UNIT - IV Diseases of Vegetable crops

Lecture 10 - DISEASES OF TOMATO

DISEASES	**CAUSAL ORGANISM**
Damping-off	*Pythium aphanidermatum*
Fusarial Wilt	*Fusarium oxysporum f. sp. Lycopersici*
Verticillium wilt	*Verticillium dahliae, Verticillium albo-atrum*
Early blight	*Alternaria solani*
Late blight	*Phyotophthora infestans*
Bacterial wilt	*Ralstonia solanacearum*
Mosaic	*Tobacco mosaic virus*
Leaf curl	Tobacco leaf curl virus
Tomato spotted wilt	Tomato spotted wilt virus (TSWV)

Blossom end rot is due to calcium deficiency

1. **Damping-off -** *Pythium aphanidermatum*, *Pythium indicum*, *Phytophthora parasitica*, *Rhizoctonia solani* and *Sclerotium rolfsii*.

Symptoms:

Damping-off disease occurs in two stages (pre-emergence and post-emergence phase). In the pre-emergence phase the seedlings are killed just before they reach the soil surface. The post-emergence phase is characterized by **water soaked lesions appear** on the stems near the soil surface and stem may rot leading **to toppling over of the seedlings.**

Mode of spread and survival:

The pathogen survives in the soil as **oospores and chlamydospores**. The primary infection is soil-borne oospores and secondary spread through sporangia and zoospores transmitted by irrigation water.

Epidemiology: Overcrowding of seedling, ill-drained nursery beds, heavy shade in nursery, high soil moisture.

Management:

- Prepare raised seed beds with adequate drainage facility.
- Drench the seed bed with Bordeaux mixture 1% or Copper oxychloride 0.2%, two days before sowing.
- Avoid overcrowding of seedlings.
- Avoid excess watering of the seedlings.
- Seed treatment with *Trichoderma viride* (4 g/kg of seed) or *Pseudomonas fluorescens* (10 g/kg of seed) or Thiram (3 g/kg of seed).
- Soil application of *Pseudomonas fluorescens* 2.5 kg/ha mixed with 50 kg of FYM.
- Spray the nursery beds two weeks after sowing with Metalaxyl 0.2% at 10 days interval.

2. Fusarium Wilt – *Fusarium oxysporum* f. sp. *lycopersici*

Symptoms:

The first symptom of the disease yellowing of the lower leaves and affected leaflets wilt and die.The symptoms continue in subsequent leaves. At later stage, browning of vascular system occurs.

Mode of spread and survival:

The fungus is seed-borne and soil-borne. The fungus survives in the soil as chlamydospores. Wind-borne macro-conidia and micro-conidia help in distribution of the pathogen from field to field.

Epidemiology: Warm soil temperature.

Management:

- The affected plants should be removed and destroyed.
- Seed treatment with *Pseudomonas fluorescens* (Pf) 10 g/kg of seed, followed by nursery application of *P.flurorescens* 20 g/m^2 and seedling dip with Pf 5 g/lit along with soil application of *P.f* 2.5 kg/ha mixed with 50 kg FYM at 30 days after transplanting.
- Spot drench with Carbendazim 1 g/lit for wilt affected plants.

3. Early blight – *Alternaria tomatophila* (syn: *Alternaria solani*)

Symptoms:

- Disease symptoms observed as **small, black lesions mostly on the older foliage**. Spots enlarge, **concentric rings in the center of the diseased area**.
- Tissue surrounding the spots may turn yellow.
- Lesions on the stems are similar to those on leaves, sometimes girdling the plant if they occur near the soil line. The fungus infects the fruit, generally through the calyx or stem attachment.
- **Concentric rings are also present on the fruit.**

Pathogen: Mycelium is septate, branched and light brown colour. Conidiophores are dark coloured. **Conidia** are beaked, **muriform**, dark coloured and borne singly.

Mode of spread and survival:

The pathogen is spread by wind and rain splashes. Under dry conditions pathogen survives in infected plant debris in the soil and seed-borne.

Epidemiology: High soil moisture creates high humidity that favours disease development.

Management:

- Removal and destruction of crop debris.
- Practicing crop rotation helps to minimize the disease incidence.
- Spray with Mancozeb 0.2% for effective disease control.

