



LECTURE NOTES

PRINCIPLES OF PLANT PATHOLOGY, DISEASES OF CROPS AND THEIR MANAGEMENT

DA171

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Lecture out lines

1. Introduction to plant pathology, objectives
2. Plant disease causing organisms – Fungi, bacteria
3. Virus, nematodes, phanerogamic parasites
4. Terms used in plant pathology
5. Classification of plant diseases – caused by Fungi, Bacteria, virus
6. Survival of pathogens in plants- infected host, saprophytic survival, dormant spores
7. Dispersal of plant pathogens – Active, passive
8. Infection process- pre penetration, penetration & post penetration process
9. Principles of plant disease management- Avoidance, Exclusion, Eradication & Protection
10. Classification of fungicides
11. Host plant resistance
12. Study of symptomatology- smuts, powdery mildews, Rusts, Rots, Leafblights
13. Management methods for important diseases- wilts, canker, mosaic, Anthracnose
14. Symptoms of nematodes and plant parasites attack, nutrient deficiencies
15. Integrated plant disease management
16. Paddy- Blast, Brown spot, sheath blight
17. Paddy- Bacteria leaf blight, Tungro
18. Jowar- Rust, downy mildew, smut, leaf blight, Ergot, Anthracnose
19. Maize- Leaf blight, stemrot, sheath blight
20. Bajra, downy mildew, rust, ergot . Ragi- blast,
21. Sugarcane- Red rot, smut, mycoplasma
22. Groundnut- Tikka spot, Rust, budnecrosis
23. Castor- Wilt, Botrytis
24. Gingelly- Powdery mildew, cercospora spot, Alternaria spot, Bacteria leaf blight, Root & stemrot, phyllody
25. Sunflower- Rust, Alternaria spot, downy mildew, stemrot
26. Redgram- wilt, sterility mosaic, bacteria leaf spot
27. Green gram & Black gram- Root rot, powdery mildew, Rust, cercospora spot, corynospora spot, yellow mosaic, Bacteria leaf spot
28. Bengal gram- wilt, Ascocyta blight
29. Citrus- Gummosis, wilt
30. Citrus- Tristeza, Mosaic, Bud union creze
31. Citrus- Nutrient deficiencies symptoms
32. Mango- Powdery mildew. Grape- Powdery mildew
33. Guava- canker, wilt
34. Papaya- Powdermildew, Mosaic, Leafcurl, Stem rot
35. Banana- Anthracnose, Sigatoka leaf spot
36. Banana- Bacterial wilt, mosaic
37. Pomegranate- Cercospora spot, Anthracnose

38. Pomegranate- Bacteria leaf spot, powdery mildew
39. Chilli- seedling rot, Dieback, Fruit rot
40. Chilli- Powdery mildew, Alternaria blight, Bacteria leaf spot
41. Bhendi- Powdery mildew, Yellow vein mosaic
42. Cucurbits- Powdery mildew, Alternaria spot, Black rot
43. Tomato- Phytophthora blight, Alternaria blight, Fusarium wilt, Bacteria wilt
44. Tomato- Root knots, Mosaic, leaf curl
45. Coconut- Budrot, Ganoderma root rot, stem bleeding
46. Rose- Powdery mildew, Dieback, black spot
47. Turmeric- Leaf spot, rhizome rot
48. Ginger- Phyllosticta leaf spot, Rhizome rot

Plant Pathology/Phytopathology(Phyton= plant,Pathos=suffering,ailment,Logos=study) ie., the study of nature, development and management of plant diseases.

Definition: A branch of Agricultural science which deals with cause, etiology, resulting losses and management of plant diseases.

Objectives of Plant Pathology:

Study of biotic and abiotic causes of disease

Factors helping in disease development

Study of Host-pathogen interaction

Management of diseases and reduction of plant loss

Important Phytopathogenic organisms :

1.Fungi: Fungi are eukaryotic, spore bearing, achlorophyllous heterotrophic organisms that generally reproduce sexually and asexually and whose filamentous, branched somatic structures are typically surrounded by cell walls consisting chitin or cellulose or both with many organic molecules and exhibiting absorptive nutrition.

2. Bacteria: Bacteria are extremely minute, prokaryotic microorganisms, rigid, essentially unicellular organisms lacking chlorophyll and generally devoid of any photosynthetic pigment, characterised by rapid reproduction (mostly asexually). Bacteria are ubiquitous and physiologically diverse and they occupy a wide range of ecological niches.

