from tip downwards and exhibits dieback symptom.
- Blackening of collar region
- Infection starts from the main roots or on the feeder roots. Progresses from the feeder root to the lateral roots and finally to the main roots. The root system is weakened leading to death of the vine.

Pathogen: ***Phytophthora capsici***

- Hyaline , branched, coenocytic mycelium
- It produces sporangia, sporangia are pedicelled, spherical / oval
- Resting spores are Oospores

2. ANTHRACNOSE / POLLU

Symptoms

On leavess

- Produces grey circular / irregular necrotic spots with grey colour centre and dark brown margin.
- Spots enlarge in size and covers the entire leaf surface and exhibits shot hole symptoms.
- Produces black dot like Acervuli at the centre of necrotic spots.

On berries

- Causes internal rotting / browning of tissues. causes black colour crack / split on affected berry.

Pathogen: ***Collecotrichum gloeosporioides***

- Mycelium is septate and branched
- Conidiophore bears the conidia which are falcate ,hyaline unicellular with narrow ends
- Acervuli and setae present
- Sexual spores are ascospores

3. CERCOSPORA LEAF SPOT

Symptoms:

- Produces circular / irregular reddish brown spots in large number on the upper surface of leaves.
- Spots are surrounded by yellow border,
- Later these spots join together and cover the entire leaf surface.

Pathogen: ***Cercospora capsici***

- Produces conidiophore, conidia multiseptate / 1-5 septate, straight / slightly curved, hyaline in nature.
- Conidiophores bears conidia which are sub hyaline to coloured , obculate
- Primary spread is by Ascospores from the infected plant debris and secondary spread by wind borne conidia

DISEASES OF VANILLA

1. Black rot

Symptoms

- Water-soaked green to black rot of stems, leaves and/or pods
- thin white mycelium may be visible in infected tissues
- disease usually begins at the apical part of the plant and spreads to leaves, stems and all other parts of the plant

Pathogen: *Phytophthora* spp.

- Hyaline , branched, coenocytic mycelium
- It produces sporangia, sporangia are pedicelled, spherical / oval
- Resting spores are Oospores

2. Root and stem rot

Symptoms:

- Fungus causes brown lesions on roots which turn brown and dry out
- plants begin to rot at the apical tip and stop growing
- plant begins to produce new roots from apical tissue
- if there is not enough moisture, stems dry out and crack longitudinally
- cracks will eventually cover the whole stem and the plant will die

Pathogen: *Fusarium batatatis*

- Soil borne fungus with hyaline septate mycelium
- Produces micro conidia, macro conidia and chlamydospores

3. Anthracnose

Symptoms:

- Small, sunken, dark brown spots on leaves, fruits, stems and/or flowers
- Infected fruits dropping from plants before they reach maturity
- Damage to fruit is more pronounced during warm and humid periods of the growing season
- Symptoms generally develop first on apical parts of plant and spread to leaves and stems

Pathogen: *Colletotrichum spp*

- Mycelium is septate and branched
- Conidiophore bears the conidia which are falcate ,hyaline unicellular with narrow ends
- Acervuli and setae present
- Sexual spores are ascospores

4. Rust

Symptoms:

- Yellow to orange pustules on undersides of leaves which enlarge and coalesce causing the entire leaf to dry out
- Plant development slows and defoliates and dies

Pathogen: ***Uromyces joffrini***

- It is an biotroph
- Produces ehinulated single celled uredospores and single celled teliospores with thickened apex

Ex. No. 13 **DISEASES OF ROSE, JASMINE, MARIGOLD AND CROSSANDRA**

Date:

DISEASES OF ROSE

1. POWDERY MILDEW

Symptoms

- Leaves covered with greyish white, powdery fungal growth.
- Young leaves curled and distorted.
- Diseased buds fail to open.
- Flowers discoloured, dwarfed and dried.

Pathogen: ***Sphaerotheca pannosa***

- Ectophytic mycelium, septate produces conidiophore which bears chain of conidia
- Chasmothecia bears single ascus with 8 ascospores with myceloid appendages.

2. DIE BACK

Symptoms:

- Twigs dry from tip downwards.
- Twigs become brown to dark brown or black and infection spreads to roots.
- Browning of internal tissues, plant kills.

Pathogen: ***Diplodia rosarum***

- Produces black pycnidia which bear dark coloured 2 celled pycnidiopores.
- Perithecia produce ascus which bears ascospores.