4. Late blight: *Phyotophthora infestans*

Symptoms

Water soaked **brown to purplish lessions with faded green patches appears in leaves,** spread fast to entire leaf and petiole. In leaf tip and margin whitish mildew like growth appears on leaves, which are killed or the dead area become dry. **Russet brown marbled areas appear** on fruits and spots enlarge. Fruits remain firm; if fruit is cracked a weft of fungus appear resulting in soft rot

Etiology:

Sporangiophores are slender, hyaline and branched, **produce pear shaped sporangia with papilla.** Produces biflagellate zoospores.**Antheridium is amphigynous** and sexual spores are oospores.

Mode of spread and survival

The pathogen is soil borne and spread through sporangia or zoospores dispersed by wind or rainwater. Survives in plant debris

Epidemiology

High humidity, low temperature, cloudy weather and rain fall with splashing rains favours the disease development.

Management

Prophylactic sprays with copper fungicides or dithiocarbomates 0.25% based on weather conditions.

5. Verticillium wilt – *Verticillum dahliae, Verticillium albo-atrum*

Symptoms:

Plants are stunted, leaves show dark green patches with interveinal and marginal yellowing. Leaves wilt, dry and fall off. **Brown pink disolouration in xylem vessels**. Many adventitious roots develope.

Etiology:

Conidiophores are vertically branched and conidia are single, cylindrical.

Mode of spread:

Primary spread is through soil borne chlamydospores and dormant mycelium, secondary mycelium is through water borne conidia.

BACTERIAL DISEASES

6. Bacterial wilt – *Ralstonia solanacearum*

Symptoms:

Characteristic symptoms of **bacterial wilt are the rapid and complete wilting of normal grown** up plants. Lower leaves may drop before wilting. Pathogen is mostly confined to vascular region; in advantage cases, it may invade the cortex and pith and cause yellow brown discolouration of tissues and **xylem blackening**.Infected plant parts when cut and immersed in clear water, **a white streak of bacterial ooze** is coming out from cut ends.

Etiology: Rod shaped with tuft of polar flagellum and gram negative.

Mode of spread and survival:

The bacterium survives in soil and they spread through irrigation water and by transplanting of infected seedlings.

Epidemiology: Relatively high soil moisture and soil temperature favour disease development.

Management:

- Avoid damage to seedling while transplanting.
- Apply bleaching powder 10 kg/ha.
- Crop rotations are effective in reducing bacterial wilt of tomato.
- Fields should be kept clean and affected parts are to be collected and burnt.

VIRAL DISEASES

7. Tomato spotted wilt disease (TSWV) OR Bronzy wilt

Symptoms:

- **Numerous small, dark, circular spots appear on younger leaves**. Leaves may have a bronzed appearance and later turn dark brown and wither.
- Fruits show numerous spots with concentric, circular markings. On **ripe fruit, these markings are alternate bands of red and yellow.**

Mode of spread:

Tomato spotted wilt virus is transmitted through thrips (*Thrips tabaci, Frankliniella schultzi* and *Frankliniella occidentalis*).

Management:

- The affected plants should be removed and destroyed.

- Alternate or collateral hosts harbouring the virus have to be removed.
- Raise barrier crops – sorghum, maize, cumbu 5-6 rows around the field before planting tomato.
- Spray Imidacloroprid to control the vector.

Blossom-end rot is due to calcium deficiency

Symptoms: The diagnostic symptom is a light tan lesion turning to a dark brown sunken area at the blossom-end of the fruit.

Control: Applications of limestone or gypsum before planting are used to reduce the incidence of blossom-end rot.

Other diseases of tomato are the following:

Leaf spot – *Septroia lycopersici*

Leaf mold – *Cladosporium fulvum*

Buckeye rot – *Phytophthora parasitica*

Powdery mildew – *Leveillula taurica* and *Erysiphe polygoni*

Bacterial leaf spot – *Xanthomonas campestris* pv. *vesicatoria*

Bacterial canker and wilt – *Clavibacter michiganensis* sub sp. *michiganensis*

Big bud – *Candidatus* Phytoplasma aurantifolia

Tomato mosaic virus transmitted by Seeds and Mechanical

Transit and storage diseases,

Fruit rot is caused by *Phytophthora* spp., *Botrytis cinerea*, *Rhizopus stolonifer*, *Alternaria solani*, *Fusarium* spp. and *Erwinia carotovora* pv. *carotovora*.

Difference between *Alternaria* leaf spot and Spotted wilt.