Bacterial diseases of plants occur worldwide. As they favour moist or warm conditions, bacteria are of most importance in tropical, subtropical and warm-temperate areas. Most bacteria can survive on crop residues, in soil, on seeds or on living plants. Bacteria infect plants through wounds or natural openings (eg stomata and lenticels). Infected seeds, infected propagating material, water splash, insects and machinery can all spread bacteria.

3. Phytoplasma:

Phytoplasmas, previously known as Mycoplasma-like organisms, are prokaryotes in the class Mollicutes. They are similar to bacteria, but lack a rigid cell wall and cannot live freely in the environment. They have not been grown in culture. Phytoplasmas are found in the sieve tube cells of plant phloem tissue and most are transmitted by phloem-feeding leafhoppers and plant hoppers. Phytoplasmas are obligate parasites and complete their life cycle within host tissues. They cause disease in a wide range of plant hosts. Symptoms commonly caused by phytoplasmas are leaf discoloration, stunting, dieback, reduced leaf size ('little leaf'), witches' broom, phyllody, virescence.

4.Virus: A sub-microscopic, obligate parasite consisting of nucleic acid and protein that multiplies only intracellularly and is potentially pathogenic. Viruses are comprised of a protein coat or shell called a capsid, surrounding a genome of ribonucleic acid (RNA) or DNA (deoxyribonucleic acid). Viruses can only multiply in living cells in infected plant. The energy resources of the plant are thereby redirected to reproduce viruses. Viral infection impairs the plant's normal functions, such as photosynthesis and growth.

5.Nematodes:

Nematodes are eel shaped organisms without legs or other appendages. Plant Pathogenic nematodes obtain their food from living plants using spears or stylets thereby causing diseases in plants. Some nematodes can survive as cysts or eggs in absence of host plants.

Crops such as banana, citrus, coffee, cotton, fruits, peanut, pineapple, potato, rice, soybean, tobacco and vegetables are affected. Some nematodes have a very broad host range, while others

have very narrow ones. All parasitic nematodes belong to the Phylum *Nematoda* and belong to orders *Tylenchida* and *Dorylaimida*. General symptoms include Stunting, yellowing of leaves, root knot galls, necrosis, swelling of stem, curled leaves and splitting of bulbs, rotting and ultimately poor growth and yield. Eg. *Meloidogyne*, *Heterodera*

6. Phanerogamic plant parasites:

A parasitic plant is a plant that derives some or all of its nutritional requirements from another living plant by establishing connections (Haustoria) with host plant vascular elements.

Phanerogamic plant parasites are characterized by their varied dependence on host for water, nutrients, minerals; production of flowers and seeds; presence and absence of chloroplasts. Ex. Stem- *Cuscuta*, *Loranthus*, Root-*Orabanche*, *Striga*.

Classification of diseases Based on

1. Type of crop: Field crops, Horticultural crops etc
2. Plant part affected: Leaves, Fruits etc
3. Causal organism: Fungi, Bacteria, Virus
4. Source of pathogen: Soil borne, wind borne, Seed borne
5. Host reaction: warts, Galls, Necrosis
6. Severity of disease occurrence: Epidemic, endemic, sporadic
7. Symptoms of disease: Root rot, wilt, Smut, Powdery mildew, Damping off etc
8. Disease causal organism: Infectious and non-infectious

TERMS AND CONCEPTS USED IN PLANT PATHOLOGY

Disease: Any malfunctioning of host cells and tissues that result from continuous irritation by a pathogenic agent or environmental factor and leads to development of symptoms

Disorder: Non-infectious plant diseases due to abiotic causes such as adverse soil and environmental conditions are termed disorders. occur in the absence of pathogens, and cannot, therefore, be transmitted from diseased to healthy plants.

Pathogen: An entity, usually a micro-organism that can incite disease. Pathogen is any agent that causes *pathos* (ailment, suffering) or damage. However, the term is generally used to denote living organisms (Fungi, bacteria, MLO's, nematodes etc.) and viruses but not nutritional deficiencies.

Sign: The pathogen or its parts or products seen on a host plant.

Symptom: The external or internal reactions or alterations of a plant as a result of a disease.

Inoculum: It is the part of the pathogen which on contact with susceptible host plant causes infection (or) the infective propagules which on coming in contact with the host plant causes an infection are known as inoculum

Epidemic disease: A disease usually occurs widely but periodically in a destructive form. Ex: Late blight of potato – Irish famine (1845)

Endemic: Constantly present in a moderate to severe form and is confined to a particular country or district.