3. BLACK SPOT

Symptoms:

- Black spot on the leaves.
- Spots more or less circular, irregular fibrillose border due to the radiating strands of mycelium.
- Plant blossoms poorly.
- Disease spreads on to stem and flowers.
- Blackened blisters on stem with dotted pustules.

Pathogen: *Diplocarpon rosae*

- Acervuli bear the hyaline two celled fusiform conidia.
- Apothecium bears the asci which contains 8 ascopores

4. RUST

Symptoms:

- Under side of the leaves and stem show orange to lemon yellow pustules.
- Turns brick red representing uredial stage.
- Later turns black representing teliospore stage.
- Leaves turn yellow, deformed and fall prematurely.

Pathogen: *Phragmidium mucronatum*

- Uredopores are ovate echinulate orange yellow borne on short pedicels.
- Teliospores are dark coloured cylindrical 6 to 8 celled with a pointed papilla borne on long persistent pedicels.
- They are hyaline and swollen at the base.

DISEASES OF JASMINE

1. LEAF BLIGHT

Symptoms

- Dark brown concentric rings seen.
- Burnt like fire, leaflets dry and fall off.
- Petioles, stem, calyx and tubular corollas affected.

Pathogen: *Alternaria jasmini*

- Fungus possess brown colured, septate , branched mycelim
- Muriform conidia with acropetal succession
- Asci and ascospores are formed inside Pseudothecium

2. CERCOSPORA LEAF SPOT

Symptoms:

- Circular to irregular reddish brown spots covers entire leaf.
- Leaves become hard and brittle.
- Vegetative buds and young branches affected leads to defoliation.

Pathogen: *Cercospora jasminicola*

- Hyaline , multiseptate , needle shaped conidia are produced by the fungus
- Sexual spores are ascospores produced in pseudothecia

3. RUST

Symptoms:

- Attacks all aerial parts like leaves, stems and inflorescence and cause blisters or tumors on the plant.
- Orange coloured pustules on both the surfaces of leaves. Infected portions become hypertrophied.
- Orange coloured cankers are seen on the stems and twigs.
- Infected flower buds are swollen and deformed.

Pathogen: *Uromyces hobsonii*

- It is an autoecious macrocyclic rust fungus
- The urediniospores are round to ovate, light brown echinulate, with -4 equatorial germ pores
- The teleutospores are dark brown, one celled, mostly ovate, thick-walled

4. PHYLLODY: PHYTOPLASMA DISEASE

- Leaves are small, malformed and closely arranged.
- Flowers transformed into green leaf like malformed structure.
- Panicles are closely packed.
- **Mode of spread**: Transmitted by grafting and white fly: *Dialeurodes kirkaldii*

DISEASES OF MARIGOLD

1. FUSARIUM WILT

Symptoms:

- Yellowing and drooping of leaves
- Vascular browning of stem
- In the field the infected plants show wilting.

Pathogen: *Fusarium oxysporum* f.sp. *callistephi*

- Fungus produces 3 types of spores
- Microconidia-Ovate / elongate / 1 celled, hyaline
- Macroconidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

2. LEAF SPOT AND BLIGHT

Symptoms:

- Brown necrotic spots develop on leaves, which get enlarged at the later stage of infection.
- The entire foliage gets damaged and results in poor vegetative growth

Pathogen: *Alternaria, Cercospora* and *Septoria sp*.

- *Alternaria* species produces muriform conidia
- *Cercospora* produces needle shaped multiseptate conidia
- *Septoria* produces hyaline multiseptate curved conidia

DISEASES OF CROSSANDRA

1. WILT

Symptoms:

- Wilt is observed in patches. In the field the disease is observed one month after transplanting.
- Leaves of infected plants become pale and droop. Margin of the leaves show pinkish brown discoloration.
- The discoloration spreads to the midrib in a period of 7 to 10 days.
- Stem portion gets shrivelled. Dark lesions are noticed on the roots extending upto collar region which result in sloughing off the cortical tissue

Pathogen: *Fusarium solani*

- Fungus produces 3 types of spores
- Microconidia-Ovate / elongate / 1 celled, hyaline
- Macroconidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

2. STEM ROT

Symptoms:

- The Pathogen also causes pre-emergence damping off, Brown to black lesions develop on stem just above soil level and result in girdling of the stem.
- The lesions extend to the upper part of the stem and results in collapse of seedlings.
- The roots are also rotted.