***Alternaria* leaf spot**	**Spotted wilt**
Necrotic spots with concentric rings	Necrotic rings with a central green portion which later turns necrotic
Leaf shape not changed but may dry	Leaves curl upwards
No bronzing	Bronzing Characteristic
Plant usually not killed	Plants wilt
No fruit symptoms	Concentric rings on fruits
Air-borne	Thrips transmitted

Lecture 11 - DISEASES OF BRINJAL

DISEASES	**CAUSAL ORGANISM**
Damping-off	*Pythium aphanidermatum*
Phomosis blight and fruit rot	*Phomosis vexans*
Leaf spot	*Cercospora melongenae*
Alternaria leaf spot	*Alternaria melongenae*
Verticillium wilt	*Verticillium dahliae*
Bacterial wilt	*Pseudomonas solanacearum*
Phytoplasmal diseases	
Little leaf	*Hishimonas phycitis (Leaf hopper)*

1. Damping-off - *Pythium aphanidermatum*, *Pythium indicum*, *Phytophthora parasitica*, *Rhizoctonia solani* and *Sclerotium rolfsii*.

Symptoms:

Damping-off disease occurs in two stages (pre-emergence and post-emergence phase). In the pre-emergence phase the seedlings are killed just before they reach the soil surface. The post-emergence phase is characterized by **water soaked lesions appear** on the stems near the soil surface and stem may rot leading **to toppling over of the seedlings.**

Mode of spread and survival:

The pathogen survives in the soil as **oospores and chlamydospores**. The primary infection is soil-borne oospores and secondary spread through sporangia and zoospores transmitted by irrigation water.

Epidemiology: Overcrowding of seedling, ill-drained nursery beds, heavy shade in nursery, high soil moisture.

Management:

- Prepare raised seed beds with adequate drainage facility.
- Drench the seed bed with Bordeaux mixture 1% or Copper oxychloride 0.2%, two days before sowing.
- Avoid overcrowding of seedlings.
- Avoid excess watering of the seedlings.
- Seed treatment with *Trichoderma viride* (4 g/kg of seed) or *Pseudomonas fluorescens* (10 g/kg of seed) or Thiram (3 g/kg of seed).
- Soil application of *Pseudomonas fluorescens* 2.5 kg/ha mixed with 50 kg of FYM.
- Spray the nursery beds two weeks after sowing with Metalaxyl 0.2% at 10 days interval.

2. *Phomopsis* blight and fruit rot: *Phomopsis vexans*

Symptoms

- Affects all above the ground plant parts.
- Spots generally appear first on seedling stems or leaves.
- **Girdle seedling** stems and kill the seedlings.
- Leaf spots are clearly defined, circular, up to about 1 inch in diameter, and brown to gray with a narrow dark brown margin.
- **Fruit spots are much larger, affected fruit are first soft and watery but later may become black and mummified. Centre of the spot becomes gray, and black pycnidia develop**.

Pathogen

- **Pycnidia with or without beak** are found in the affected tissue. They are globose or irregular. Conidiophores in the pycnidium are hyaline, simple or branched. Conidia are hyaline, one celled and sub cylindrical. Ascospores are hyaline, narrowly ellipsoid to bluntly fusoid with **one septum.**

Mode of spread and survival

The fungus survives in the infected plant debris in the soil.

It is **seed borne and soil borne.** The spores are spread by rain splashes. The fungus spreads through implements and insects.

Epidemiology

Temperature ranging from **21°C to 32°C** with an optimum **29°C** favours the disease. Wet weather with **26°C** favors fruit rot in storage.

Management

- Seeds should be dipped in hot water at 50˚C for 30 min. spraying with defoliation 0.2% or captan 0.2% in the nursery and field at 7 – 10 days interval controls the disease.
- Deep summer ploughing, three year crop roation and collection and destruction of diseased plant debris are some of the other control methods.
- Spraying the crop in the field with zineb 0.2% or Bordeaux mixture 0.8% is effective in controlling Phomopsis blight.

3. Leaf spot: *Cercospora solani -melongenae, C. solani*

Symptoms:

The leaf spots are characterized by chlorotic lesions, angular to irregular in shape, later turn grayish-brown with profuse sporulation at the centre of the spot. Severely infected leaves drop off prematurely, resulting in reduced fruit yield.

Pathogen

The fungus produces stromata which are globular. Conidiophores in mass are medium dark and slightly olivaceous brown in colour and paler towards the tip. Conidia are sub hyaline to pale olivaceous.

Mode of spread and survival

The disease is spread by air borne conidia.

Management

- **Pant Samrat** variety is resistant to both the leaf spots.
- Diseases can be managed by growing resistant varieties.
- Spraying 1 per cent Bordeaux mixture or 2 g Copper oxychloride or 2.5 g Zineb per litre of water effectively controls leaf spots.