Ex: Club root of cabbage in Nilgiris, Black wart of potato, Onion smut

Sporadic disease: Occur at very irregular intervals and locations and in relatively fewer instances. Ex: Udbatta disease of rice, Angular leaf spot of cucumber

SYMPTOMS OF FUNGAL DISEASES

Downy mildews : Under low temperature & humid conditions, owing to the production of sporangiophores and sporangia, a white or grey bloom develops on the lesions produced usually on the under surface of leaves. This is called the “downy growth”. *Pernospora* and *Plasmopara* cause downy mildews. Ex : Downy mildew of grapevine & cucurbits.

Powdery mildews : Enormous numbers of conidia are formed on superficial growth of the fungus giving the host surface a dusty or powdery appearance. Black minute fruiting bodies may also be seen. *Erysiphe* family pathogens cause this

Eg : Powdery mildew of cucurbits, grapevine, chillies

Rusts : The rusts appear as relatively small pustules of spores and red, brown, yellow or black in colour.

Smuts : Smut affected parts of the plant show a black or purplish black dusty mass usually appear on floral organs.

Eg : Loose smut of wheat – *Ustilago tritici*

Hypertrophy : Hyperplasia is the abnormal increase in the size of a plant part due to increase in number of cells. In hypertrophy the increased size is due to increase in the size of cells of a particular tissue. The over growths are of various forms in different diseases

a. Galls : These are malformations of more or less globose, elongate or irregular shape. They may be fleshy or woody.

Eg : Club root of cabbage, Stem gall of coriander

b. Warts : Smaller galls are called warts **Eg** : Black wart of potato

c. Leaf Curl : Leaves are twisted, curled and distorted due to growth in tissues in localized are of the leaf.

d. Transormation of plant parts : The earheads are converted into green leaf like structures.

Eg : Green ear of pearl millet, Green ear of Korra

Hypoplasia or dwarfing : inhibition of growth resulting in stunting or dwarfing of whole plant or only certain parts.

Leaf Spots: The shape of lesions on leaves and fruits may be round, angular or irregular. The dead areas are often surrounded by a purple, red, yellow or brown margin.

Anthracnose : circular to angular, sometimes irregular spots occurring along the leaf veins, petioles, stems and fruits. The affected tissues are discoloured and killed resulting in characteristic lesions. **Eg** : Anthracnose of grapevine ,Anthracnose of mango

Blight and blast : In a diseased plant, due to severity of infection the tissues are rapidly killed, resulting in death of foliage, blossom or other above ground plant parts. Such a symptom is known as blight. When the entire leaf blade, bud or other plant parts are involved resulting in quick death of the part of plant as a whole then it is known as blast.

Eg : Early blight of potato and tomato,

Cankers : Corky growths often develop in the affected parts. Cankers mostly cause localized death of the cortical tissues of stem, fruits or leaves .Infection may be deep seated.

Scab : The infection is not deep seated. Sunken lesions are produced.

Damping-off : It is a condition in which the stem is attacked near the soil surface. The affected portion becomes constricted and weak, incapable of bearing the load of the upper portion. As a result the seedlings topple down and die.Pre emergence and post emergence damping off occur. Pythium, Phytophthora, Fusarium cause these.

Eg : Damping-off tobacco, tomato, chilli, brinjal etc.

Rot : The affected tissues die, decompose to greater extent, and turn brown. fungi dissolve the cell walls more or less completely by means of enzymes. According to the plant part attacked the rot may be called root rot, leaf or stem rot, bud-rot and fruit rot. Depending upon the type of dissolution brought about by the pathogen the rots may be grouped as soft rot, wet rot or dry rot.

Eg : Bud rot of palmyrah ,Fruit rot of chilli

Wilts :The leaves and other green or succulent parts lose their turgidity, become flaccid, usually seen first in some of the leaves. Later, the young growing tip or the whole plant may suddenly or gradually dry up. Wilting may be the result of injury to the root system, partial plugging of water conducting vessels or toxic substances secreted by the pathogen.

Eg : Tomato wilt,Guava wilt

SYMPTOMS OF VIRAL DISEASES

External

1. Mosaic: Alternate green and yellow patches. Eg. Tmv

2. Vein clearing : Tissue close to vein is yellow and remaining area is green. Eg vein clearing of bhendi.

3. Vein banding : Tissue along vein is green and tissue between veins is chlorotic. Eg tobacco leaf curl.

4. Ring spot : circular chlorosis with green centre. Eg papaya ring spot.

5. Necrosis: death of cells in the stem Eg. Top rot of potato

6. Distortion / malformation :Leaves and flowers twisted, become narrow, end in rat tail appearance
Eg.. Leaf curl of papaya

7. Enation : Masses of hypertrophoid tissue on leaf surface. Eg. Leaf curl of tobacco

8. Masked symptoms : Plants contain virus , but symptomless under unfavourable conditions.
Symptoms reappear under favourable conditions.