Pathogen: *Rhizoctonia solani*

- Septate mycelium. Sclerotia are irregular brown to black.
- Produces terminal and intercalary chalamydospores.
- Perfect stage: *Thanatephorus cucumeris*. Basidia with basidiospores are produced

3. LEAF BLIGHT

Symptoms:

- The symptoms of leaves consist of the development of brownish, depressed necrotic areas surrounded by reddish and slightly raised margins.
- Initially the spots appear as brownish specks but become darker as they expand.
- The lesions are more prominent on lower leaves and confined to the margins.
- Infected leaves roll up, shrivel and drop off, leaving a barren stem with a whorl of young leaves at the top.

Pathogen: *Colletotrichum crossandrae*

- It produces acervuli which is rounded or irregular in shape. Conidiophores are simple, septate.
- Conidia are cylindrical, non-septate with oil globules.

4. LEAF SPOT

Symptoms:

- This disease was first reported from Tamil Nadu during 1972. Infected leaves show small, circular or irregular yellow spots on the upper surface.
- They soon enlarge turn brown and develop dark brown concentric rings.
- Infected leaves become yellow and drop off prematurely.

Pathogen: ***Alternaria amaranthi*** **var. c*rossandrae***

- Primary spread is through Ascospores and secondary spread by wind borne conidia

Ex.No.14 DISEASE OF TUBEROSE, CARNATION, LILLIUM AND ORCHIDS

Date:

DISEASES OF TUBE ROSE

1. Blossom blight

- **Symptoms**
- Light brown lesions on the petals and soon darken and results in drying up of the affected portion.
- The blighted blossoms drop off and infects flower stalk and tips turn brown

Pathogen: *Fusarium equiseti*

Fungus produces 3 types of spores

- Microconidia-Ovate / elongate / 1 celled, hyaline
- Macroconidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

2. Leaf Spot

- The disease appears as brown spots with faint concentric rings on midrib.
- Circular to oval spots are seen on peduncle
- Infected leaves and peduncles become necrotic and dry up.

Pathogen : *Alternaria polyanthi*

- The pathogen produces cylindrical conidiophores, which are pale grey-yellow coloured, straight or curved, geniculate, simple or branched, septate and bear single conidium.
- Conidia are cylindrical to long ellipsoid, straight or slightly curved, pale grey-yellow to pale brown, 1 to 2 septate with longitudinal septa.

3. Wilt and stem rot / Foot and tuber rot

- Disease appears in patches.
- Yellowing and drooping of leaves followed by drying of plants.
- Fungal mycelial mat is seen at the base of the infected plant near the soil line.
- The roots of diseased plants rot and plant wilts and die.
- Brown coloured mustards seed-like sclerotia are seen on the surface of the diseased stem tissues and at the soil level near the root region.

Pathogen: *Sclerotium rolfsii*

- Septate mycelium. Sclerotia are mustard like and dark brown.

3. Blight / Leaf and Flower Spot:

Symptoms

- The disease appears during rainy season. Reddish brown and oval spots coalesce and blight the leaves
- Infected flowers show dark brown spots and ultimately the entire inflorescence dries up.

Pathogen: ***Botrytis elliptica***

- Septate, branched and hyaline mycelium. Blakish, round or elliptical, irregular sclerotia appear on the diseased tissues which help the fungus to perpetuate.

5. Flower bud rot

Symptoms

- It occurs mainly on young flower buds and results in dry rot of buds and brown, scorched and necrotic discolouration of peduncles.
- Affected buds shrivel and dry.

Pathogen: *Erwinia* sp.

- Rod shaped gram negative bacterium with peritrichus flagella

DISEASES OF CARNATION

1. Stem and Root Rot

Symptoms

- Wilting of plants
- Infected plants express the presence of brown discolouration on the collar region
- death of plant

Pathogen: *P. nicotianae* var. *parasitica*

- Inter cellular mycelium.
- Zoospores are reniform, biflagellate,
- Oogonia are spherical, antheredia is amphigynous and often curved.
- Oospores are spherical with smooth wall.

2. *Sclerotinia* stem rot

- Stem rot affected plants wilt gradually and the wilting is not observed on one side as *Fusarium* wilt.
- The leaves become straw coloured.
- The affected stems are hollow.
- Longitudinal section of the affected stem reveals the presence of irregular brown coloured sclerotia of irregular shape.
- In the affected plants, vascular system turns brown

Pathogen: *Sclerotinia sclerotiarum*

- Mycelium of the fungus is hyaline, septate, branched and radiating on infected parts.
- The fungus produces hard, irregular, flattened sclerotia during asexual reproduction.
- The sclerotia germinate and produce apothecia with asci and ascospores

3. Collar rot/ Stem rot/ Root rot:

- *Rhizoctonia solani* infect carnation plants at or just below the soil level.
- Affected plants are stunted.
- Lesions develop on the stem and the stem breaks off.
- Subsequently, the entire plant wilts and dies.