4. Alternaria leaf spot – *Alternaria melongenae*

Symptoms

Cracks appear on leaf. The spots are brown and irregular in shape. **Concentric rings** are present in them. Several spots coalesce to form larger necrotic patches and later cause defoliation of leaves. Fruits are also affected. **Large necrotic sunken spots** develop on the **fruits** which turn yellow and drops.

Pathogen:

The fungi consist of septate, branched hyphae. Conidiophores emerge through the stomata bear conidia singly or in short chains. The conidia are beaked, **muriform**, dark colored, with 5 - 10 **transverse septa and a few longitudinal septa**.

Mode of spread: The pathogen is seed and soil borne.

Management

Nursery application with mancozeb 0.2% Difolatan 0.2% or captan 0.2% in the main field at intervals of 10 to 15 days reduces the disease incidence.

5. Bacterial wilt: *Pseudomonas solanacearum/Ralstonia solanacearum*

Symptoms

The affected plants show yellowing of foliage, wilting and stunting of plants followed by death. The vascular systems turn brown and on culturing bacterial ooze can be observed.

Mode of spread and survival

The pathogen is soil borne and survives for several years in soil. The primary infection is through wounds.

Epidemiology

Humid weather and high temperature favour the disease.

Management

- Use resistant variety Pant samrat, Arka Nidhi, Arka Neelakantha,Surya and BB1 ,44 and 49.
- Crop rotationand green manuring with cruciferous vegetables such as cauliflower helps in reducing the disease incidence. (Biofumigation).
- Fields should be kept clean and effected parts are to be collected and burnt. Spray Copper fungicides to control the disease (2% Bordeaux mixture.).
- The disease is more prevalent in the presence of root knot Nematodes, so control of these nematodes will suppress the disease spread.

6. Little leaf: Phytoplasmal diseases

Symptom

- The most characteristic symptom is the **reduction in size of leaf.**
- Leaves become almost **sessile**. The leaves become thin, soft, glabrous and pale green.
- **The internodes get shortened** and the axillary buds are stimulated to sprout and they grow into short branches, with very small leaves. Gives plants a **bushy appearance**. In the affected plants there will be **no floral parts** and if present they are modified in to **green leaf like structures**.
- Fruit formation is very rare and the fruits formed are tough, leathery and may fail to mature normally.

Mode of spread

Insect vector leaf hoppers spread the pathogen.

Management

- Rogeuing of infected plants.
- Eradication of all solanaceous weed host; Spraying malathion 0.05% to control the leaf hoppers are advised.
- The antibiotic gives only a temporary control of the disease. (10 to 50 ppm of tetracycline antibiotic or 50 to 100 ppm of chloromphenicol) -Grow resistant varieties like **Arka sheel, Aushy, Banaras, Pus purple round, Pus purple cluster.**
- Seed dip in tetracyclines @10-50ppm.

Lecture 11- DISEASES OF BHENDI (OKRA)

1. Powdery mildew : *Golvinomyces cichoracearum*
2. *Cercospora* leaf spot : *Cercospora abelmoschi; C. malayensis,*
3. *Fusarium* wilt : *Fusarium oxysporum f.sp. vasinfectum*
4. Yellow vein mosaic : Bhendi yellow vein mosaic virus

1. Powdery mildew: *Golvinomyces cichoracearum*

Symptoms

Powdery mildew is very severe on bhendi. Greyish powdery growth occurs on the under as well as on the upper surface of the leaf causing severe reduction in fruit yield.

Pathogen: Ectophytic mycelium producing barrel shaped conidia.

Mode of spread and survival

Air borne conidia spread the disease and the pathogen survives in the plant debris.

Management

Spray wettable sulphur 0.25% or Dinocab (Karathane) 0.07%

2. *Cercospora* leaf spot: *Cercospora abelmoschi ; Cercospora malayensis*

Symptoms

In India, two species of *Cercospora* produce leaf spots in bhendi. C. *Malayensis* causes brown, irregular spots and *C*. *abelmoschi* causes **sooty black, angular spots.** Both the leaf spots cause severe defoliation and are common during humid seasons.

Mode of spread and survival

Air borne conidia spread the disease and the pathogen survives in the plant debris.

Epidemiology

The fungus requires 25 or 29°C for maximum infection.

Management

Regular spraying with copper oxychloride 0.25% or Mancozeb 0.25% or Captan 0.1% reduces the incidence.