9.Stunting: stoppage of plant growth. Decrease in size of leaves, flowers, fruits etc Eg:Rice dwarf

Internal

Hypertrophy, hyperplasia or hypoplasia

SYMPTOMS OF BACTERIAL DISEASES

Bacterial leaf spots and Blights: Spots on leaves of dicotyledonous plants initially water soaked and often confined between the leaf veins and will appear angular. Sometimes a chlorotic halo will surround the bacterial lesion of an infected leaf. Spots may coalesce causing large areas of necrotic tissue. If the spots appear and advance rapidly the disease is considered as **blight**. Bacterial spots will appear as streaks or stripes on monocotyledonous plants. genera *Pseudomonas* and *Xanthomonas*.

Cankers: Canker symptoms can appear on stems, branches and fruits, leaves. when conditions are highly favourable for infection causes girdling of the branches and trunks, can result in corky growths. Ex: Citrus canker.

Bacterial Soft Rots: bacteria produce enzymes that causes disintegration of cells and rotting of tissue becomes soft and watery, contains a slimy foul smelling ooze.Ex: Bacterial Soft Rot of carrot, melon.

Bacterial Vascular Wilts: wilting and death of the above ground parts of the plant. In some cases bacterial ooze seeps out through stomata or cracks onto the surface of infected dead tissue The causal pathogen enters, multiplies in, and moves through the xylem vessels of the host plant and interferes with the translocation of nutrients and water.

Ex: Tomato wilt

Bacterial Galls/tumors: bacteria present in the soil gain entry into the host tissue through wound in the host. Gall tissue in the vicinity of the wound- hyperplasia and hypertrophy.

Ex: Crown gall of Apple.

Study of Symptomology

A.Necrotic symptoms eg: Blight, Blotch, Decay, Dieback, Spot, Wilt, Yellowing

B.Hypertrophy/Hyperplasia eg; Callus, Witches broom, Scab,

C.Hypoplasia eg:Chlorosis, Dwarfing, Etiolation,

Signs:

1.Vegetative structures: Haustorium, Mycelium, Rhizomorph, sclerotia etc

2.Reproductive Products: Asci, Basidium, Conidiophores, Mildews, Mold, Sporangium, Pycniia Sporodochium etc

3.Disease products: ooze in paddy blight, sugary disease in sorghum

SURVIVAL OF PLANT PATHOGENS

The means of survival are the **first link** in infection chain or disease cycle. The initial infection that occurs from the sources of pathogen survival in the crop is *primary infection* and the propagules that cause this infection are called *primary inoculum*. After initiation of the disease in the crop, the spores or other structures of the pathogen are sources of *secondary inoculum* and cause *secondary infection*, thereby spreading the disease in the field.

SOURCES OF SURVIVAL OF PATHOGENS:

1) Infected host as reservoir of inoculum:

- a) **Seed:** seed borne pathogens survive as long as seed remains viable.
- b) **Collateral hosts(wild hosts of same families):** Collateral hosts are those which are susceptible to the plant pathogens of crop plants and provide adequate facilities for their growth and reproduction of these pathogens during offseason. weed hosts help to bridge the gap between two crop seasons.
- c) **Alternate hosts (wild hosts of other families):** When a pathogen has very wide host range and is tolerant to wide range of weather conditions the alternate hosts become very important source of survival of the pathogen.

2) Saprophytic survival outside the host:

In the absence of the cultivated host plant, fungi are capable of surviving as saprophytes and few in soil.

3) Survival as dormant spores or specialized resting structures in or on the host or outside the host:

Plant viruses have no resting stage, plant bacteria do not produce resting spores

Nematodes survive through dormant structures, i.e., eggs, cysts, galls, formed in host tissues.

These structures may be present in soil or in seed lots

Phanerogamic parasites: They survive in dormant state for many years through seeds.

Fungi are the only organisms that produce spores for their inactive survival and in favorable condition act as source of primary infection.

4) Survival in association with insects, nematodes and fungi

Several important plant pathogens may survive within the insect body and over winter therein.

Few plant viruses survive with nematodes or fungi found in the soil between crop seasons.

DISPERSAL OF PLANT PATHOGENS

Transport of inoculum from one host to another host at various distances resulting in the spread of the disease, is called **dispersal** of plant pathogens. It is also important for continuity of the life cycle of the pathogen. This knowledge is essential for control of plant diseases because possibilities of preventing dispersal and thereby breaking the infection chain exist.