Pathogen: *Rhizoctonia solani*

- It produces light brown coloured mycelium which is septate , and branched with constriction
- It produces spongy, irregular sclerotia

4. Sclerotium root rot / basal rot

- Leaves of the carnation plants infected by *Sclerotium rolfsii* turns pale green and dry.
- Infected plants exhibit the presence of white, cottony growth of mycelium at the collar region of the stem leading to rotting of the stems at the soil level.
- During severe cases of infection, Rotting of stem starts at the pathogen spread to the leaf.
- Subsequently, it leads to rotting of the stem and death of the plants.
- During the advanced stages of infection, on the soil level and at the basal portion of the stem white to dark brown spherical sclerotial bodies are noticed

Pathogen: *Sclerotium rolfsii*

- The mycelium of the fungus is hyaline, branched at clamp connections and septate.
- The abundant brown mustard like sclerotia are produced

5. Wilt

Symptoms

- Yellowing of leaves, withering of leaves at the basal portion, and yellowing of midribs.
- The infected leaves turn chlorotic and finally wilt.
- During certain occasions, a portion of the plant wilts and subsequently spread to all the portions of the plant

Pathogen: *Fusarium oxysporum f. sp. dianthi*

- Produces microconidia, macroconidia, and chlamydospores
- Primary spread is by Soil borne chlamydospores and Secondary spread by conidia

6. *Alternaria* leaf spot / blight

Symptoms

- Small purple lesions on leaves and later turn as greyish-brown spots.
- During favourable conditions, lesions enlarge and merge together and results in blighting of leaves.
- Lesions also spread from the leaf to the stems and lead to girdling of the stem

Pathogen: *Alternaria dianthi*

- Conidia are dark brown or olive-brown in colour, short beaked,
- Conidia are borne in long chains, oval and bean shaped with 3-5 transverse septa.

7. Fairy ring leaf spot

Symptoms

- Leaf spot is characterized with pin head like necrotic tan spots on the leaf and leaf sheath.
- The margin of the spots is purple to dark purplish.
- During favourable conditions, the spots enlarge as circular – oval spots with grey centre.
- Conidiophores and conidia develop in the spots. Dark spores form in spots. This brownish growth appears as dull and dark bands, giving the name „fairy ring" spot to the disease.

Pathogen: ***Cladosporium echinulatum***

- Conidia solitary or in short and unbranched chains, mostly of two types: small conidia ellipsoid to subcylindrical, 0-1 septate, smooth to minutely verruculose, pale brown
- large conidia ellipsoid to cylindrical, often soleiform, up to six septa, somewhat septa appearing curved and brown,

8. Rust

Symptoms

- Rust symptoms are initially characterized with light green coloured lesions.
- On the lesions small brown pustules with powdery mass of brown spores develop on the leaves.
- During severe cases of infection, the lesions also spread to the stems.
- Due to high disease intensity, plants wither and affect the growth and flower quality. Severe infection leads to drying of leaves and stems.

Pathogen: ***Uromyces dianthi***

- The uredospores are spherical, brownish yellow in colour, loosey echinulated with 4-8 germ pores.
- Teliospores are round to oval, brown, single celled with unthickened apex and the walls are rough, brown and warty.

9. Grey mould

Symptoms

- Symptoms initially appeared as water-soaked brown lesion on the petals.
- Later, tan to grey, fuzzy mould, composed of thousands of spores, borne in grape like clusters covered the entire flower, under humid conditions.
- Fuzzy mould covered the flowers and flower buds and left them to choke.
- Under severe conditions, mold covers the entire plant and leads to complete drying.
- During prolonged period of sunshine without rain, irregular black resting bodies (sclerotia) of the fungus were found inside the split opened flowers

Pathogen: ***Botrytis cinerea***

- Hyaline, septate hyphae and produced grape bunch like conidia
- Sclerotia germinated both by myceliogenous and sporogenous modes

10. Bacterial wilt

- Infected plants exhibit greyish green foliage followed by sudden wilting and death of the plants.
- Roots of the affected plants rot and emit bad odour.
- Affected vascular tissues turn yellowish to brown.

- Basal portion of the affected stems cracks.