3. *Fusarium* wilt*:* *Fusarium oxysporum f.sp. vasinfectum*

Symptoms

The conspicuous symptom is a typical wilt, beginning with a yellowing and stunting of the plant, followed by wilting and rolling of the leaves as if the roots were unable to supply sufficient water. Finally, the plant dies. If a diseased stem is split lengthwise, the vascular bundles appear as dark streaks. When severely infected, nearly the whole stem is blackened.

Pathogen

Macroconidia are 3- 5 septate formed on sporodochia and pionnotes. In mass conidia appear buff or salmon orange in color. Macroconidia are fusiform and curved inward at both ends. The base is pedicellate. Microconidia are septate. Terminal and intercalary chlamydospores are broadly ovate.

Mode of spread and survival

The fungus is soil borne.

Management

Treat the seeds with Mancozeb @ 3g/kg seed. Drench the field with Copper oxy chloride @ 0.25%.

4. Yellow vein mosaic: Bhendi Yellow Vein Mosaic Virus

Symptoms

- **Yellowing of the entire network of veins in the leaf blade is the characteristic symptom**.
- In severe infections the younger leaves turn yellow, become reduced in size and the plant is highly stunted.
- The veins of the leaves will be cleared by the virus and intervenal area becomes completely yellow or white. In a field, most of the plants may be diseased and the infection may start at any stage of plant growth.
- **Infection restricts flowering and fruits**, if formed, may be smaller and harder.

Mode of spread and survival

The virus is transimtted by ***Bemisia tabaci.*** Survive on weed host *croton sparsiflorus*

Management

- Take up vector control by using Nuvan and Dimecron Starting from 7 DAS and repeat every 15 days.
- The variety CO3 is moderately resistant and Parbani Kranthi is resistant. For sowing during the summer season, when the whitefly activity is high, the susceptible varieties should be avoided.
- Spraying monocrotophos 1.5 ml/litre of water can restrict the disease spread. Synthetic pyrethroids should not be used because it will aggravate the situation. It can be controlled by application of Chlorpyriphos 2.5 ml + neem oil 2 ml lit of water.

Lecture -12 - Diseases of Cruciferous

(**Cole crops**: Cabbage, Cauliflower and Knol-knol)

Diseases of **Cabbage** (*Brassica oleracea* var. *capitata*),Cauliflower and Knol- khol

DISEASES	**CAUSAL ORGANISM**
Club root of Cabbage	*Plasmodiophora brassicae*
Downy mildew	*Peronospora parasitica*
Leaf spot or Black spot	*Alternaria brassicae*
Black leg of cabbage	*Phoma lingum*
Yellows or fusarium wilt	*Fusarium oxysporum f sp. conglutinans*
Head rot	*Sclerotinia sclerotiorum*
White rust	*Albugo candida*
Damping off or wire stem	*Pythium debaryanum* or *Rhizoctonia sola*
Black rot	*Xanthomonas campestris* pv. *Campestris*
Cauliflower	Cauliflower Mosaic Virus (CMV)

Non-pathogenic diseases are:

(i) **Boron** deficiency, characterized by **brown necrosis of pith**;

(ii) **Molybdenum** deficiency, characterized by production of **whip-tails** in the leaves; and

(iii) **Potash** deficiency, recognizable by chlorosis of the **old leaves in zones** adjacent to leaf margins, which later become brown and brittle.

1. **Club root** – *Plasmodiophora brassicae* (Woronin)

Symptoms:

The above-ground plant parts show **stunting, reduction in the size of head leaves** shown pale green to yellowish. When such plants are pulled out and the roots

examined, the roots are malformed into **spherical, knobby and club-like structures**. In advanced cases the malformed tissues rot and turn black, due to the action of the soft rot bacteria.

Etiology: Protozoan diseases. Plasmodium produces zoospores.

Mode of spread and survival:

The pathogen is capable of surviving in the soil for 7-10 years as resting spores. The resting spores of the fungus can be spread from field to field by infested soil, contaminated water supplies, infected transplants, farm machinery and animals.

Epidemiology:

Disease development is favored by high soil moisture and soil temperatures between 18-25°C. Although club root has been found in soils exhibiting a wide pH range from 4.5-8.1, the disease is primarily associated with acid soils.

Management:

- The disease is severe in acidic soils; hence, application of lime 2.5 t/ha to increase the soil pH.
- Soil drenching with Copper oxychloride 0.25%.
- Development of disease-resistant varieties.