The dispersal of infectious plant pathogens in *space* occurs through two ways:

I) Autonomous or direct or active dispersal:

In this method the dispersal of plant pathogens takes place through soil, seed and planting material during normal agronomic operations.

1) Seed as the source of autonomous dispersal:

2) Soil as a means of autonomous dispersal:

a) Dispersal in soil:

b) Dispersal by the soil:

3) The plant and the plant parts as a means of autonomous dispersal:

The plant parts that are used for vegetative propagation, raw field produce and plant debris that accumulates during the course of cropping.

II) Passive or Indirect dispersal:

1) Animate agents: Insects, Mites, Nematodes, birds, Farm and wild animals, phanerogamic parasites and **Human beings in** Transportation of seeds, Planting diseased seed materials

During adoption of normal farming practices, by use of contaminated implements

by use of diseased grafting and budding material

Vegetatively propagated crops-banana suckers, sugarcane setts, tuber crops, fruit plants

2) Inanimate agents: Wind and Irrigation water

PHENOMENON OF INFECTION/ INFECTION PROCESS

It is the **third link** in the infection chain. Infection process means establishment of pathogen in the host plant.

The success of process of infection depends on

Susceptibility of host: It is genetically controlled by DNA and it is an inheritable character which is transmitted from parents to off springs.

Virulence of the pathogen: It is determined by genetic material which is inheritable.

Fast multiplication rate of the pathogen: Chances of infection increases with high rate of multiplication. High birth rate and low death rate is highly essential for successful infection.

Proper inoculum potential: In case of specialized pathogens very few or even one spore is capable of causing infection successfully, whereas, non-specialized pathogens as *Pythium*, *Phytophthora* require high density of inoculum for infection.

Environmental factors: temperature, relative humidity, moisture, etc., are very important for survival, dissemination and infection process.

Stages in the development of infection or disease cycle/ Process of infection

1. PRE-PENETRATION:

Plant viruses do not have any capacity to enter the host cell so they do not make any aggressive effort for entry, but depend on different insect vectors for their entry into host cell. Bacteria have no dormant structures; hence no pre penetration activity except for multiplication in infection drops on the natural openings. However, nematodes show some orientation towards root surface before actual penetration. In fungal pathogens, pre-penetration includes spore germination and growth of the resulting germ tube on the surface of the host plant. In some fungi the hypha act in a concerted way to achieve the penetration.

2. PENETRATION: Pathogens penetrate plant surfaces by direct penetration or indirectly through wounds or natural openings. Bacteria enter plants mostly through wounds and less frequently through natural openings. Viruses, fastidious bacteria enter through wounds made by vectors. Fungi, nematodes and parasitic higher plants enter through direct penetration and less frequently through natural openings and wounds.

A. Indirect Penetration

1. **Wounds:** Wounds caused by farm operations, hail storms, or insect punctures, etc. will help in the entry of different plant pathogens into the host cells.

2. **Natural openings:** a) stomata b) Lenticels:

B) Direct penetration: Most fungi, nematodes and parasitic higher plants are capable of penetrating the host surface directly.

3. POST PENETRATION

Invasion and colonization: Infection is the process by which pathogens establish contact with the susceptible cells or tissues of the host and derive nutrients from them. A parasitic relationship is formed between host cytoplasm and parasite cytoplasm. During infection, pathogens grow and multiply within the plant tissues. **Invasion** of plant tissues by the pathogen, and growth and reproduction of the pathogen (**colonization**) are two concurrent stages of disease development. Fungi spread into all parts of host organs, either by growing directly through the cells as an intracellular mycelium or by growing between the cells as an intercellular mycelium. During establishment, pathogen produces different substances which include enzymes, toxins, growth hormones and polysaccharides which will help in colonization of the host.

PRINCIPLES OF PLANT DISEASE MANAGEMENT

It conveys a concept of continuous process which is based not on the principle of eradication of the pathogen but mainly on reducing the amount of inoculums and minimizing the damage or loss below economic injury level.

General principles of plant disease management

I. Avoidance of the pathogen: These methods aim at avoiding the contact between the pathogen and susceptible stage of the crop. This is achieved by

a) Proper selection of geographical area: Many fungal and bacterial diseases are more severe in wet areas than in dry areas. Cultivation of bajra in wet areas is not profitable due to smut and ergot.

b) Proper selection of the field: This helps in the management of many soil borne diseases. Avoid raising of a particular crop year after year in the same field to reduce severity.