Pathogen: *Burkholderia caryophylli*

- It is a gram negative , rod shaped motile bacteria with flagella

DISEASES OF LIILIUM

1. Basal rot or bulb rot

Symptoms

- Unlike other *Fusarium* diseases, it is not a vascular wilt but it is a rot of the cortical tissues of the root.
- Chocolate or bluish-grey rot that extends from the basal plate in the scales
- Scales detach at the basal plate and bulbs fall to pieces after digging
- Premature yellowing of the foliage, stunting and premature senescence.
- Flower buts wilt and fail to open.
- The vascular tissues of the infected stem turn in to dark brown colour.

Pathogen: *Fusarium oxysporum* f.sp. *lilii*

- Fungus produces 3 types of spores
- Microconidia-Ovate / elongate / 1 celled, hyaline
- Microconidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

2. Foot rot

Symptoms

- Stem at collar region is mostly attacked. Affected plants wilt and die
- Sometimes leaves and flowers on the upper plant parts are also affected.

Pathogen: *Phytophthora cactorum*

- Hyaline coenocytic mycelium.
- Sporangiophores are slender sympodially branched which bears elliptical non-papillate sporangia with slight apical thickening with kidney shaped, biflagellate zoospores.
- Sexual spore is oospore

3. Botrytis blight

Symptoms

- Orange to reddish browm, oval spots with yellow halo or with water-soaked margin appear on leaves.
- Brown spots appear on stem near soil level.
- Lesions on flowers are brown and in cool and moist weather flowers are converted into wet slimy masses covered with powdery spores.

Pathogen : *Botrytis elliptica*

- Hyaline, septate hyphae and produced grape bunch like conidia
- Sclerotia germinated both by myceliogenous and sporogenous modes.

4. Anthracnose

Symptoms

- The disease infects outer scales of the bulbs in the soil
- Small, brown spots appear on linear scales.

Pathogen: *Collectotrichum lilii*

- Mycelium is septate.
- Conidiophore bears the Conidia were hyaline, aseptate, falcate, fusiform, tapered gradually to each end.
- Appressoria were dark brown to black, mostly lobed, rarely circular to clavate. Acervuli and setae present.

5. Lily mottle virus

Symptoms

- Veil clearing, mosai mottling, chlorotic and yellow streaking, leaf curling and narrowing are the common symptoms on leaves.
- Color breaking in flowers

Pathogen: Lilly mottle virus

- It belongs to Poty virus group
- Vector: Aphids

DISEASES OF ORCHIDS

1. Black rot

Symptoms

- The disease appears as water soaked patches on leaves which quickly turn black from the tip
- The rot spreads down the leaf and makes it completely black.
- The infection begins at the rhizome but the rotten patch is seen at the tip of the leaf

Pathogen: *Pythium splendens*

- *Pythium* produces coenocytic mycelium with sporangiophore bearing irregular shaped sporangia
- The sporangia put forth vesicle which bears the zoospores

2.Wilt

Symptoms

- Wilting of leaves
- Abscission and decay of roots followed by the production of few, small short-lived flowers

Pathogen: *Fusarium oxysporium f.sp.cattleyae*

- Fungus produces 3 types of spores
- Micro conidia-Ovate / elongate / 1 celled, hyaline
- Micro conidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

3.Rust

Symptoms

- Yellow pustules covered with fine powdery masses of spores on leaves

Pathogen: *Hemileia americana*

- It produces orange segment shaped uredospores and turnip shaped teliospores
- It does not produce all five stages (microcyclic)
- Pyncnial and Aecial stages have not been observed

4.Leaf Spot

Symptoms

- Yellow leaf spot and irregular blemishes seen on both the surface of leaf may enlarge and slightly suncken and necrotic and turn purplish brown to black spots and cover entire leaf
- Mosaic pattern occurs on the upper leaf surface when large sections of the leaf are diseased and undersides can be covered with dots, the sporing bodies
- Heavily infected leaves usually fall

Pathogen : ***Pseudocercospora dendrobii***

- Conidiophores bears conidia which are sub hyaline to coloured, obculate.
- Ascospores from the infected plant debris

5.Bacterial soft rot

Symptoms

- Small, water soaked dark green spots on upper end of leaves
- Pseudobulbs of infected plants turn soft and pulpy and become yellow in color
- Foul smelling liquid oozes from the bulbs.