2. **Black spot** – *Alternaria brassicae*

Symptoms:

Small, brown to black circular spots appear on older leaves. The leaf spots enlarge in **concentric circles** and mature lesions have a bull's eye type appearance. *Alternaria brassicicola* will produce black sooty colored spores within

the leaf spots. It causes damage to cabbage heads and cauliflower curds after maturity stage.

Mode of spread and survival:

Pathogens are seed borne or the conidia are borne abundantly in moist atmosphere and are disseminated readily by air currents. The fungus can also survive in infested crucifer debris in the soil or on cruciferous weeds.

Epidemiology:

Rain or dew that persists for more than 9 hours is required for germination and infection to occur.

Management:

- Use disease free seed.
- Hot water treatment or fungicide seed treatment.
- Crop rotation, alternating with non-cruciferous crops.
- Excessive irrigation should be avoided and good weed control maintained.
- First foliar spraying with Tridemorph 0.1% followed by spraying with Mancozeb 0.25% a month interval.

3. **Downy mildew** – *Hyaloperonospora brassicae*

Symptoms:

The fungus when attacks the young seedlings, discoloration occurs and in severe cases the whole plant perishes. **Purplish leaf spots or yellow brown spots on the upper surface of the leaf** appear, while fluffy downy fungus growth is found on the lower surface.

Etiology : Sporangiophores are dichotomously branched at acute angles.

Mode of spread and survival:

The fungus perennates in the soil through oospores in roots or in old diseased plant parts and as contaminant with seeds. Secondary spread of the disease is through water and wind-borne conidia.

Epidemiology: Rainy, humid weather favors the development of downy mildew.

Management:

- Seed treatment with Metalaxyl 6g/kg of seed.
- Spraying with Metalaxyl 500 g/ha or Metalaxyl + Mancozeb 1 kg/ha or Mancozeb 1 kg/ha.

4. **Black leg** – *Leptosphaeria maculans* (Anamorph: *Phoma lingam*)

Symptoms:

Fungus attacks the crop at seedling or at any stage. Stem of the affected plant when split vertically, shows severe **black discoloration of sap stream and brown canker appear on base of stem.** Whole root system decays from bottom upwards. Frequently, the affected plants fall over in the field.

Etiology: Septate mycelium produces pycnidia.

Mode of spread and survival:

Pathogen can survive for up to four years in seed and three years in infected crop debris. The pathogen infects seedlings, forms **pycnidia** and produces abundant

amounts of spores and are splashed to nearby plants to initiate new infections. Secondary infection is through water and primary infection is through Ascospores.

Epidemiology: Black leg disease is favored by wet, rainy weather.

Management:

- Seed treatment with Captan or Thiram 4g/kg, followed by *Trichoderma viride* 4g/kg.
- Pusa Drumhead, a cabbage cultivar has been reported to be tolerant under field condition.
- Spraying the plants with Copper oxychloride 0.1%.

5. Yellows – *Fusarium oxysporum* f. sp. *conglutinans*

Symptoms: Affected foliage turns dull and chlorotic. Leaves may die prematurely and senesce, starting at the base of the plant. This pathogen invades the vascular system of host plants, turning the vascular tissue brown. Plants which do not die are often stunted and have one-sided yellowing of the leaves.

Mode of survival and spread: This fungus survives in the soil and produces spores which can persist in the soil for many years. The fungus enters the plant through the roots and moves into the vascular system. Wind borne macro-conidia and micro-conidia help in distribution of the pathogen from field to field.

Epidemiology: The disease is generally favoured by warm soil temperatures above 20°C.

Management:

- Resistant varieties help provide the most effective control of this disease.

- Crop rotation for a minimum of five years.
- Collect and remove pruning debris from site or destroy by burning.
- Spot drench with Carbendazim 1 g/lit for wilt affected plants.

6. Root rot or wire stem – *Rhizoctonia solani*

Symptoms: Young plants show soft, **water soaked lesion on the stem near soil level**, the cotyledons wither and the plant eventually fall over and perishes.

When infection occurs at a later stage of growth, the lower part shows discoloration over a length of several centimeters, becomes **hard and woody and thinner than usual as the cortical tissue dies and this phenomenon is known as "wire stem".**

Management:

- Seed treatment with Captan or Thiram 4g/kg, followed by *Trichoderma viride* 4g/kg.
- Seedbed drenches with Copper oxychloride 0.25% will give good disease control.