Ex: Wilt of redgram, late blight of potato, green ear of bajra, etc.

c) Time of sowing: Alteration of date of sowing helps in avoidance of coincidence of susceptible stage of host plant with favourable conditions for pathogen.

Ex: *Rhizoctonia* root rot of redgram is more severe in the crop sown immediately after the rains. Delayed sowing will help in reducing the incidence of disease.

d) Disease escaping varieties: Certain varieties of crops escape the disease because of their growth characteristics. Ex: Early maturing varieties of pea escape the damage due to *Erysiphe polygoni*.

e) Proper selection of seed and planting material: Selection of seed and seedling material from healthy sources will effectively manage the diseases such as loose smut of wheat, bunchy top of banana and whip smut of sugarcane.

II. Exclusion of the pathogen: These measures aim at preventing the inoculum from entering or establishing in the field or area where it does not exist.

a) Seed inspection and certification: Crops grown for seed purpose are inspected periodically for the presence of diseases that are disseminated by seed. Necessary precautions are to be taken to remove the diseased plants in early stages, and then the crop is certified as disease free.

b) Plant quarantine regulation: Plant quarantine is defined as “a legal restriction on the movement of agricultural commodities for the purpose of exclusion, prevention or delaying the spread of the plant pests and diseases in uninfected areas”.

c) Seed treatment: Seed and planting material is treated with hot air, gases or chemicals to destroy the pathogen.

III. Eradication: Elimination of the pathogen from the area by destruction of sources of primary and secondary inoculum.

a) Rouging: Removal of diseased plants or their affected parts from field, which prevent the dissemination of plant pathogens.

b) Eradication of alternate and collateral hosts: Eradication of alternate hosts will help in management of many plant diseases.

c) Crop rotation: Continuous cultivation of the same crop in the same field helps in the perpetuation of the pathogen in the soil. Soils which are saturated by the pathogen are often referred as **sick soils**. To reduce the incidence and severity of many soil borne diseases, crop rotation is adopted.

d) Biological methods: Reducing the intensity of pathogen, slowing the process of disease formation, prevention of inoculum on the plants etc. eg: *Trichoderma viride*, *Pseudomonas fluorescens*

IV Protection: Spraying of chemicals to manage diseases and insecticides to control vector transmitted viral diseases, nematicides and hot water treatment etc

Management of Diseases

Rusts

- use of resistant varieties
- Destruction of weeds and infected crop residues
- Adjusting date of sowing to avoid severe infection of plants in the field
- Crop rotation with non host crops
- Spray application of oxy-carboxin (0.2%), mancozeb (0.2%), triadimefon (0.05%), BM (0.5%), COC (0.25%) and wettable S or zineb (0.2%)

Wilts

- Disease-free transplants and seed.
- Use of resistant varieties
- Soil solarization
- Prolonged crop rotation
- Soil fumigation with PCNB
- Seed treatment with carbendazim @ 2g/kg seed
- The use of antibiotic-producing soil fungi and bacteria i.e., *Gliricium* sp., *Trichoderma* sp. *Pseudomonas* spp.
- Addition of heavy doses of organic matter (green manure crops) to soil would suppress the activity of the pathogen by enhancing antagonistic micro-organisms.

Downy mildews

- Destroyal of affected plants by burning before oospore formation, reduce the inoculum potential
- Crop rotation with other crops like pulses and oilseeds.
- Grow tolerant varieties
- Seed treatment with Metalaxyl (Apron 35 SD) @4g/kg seed
- Spray Metalaxyl (Ridomyl MZ) @0.2% or Mancozeb @0.25%.

Powdery mildews

- Removal and destruction of infected plant debris
- Use of resistant varieties
- Preventive sprays with wettable sulphur @0.3%
- Spraying with Karathane 0.1% (Dinocap) or Benomyl

Alternaria diseases

- Removal and destruction of infected plant debris
- Control of volunteers and weed hosts prior to planting the new crop
- Maintenance of adequate soil fertility levels
- Use of resistant varieties

- Disease free or treated seed (Mancozeb @2.5g/kg seed)
- Spray with mancozeb (@0.25%) or chlorothalonil (0.2%) or Iprodione (0.2%) at 10 days interval.

Cercospora diseases

- Removal and destruction of infected plant debris
- Control of volunteers and weed hosts prior to planting the new crop
- Use of resistant varieties
- Spraying benomyl, Bordeaux mixture, mancozeb or chlorothalonil at 15 days interval.