Pathogen : ***Pectobacterium carotovorum subsp.carotovorum***

- Bacteria are non-spore forming, motile, short rod shaped

Ex.No.15. **DISEASES OF GLORIOSA, COLEUS , STEVIA AND ALOE**

Date :

DISEASES OF GLORIOSA

1. Root rot

Symptoms

- Ring the pustules is later ruptured irregularly exposing a powdery mass of brick red-colorInitially, brick red colored elliptical blisters or pustules, known as uredia, develop on the stem, leaf and leaf sheath.
- The epidermis coveed uredospores

Pathogen: ***Sclerotium rolfsii***

- Septate mycelium. Sclerotia are mustard like and dark brown.

2. Leaf Blight

Symptoms

- Water soaked black lesion on the leaves and drying of leaves

Pathogen: ***Curvularia lunata***

- Well branched, septate, brown and smooth mycelium. Conidiophores are dark brown bears dark, 3 to 4 septate curved conidia

3. Mosaic

Symptoms

- Leaves become chlorotic with reduced chlorophyll content
- It affects the flower and changes the original color
- **Vector : Aphid (**Glory lily mosaic virus)

DISEASES OF COLEUS

1. Wilt

Symptoms

- Yellowing and wilting of leaves
- Brown to black roots, oozing, putrefaction and decaying of roots and unhealthy plants

Pathogen: ***Fusarium chlamydosporum***

- Fungus produces 3 types of spores
- Micro conidia-Ovate / elongate / 1 celled, hyaline
- Micro conidia – Spindle shaped, tapered, 3-4 septate hyaline
- Chlamydospores - Terminal or Intercalary

2. Root rot

Symptoms

- Yellowing and drooping of the leaves,
- Blackening of the stem,
- Rotting of the root, basal stem and peeling of stem bark and root epidermis.
- The presence of black sclerotia was observed on the rotted portion.

Pathogen: ***Macrophomina phaseolina***

- The mycelium was initially hyaline and later became grey in colour.
- Sclerotia were minute, black, round to oblong or irregular in shape with mycelial attachment

3. Blight Disease

Symptoms

- Blight disease is common during monsoons or during period of high humidity.
- Symptoms include water soaked leaf spots that increased rapidly in size becoming light tan to brown and later necrotic.
- Severe infection results in defoliation and death of the plants.

Pathogen: ***Rhizoctonia solani***

- Septate mycelium. Sclerotia are irregular brown to black.
- Produces terminal and intercalary chlamydospores.
- Perfect stage: *Thanatephorus cucumeris*. Basidia with basidiospores are produced.

DISEASES OF STEVIA

1. Root Rot

- Yellowing and drooping of leaves, with wilting of plants and white cottony mycelial growth at the collar region.
- The mycelial growth spread to the stem and roots, with associated tissue rotting.
- On the diseased areas, brown sclerotia were observed.

Pathogen: ***Sclerotium rolfsii***

- The mycelium of the fungus is hyaline, branched at clamp connections and septate.
- The abundant brown mustard like sclerotia are produced.

2. Leaf Spot

Symptoms

- Initially appeared as small circular spots, light brown in colour.
- Later, many became irregular and dark brown to grey, while others remained circular with concentric rings or zones.
- On severely infected leaves several spots coalesced to form large necrotic areas.
- On older leaves concentric spots were more common at the tips. Leaf spots varied from 2-18 mm in diameter.

Pathogen: ***Alternaria alternata***

- Conidia dark brown or olive-brown in colour, short beaked, borne in long chains, oval and bean shaped with 3-5 transverse septa.

DISEASES OF ALOE

1. Base Rot

Symptoms

- The disease is common and occurs in abundance when there is too much water in the soil.
- The infection appears at the base of older or mature leaves which show yellowish brown rot.
- Under severe infection, the leaves droop and fall. This may lead to partial or complete defoliation of the plant depending on the severity of infection.
- Sometimes severe infection may lead to premature death of the plant.

Pathogen: ***Pectobacterium chrysanthemi***

- Bacteria are non-spore forming, motile, short rod shaped.
- Gram negative with peritrichous flagella

2. Leaf Spot

Symptoms

- Small, circular to oval dark brown necrotic sunken spots located mostly on the leaf tip.

Pathogen: ***Alternaria alternata***

- The conidiophores were branched, straight and golden brown in colour.
- Conidia are dark brown or olive-brown in colour, short beaked, borne in long chains, oval and bean shaped with 3-5 transverse septa.