7. White blisters or Rust of raddish: *Albugo candida*

Symptoms:

Two types of infection;

Local infection

Isolated pustules or sori develop in leaves and stems. Pustules emerge to form large patches.Host epidermis rupture after maturity of pustules.

Systemic infection

When young stems and flowering parts are infected it becomes systemic.

- **Shiny white creamy raised pustules develop on the lower surface of the leaves.** Young stem and inflorescence are infected and cause deformities like swelling and distortions due to **hypertrophy and hyperplasia**. The petals and sepals are modified into leaf like structure and results in sterility of the ovary.

Mode of spread and survival:

The disease spreads primarily by germination of oospore and secondary spread is by zoospores. The fungus survive as oospores in the soil and debris

Epidemiology

Optimum temperature is 20° C for the germination of sporangia.Moist cool weather and a thin film of water on the leaves help in the disease development.

Management

- Remove the infected debris. Destroy the oospores on surface of seed by treating in 52°C hot water for 20 minutes. Cruciferous weeds have to be removed. Spray 0.8% Bordeaux mixture.

8. Black rot – *Xanthomonas campestris* pv. *campestris*

In India it was first reported in 1929. The disease occurs on cabbage, cauliflower, turnip, Brussels sporut, broccoli, knol knol, raddish, mustard and other cruciferous plants.

Symptoms: The first sign of the disease is the occurrence of chlorotic lesions near the leaf margin, which progresses towards the center in the form of **V-shaped yellowish spots.** The vein and veinlets turn brown and finally black, which is characteristic of the disease. Such vascular blackening may extend to the petiole, stem and root.

Pathogen: The bacterium is a rod with single polar flagellum. It produces pale yellow colonies on nutrient agar medium.

Mode of spread and survival: the organism persists in soil on plant debris and is disseminated by seeds. When infected seeds are sown, the bacteria become active and gain entry into the seedlings through the stomata of the cotyledons. The bacteria also enter the host through hydathodes and incidental wounds. Secondary spread of the pathogen is the field is through irrigation water, rain, wind and cultural operations.

Epidemiology: Black rot is spread rapidly during warm, humid weather with an optimal temperature range of 27–30°C at 80–100% humidity.

Management:

- Hot water treatment of the seed at 50°C for 30 minutes is effective in killing both the internally and externally-borne pathogen.
- Seed treatment with Aureomycin 1000 ppm for 30 minutes.
- Application of bleaching powder 12.5 kg/ha.
- Rotation to avoid cruciferous crop for three years.
- Balanced nutrition, especially, potash helps the plants in resisting the parasite.

9. Cauliflower mosaic virus (CaMV)

Symptoms: CaMV induces a variety of systemic symptoms such as **mosaic, necrotic lesions on leaf surfaces, stunted growth and deformation of the overall plant structure.**

Pathogen: CaMV contains a **circular double-stranded DNA molecule.**

Mode of spread: CaMV is transmitted in a non-circulatory manner by aphid, *Myzus persicae*. Once introduced within a plant host cell, virions migrate to the nuclear envelope of the plant cell.

Management:

- Eradicate cruciferous weeds and volunteers; incorporate crop debris immediately after harvest.
- Grow resistant cultivars.

Lecture 13- DISEASES OF SWEET POTATOES

1. Black Rot : *Ceratocystis fimbriata*
2. Stem rot & wilt : *Fusarium oxysporum* f.sp. *batatas*
3. *Rhizophus* soft rot : *Rhizopus stolonifer*
4. Scurf : *Monilochaetes infuscans*
5. Charcoal Rot : *Macrophomina phaseolina*
6. Bacterial soft rot : *Erwinia chrysanthemi*

1. Black Rot: *Ceratocystis fimbriata*

Symptoms

- **Small, circular, slightly sunken, dark brown spots** are the initial symptoms of black rot.
- Spots enlarge and appear greenish black to black when wet and grayish black when dry. Within the spots are small**, black fungal structures (perithecia)** with long necks which appear to the naked eye as dark bristles. The rot usually remains firm and shallow.
- If secondary fungi or bacteria invade the tissue however, the flesh beneath the spot turns black, and this blackened area may extend to the centre of the root.
- **Tissue near the discoloured area may have a bitter taste.** Eventually, the entire root may rot. Roots may appear healthy at harvest but rot in storage, during transit, or in the market.

Management

- Propagate plants from healthy stem cuttings.
- Cure roots immediately after harvest. Apply a postharvest fungicide.
- Do not wash and package roots showing symptoms of black rot.