Anthracnoses (conidia within black acervuli)

- Use of disease free seed
- Use of resistant varieties
- Destruction of collateral hosts
- Spraying with 1% B.M. or combination of zineb and captan 0.2% found to be effective
- Other fungicides: Benomyl, Chlorothalonil, Iprodione.

Smuts

- Control of volunteers and weed hosts prior to planting the new crop
- Use of resistant varieties
- Treat the seed with fine sulphur powder @0.5% or Captan or Thiram @0.3%.
- Follow crop rotation.
- Collect the smutted ear heads in cloth bags and dip in boiling water.

Ergot or Sugary disease

- Adjust the date of sowing so that the crop does not flower during the periods of high rainfall and high humidity.
- Grow resistant varieties
- Deep summer ploughing
- Soaking seeds with 2% saline solution will aid to remove floating ergot infested seeds.
- Seed treatment with fungicides such as Captan or Thiram@4g/kg seed
- Spray Ziram (or) Zineb (or) Captan (or) Mancozeb @0.2% at emergence of earhead (5-10 per cent flowering stage) followed by a spray at 50 per cent flowering and repeat the spray after a week, if necessary.
- Control of ergot with fungicides such as Propiconazole or Tebuconazole has proved to be cost effective in seed production plots.

INTEGRATED PLANT DISEASE MANAGEMENT (IPDM)

IPDM involve management systems which utilize compatible combinations of all the available techniques to keep the pathogen population below the economic threshold level (ETL). IPDM is based on five principles of plant disease management and integrates multidisciplinary approaches for the management of plant diseases.

Main components of IPDM:

1. Cultural practices
2. Regulatory measures (quarantine)
3. Chemical methods
4. Biological methods
5. Physical methods
6. Genetic engineering

Cultural practices

a) Crop sanitation: Collection and destruction of plant debris from soil will help in the management of soil borne facultative saprophytes. It is an important method to reduce the primary inoculum.

b) Manures and fertilizers: The deficiency or excess of a nutrient may predispose a plant to some diseases. Excessive nitrogen application aggravates diseases like stem rot, bacterial leaf blight and blast of rice. Phosphorous and potash application increases the resistance of the host. Addition of FYM or green manure, 60-100 t/ha, helps to manage the diseases like cotton wilt, Ganoderma root rot of citrus, coconut, etc.

c) Mixed cropping: Root rot of cotton is reduced when cotton is grown along with sorghum. Intercropping sorghum in cluster bean reduces the incidence of root rot and wilt

d) Summer ploughing: Ploughing the soil during summer months expose soil to hot weather which will eradicate heat sensitive soil borne pathogens.

e) Soil amendments: Application of organic amendments like saw dust, straw, oil cake, etc., will effectively manage the diseases caused by *Pythium*, *Phytophthora*, *Verticillium*, and *Macrophomina*. Beneficial micro-organisms increases in soil and helps in suppression of pathogenic microbes. Ex: Application of lime reduces the club root of cabbage by increasing soil pH to 8.5, Application of Sulphur to soil brings the soil pH to 5.2 and reduces the incidence of scab of potato

f) Changing time of sowing: Pathogens are able to infect susceptible plants under certain environmental conditions. Alternation in date of sowing can help avoidance of favourable conditions for the pathogens.

Ex: Rice blast can be managed by changing planting season from June to September/October.

g) Seed rate and plant density: Close spacing raises atmospheric humidity and favours sporulation by many pathogenic fungi. A spacing of 8'X8' instead of 7'X7' reduces sigatoka disease of banana due to better ventilation and reduced humidity. High density planting in chillies leads to high incidence of damping off in nurseries.

h) Irrigation and drainage: The amount, frequency and method of irrigation may affect the dissemination of certain plant pathogens. Many pathogens, including, *Pseudomonas solanacearum*, *X. campestris pv. oryzae* and *Colletotrichum falcatum* are readily disseminated through irrigation water. High soil moisture favours root knot and other nematodes and the root rots caused by species of *Sclerotium*, *Rhizoctonia*, *Pythium*, *Phytophthora*, *Phymatotrichum*, etc.

PHYSICAL METHODS: Physical methods include soil solarization and hot water treatments.

i. Soil solarization: Soil solarization is the soil heating by covering moist soil with polyethylene sheets as soil mulch during summer months for 4-6 weeks.

ii. Soil sterilization: Soil can be sterilized in green houses and sometimes in seed beds by aerated steam or hot water. At about 50°C, nematodes, some fungi are killed. At about 60 and 72°C, most of the plant pathogenic fungi and bacteria are killed. At about 82°C, most weeds, plant pathogenic bacteria and insects are killed. Heat tolerant weed seeds and some plant viruses, such as TMV are killed at or near the boiling point (95-100°C).

iii. Hot water or Hot air treatment: Hot water treatment or hot air treatment will prevent the seed borne and sett borne infectious diseases. Hot water treatment is used for controlling sett borne diseases of sugarcane [whip smut, grassy shoot and red rot of sugarcane (52°C for 30min)] and loose smut of wheat (52°C for 10 min).