Ex.No.16. **MUSHROOM CULTIVATION**

MUSHROOM –TISSUE ISOLATION AND SPAWN PREPARATION

Date:

Tissue culture:

Tissue culture technique is used to bring the edible mushroom to pure culture so that the mushroom fungus can further be used to prepare spawn, which is an essential material for mushroom cultivation. This nucleus culture is grown on Potato Dextrose Agar medium in test tubes. A small tissue from a well-grown mushroom is aseptically transferred to agar medium in a test tube in a culture room. The test tubes are incubated under room temperature for 10 days for full white growth of fungal culture. This is further used for preparation of Mother spawn.

Procedure:

- Select well grown, disease free mushroom sample
- Take the mushroom and split open the mushroom longitudinally into two halves under aseptic conditions and pierce a small piece of tissue from junction of stipe and pileus
- Transfer tissues in to the PDA medium in the tube under aseptic condition
- The growth of mushroom mycelium takes place which covers the tube in 6-7 days and can be used as base culture

PREPARATION OF MOTHER SPAWN

Mother spawn

- Mother spawn is nothing but the mushroom fungus grown on a grain based medium.
- Wash the sorghum grains in water thoroughly to remove chaffy and damaged grains.
- Cook the grains in an autoclave / vessel for 30 minutes just to soften them.
- Take out the cooked grains and spread evenly over a Hessian cloth on a platform to remove the excess water.
- Mix calcium carbonate ($CaCO_3$) thoroughly with the cooked, dried grains @ 20 g / Kg
- Fill the grains in polypropylene bags up to $3/4^{th}$ height (approximately 300-330 g / bag), insert a PVC ring , fold the edges of the bag down and plug the mouth tightly with non-absorbent cotton wool.
- Cover the cotton plug with a piece of waste paper and tie tightly around the neck with a jute thread.
- Arrange the bags inside an autoclave and sterilize under 20 lbs pressure for 2 hours.
- Take out the bags after cooling and keep them inside the culture room
- Transfer the mushroom base culture in to the sterilized sorghum bag
- Incubate the inoculated bags in a clean room under room temperature for 10 days for the mushroom mycelium grows on the sorghum grains to form the mother spawn

PREPARATION OF BED SPAWN

Bed spawn: The method of preparation of bed spawn was same as that of mother spawn. The cooking, filling and sterilization were similar to that of mother spawn. After sterilization, the bags are taken for inoculation. One mother spawn can be transferred to 25 to 30 first generation bed spawn and from this 750 to 900 second generation bed spawn can be prepared.

CULTIVATION OF OYSTER MUSHROOM

Pleurotus spp. can be grown indoors and any well-ventilated room would be suitable. A thatched shed with false roofing is an ideal room for successful cultivation of this mushroom, as the required temperature of 20- 25□ C and relative humidity of 80-85 % can easily be maintained. Bed spawn and mother spawn are prepared as above.

OYSTER MUSHROOM (*Pleurotus sp.)*

- Sub tropical mushroom
- Genus – more than 50 species
- Short Stipe , colour of stipe and pileus same
- distinct shell shape, soft, mostly white or pink, dull white, grey, yellow
- stipe laterally attached to pileus, decurrent gills
- Cultivated in thatched sheds
- Temperature : 25- 28ºC and RH of 80 to 85 %

Preparation of substrate:

Paddy straw is found to be the best substrate giving more bio efficiency. Paddy straw is chopped into bits of size 2-3" for easy handling and operation. There are three methods with which the chopped straw can be sterilized *viz*., Hot water treatment / Boiling method which involves boiling the paddy straw for 30 to 45 minutes, steaming in which the substrate is steamed under 15 lbs for 30 minutes, Chemical method which includes soaking substrate in 10 g of carbendazim and 120 ml. of formalin for 16 h. After these processes, the excess water is drained from the substrate by spreading on a hessian cloth to get 60-65 % moisture capacity.

BED PREAPRATION AND CROPPING:

The cultivation of oyster mushroom is usually carried out in transparent polythene covers. The size of the cover should be 60 x 30 cm, with a thickness of 80 gauge.

- Take the polythene cover and tie the bottom end with a thread and turn it inwards
- Take out a well-grown bed spawn, squeeze thoroughly and divide into two halves.(Two beds are prepared from the single spawn bag)
- Fill the straw to a height of 3" in the bottom of polythene bag, take a handful of spawn and sprinkle over the straw layer, concentrating more on the edges.
- Fill the second layer of the straw to a height of 5" and spawn it as above.
- Repeat this process to get five straw layers with spawns.
- Gently press the bed and tie it tightly with a thread.
- Put 6 ventilation holes randomly for ventilation as well as to remove excess moisture

present inside the bed.