- Decontaminate equipment that comes into contact with an infected crop.
- Spray empty washing machines and crates with a fungicide.
- Fumigate storage structures.

2. *Rhizophus* soft rot: *Rhizopus stolonifer*

Symptoms

- Infection and decay commonly occur at one or both ends of the root, although infection occasionally begins elsewhere.
- Rotting may be inhibited under dry conditions, but under humid conditions the affected sweet potatoes become soft and watery, and the entire root rots within a few days.
- If the humidity is high, the sweet potatoes become heavily **"whiskered" with a grayish black fungal growth.** This feature distinguishes Rhizopus soft rot from other storage rots.
- The colour of the root is not significantly altered, but an odour is produced that attracts fruit flies to the area.
- Infection is especially likely if the relative humidity is between 75 and 85 percent during storage or transport. Also, the longer roots are stored, the more susceptible they become.
- Chilling and heat damage also predispose sweet potatoes to infection. Soft rot is very destructive when sweet potatoes are washed, packed, or shipped to market during cold weather.

Management

- Carefully handle sweet potatoes during harvest to prevent unnecessary wounding. This is the most important control method for soft rot.

- Properly cure roots immediately after harvest.
- Store roots at 55 to 60 degrees F.
- Avoid handling stored roots because handling can create new wounds. Recuring is one possible solution to this problem.
- Apply a recommended fungicide after harvest.
- Do not allow sweet potatoes to be exposed to sunlight for extended periods (to prevent heat damage) or to be chilled in the field.

3. White rust/ Blister – *Albugo ipomoea – panduratae*

Symptoms:

Presence of chlorotic or yellowish blotches, initially round to angular where they are limited by veins, on the upper surface of leaves.

On the lower surface, **white creamy pustules produced corresponding upper surface yellow discolouration**. Complete yellowing and pre-mature shedding of leaves.

4. Bacterial soft rot*: Erwinia chrysanthemi*

Symptoms

- Roots are affected in the field, or more commonly in storage, by a soft rot that turns diseased tissue light brown and watery.
- Lesions on storage roots often have a dark brown margin. Some storage roots appear healthy from the outside but are decayed internally.
- Infected roots show black streaks in the vascular tissue and eventually undergo a soft, moist decay.
- Mother roots often decay in plant beds. In the field, brown to black, water-soaked lesions appear on stems and petioles. Eventually, the stem may become watery and collapse, causing the ends of vines to wilt.

- Usually, one or two vines may collapse, but occasionally the entire plant dies.

Management

- Carefully handle sweet potatoes during all stages of production. This is the most important control method for bacterial soft rot.
- Select mother roots from fields free of the disease.
- Cull roots infected during storage.
- Use vines cut above the soil surface for transplanting.
- Use a handling system that does not involve immersion of sweet potatoes in water.

Lecture-13- DISEASES OF BEANS

1. Anthracnose : *Colletotrichum lindemuthianum*
2. Rust : *Uromyces phaseoli- typica*
3. Foot rot : *Fusarium solani* f.sp. *phaseoli*
3. Powdery Mildew : *Erysiphe polygonii*
4. Halo blight : *Pseudomonas syringae* pv. *phaseolicola*

1. Halo Blight of Bean: *Pseudomonas syringae* pv. *phaseolicola*

Symptoms:

- Characteristic symptoms are formed on the stem, leaf petioles, pods, seeds and on seedlings.

- Initially, the lesions appear as water-soaked area, and as the spots dry out, a reddish margin is developed.
- Sometimes, deep cracks are formed in the stem, through which the bacterial exudate comes out. On the pods, the spots appear water-soaked, but turn reddish-brown as they dry out.
- The bacterial ooze, which exudes from the pod lesions, dries into a thin, silvery crust on the surface.
- Tissue destruction and occupation of vascular bundles result in wilting and death of seedlings. The seeds inside the infected pods may get infected and become small, wrinkled and are yellowish in colour.

Mode of survival, spread:

The disease is primarily seed-borne. Dew, splashing of rain, contact of infected plants with healthy plants and some insects are the sources of spread of the disease.

Epidemiology:

Optimum temperature for the growth of the bacteria is 25° - 30°C. Moist and humid conditions favour the occurrence of the disease.

Management

- Selection of disease-free seeds, removal and destruction of infected plant debris, and crop rotation help to minimize the disease.
- Steeping seeds in hot water at 50° - 55°c for 15 - 30 minutes, following a for 12 hour soak in ordinary water eliminates the seed-borne bacteria.