- Arrange the beds inside the thatched shed, (Spawn running room) following rack system or hanging system. Maintain the temperature of 22-25 C and relative humidity of 85-90 % inside the sheds.
- Observe the beds daily for the infestation of insect pests and moulds
- The fully spawn run beds should be transferred to cropping room in the thatched shed, where the diffused light and good ventilation are necessary for the button development.
- Open the bed cover and spray water on the beds from second day of opening using an atomizer.
- Two to three days after opening pinheads of mushroom button develop which will be ready for harvest with in another 4 days.
- Harvest the entire bunch of mushroom gently in the early hours of morning.

CULTIVATION OF MILKY MUSHROOM

The cultivation of milky mushroom *Calocybe indica* is usually carried out in transparent polythene covers. The size of the cover should be 60 x 30 cm, with a thickness of 80 gauge.

MILKY MUSHROOM

- Pure milky white colour
- similar to button mushroom in appearance
- Long stipe, sub bulbous at the base, centrally attached to stipe, no annulus or volva
- Pileus/ cap- smooth, convex later expanded
- Adnate to decurrent gills
- Long shelf life and more fibre (41%)
- Cultivated in polysheds
- Temperature requirement :30-35ºC; RH of 75 to 85 %

Preparation of substrate: Substrate preparation is similar to oyster mushroom.

Bed preparation: Bed preparation is similar to oyster mushroom.

Casing and cropping: In the case of milky mushroom, an extra process called casing has to be done to induce button formation. Casing is nothing but the application of thin layer of sterilized soil on the surface of mushroom bed to induce button formation. For casing, garden land soil rich in calcium is preferable. The soil is mixed with calcium carbonate @ 100 g/ kg and used as a casing medium and steamed in an autoclave or pressure for 45 minutes. After casing operation, the beds should be arranged inside the blue polythene covered pit tent. The fungus requires an optimum temperature of 30-35°C and relative humidity of 80-85 per cent for the better growth and production of sporocarp. In addition, the fungus needs a light intensity of 2500-3000 lux for production of buttons.

The fully grown beds are cut in to two halves and over each half casing soil is to be

layered to 1 inch height and such cased beds should be kept inside the blue tent. Observe the beds daily and spray water if necessary, to keep the beds wet. Watch for any contamination and insect pests. If noticed take necessary steps. Ten days after casing the small pin head buttons develop and with in another 7 days mushrooms are ready for harvest. Harvest the mushroom, clean it and pack it in a polythene bag for sales. Three harvests can be made from these beds. The mushroom yield of 350 –400 g can be obtained from 250 g dry weight of the straw, providing all optimum conditions inside the mushroom shed.

PADDY STRAW MUSHROOM- BED PREPARATION AND CROPPING

The cultivation of paddy straw mushroom can be done in a thatched house and also under the shade of a tree. Fresh, disease free paddy straw is the ideal substrate. In recent years, it is cultivated inside plastic film houses to maintain the temperature of around 25 -35 C and relative humidity of 75-80 %.

PADDY STRAW MUSHROOM

- Volva- distinct character
- pileus initially bell shaped, later umboniform
- stipe colour white and long (5-12 cm), pileus light brownish red
- Homothallic mushroom
- Cultivated in poly sheds and outdoor cultivation
- Temp: 30-35ºC, RH- 85%

Spawn: Paddy straw bits are soaked in water for 1 hour, excess water is drained and mixed with 10% horse gram powder and autoclaved in polythene bag at 15 lbs for 1 hour. After cooling, paddy straw base culture is transferred to the autoclaved paddy straw bits and the mycelium covers the bag in 6- 7 days which form the spawn

Circular compact bed method: Instead of bundled straw, twisted paddy straw can also be used for cultivation. At least ten kg paddy straw is necessary for preparing one bed.

- Make the straw into twists of about 5-8 m long and 5-10 cm diameter.
- Immerse the twists in water for 12 hr.
- Take out the straw and drain the excess water.
- Place them in a circular manner over a platform.
- Sprinkle the coarsely powdered horse gram and place small bits of spawn all along the periphery as above.
- Build another layer as described above and spawn the layer.
- Build up 4-5 layers and spawn as usual.
- Compact the bed by pressing and cover it with a polythene sheet.

The beds are to be sprinkled with water to maintain 50 to 60 % moisture and the mushroom spawning is completed in 5-6 days and pinheads appear from 8-9th day and the mushroom is ready for harvest by 10th day. Within 20-22 days three harvests can be completed.