Biological methods:

Def: Biological control of plant disease is a condition or practice whereby survival or activity of a pathogen is reduced through the agency of any other living organism, with the result that there is reduction in incidence of the disease caused by the pathogen.

Mechanisms of biological control

1. Competition: Most of the biocontrol agents are fast growing and they compete with plant pathogens for space, organic nutrients and minerals.

2. Antibiosis: Antagonism mediated by specific or non-specific metabolites of microbial origin, by lytic agents, enzymes, volatile compounds or other toxic substances is known as antibiosis.

3. Hyperparasitism: Direct parasitism or lysis and death of the pathogen by another micro-organism when the pathogen is in parasitic phase is known as hyperparasitism.

Important fungal and bacterial biocontrol agents: *T. viride* and *Pseudomonas fluorescens*

CHEMICAL CONTROL

Fungicides are classified into three categories: Protectants, eradicants and therapeutants.

1. Protectants: These are the chemicals which are effective only when used before infection (prophylactic). Contact fungicides which kill the pathogen present on the host surface when it comes in contact with the host are called protectants. These are applied to seeds, plant surfaces or soil. These are non-systemic in action. Ex: Zineb, sulphur, captan, Thiram, etc.

2. Eradicants: Those chemicals which eradicate the dormant or active pathogen from the host. They can remain on/in the host for some time. Ex: Lime sulphur.

3. Therapeutants: These are the agents that inhibit the development of a disease syndrome in a plant when applied after infection by a pathogen. Therapy can be by physical means (solar and hot water treatment) and chemical means (by use of systemic fungicides).

Classification Of Fungicides Based On Chemical Nature

COPPER FUNGICIDES	
Preparatory copper fungicides	Proprietary copper fungicides or Fixed or insoluble copper fungicides
1. Bordeaux mixture 2. Bordeaux paste 3. Cheshunt compound	1. Copper oxychloride 2. Cuprous oxide 3. Copper hydroxide
SULPHUR FUNGICIDES	

Inorganic Sulphur Fungicides	Organic Sulphur Compounds	
1. Lime sulphur 2. Sulphur dust 3. Wettable sulphur	Dialkyl Dithiocarbamates 1. Ziram 2. Ferbam 3. Thiram	Monoalkyl dithiocarbamates 1. Nabam -Dithane D-14 2. Zineb- Dithane Z-78 3. Vapam or Metham sodium 4. Maneb - Dithane M45
HETROCYCLIC NITROGENOUS COMPOUNDS	MISCELLANEOUS FUNGICIDES	
1. Captan 2. Captafol 3. Difoltan	1. Chlorothalonil 2. Dinocap	
SYSTEMIC FUNGICIDES		
ACYLALANINES 1. Metalaxyl 2. Benalaxyl	AROMATIC HYDROCARBONS 1. Chloroneb	
BENZIMIDAZOLES 1. Carbendazim 2. Benomyl 3. Thiabendazole	ALIPHATICS 1. Prothiocarb 2. Propamocarb	
OXATHINS or CARBOXIMIDES 1. Carboxin 2. Oxycarboxin	IMIDAZOLES 1. Imazalil 2. Fanapanil	
MORPHOLINES 1. Tridemorph	ORGANOPHOSPHATES 1. Kitazin 2. Ediphenphos	
ALKYL PHOSPHONATES 1. Fosetyl-Al	PYRIMIDINES 1. Fenarimol	
THIOPHANATES 1. Thiophanate 2. Thiophanate methyl	STROBILURINS 1. Azoxystrobin 2. Kresoxim methyl	
TRIAZOLES 1. Triadimefon 2. Tricyclazole 3. Hexaconazole 4. Propiconazole	QUINONES 1. Chloranil	
MERCURIALS		
Inorganic 1. Mercuric chloride	Organic 1. Ethyl mercury chloride	
Biocontrol agents		
Fungal antagonists <i>Trichoderma viride</i> <i>T harzianum</i> <i>T. polysporum</i> <i>Gliocladium virens</i>	Bacterial antagonists <i>Bacillus subtilis</i> <i>Agrobacterium radiobacter</i> <i>Pseudomonas fluorescens</i>	

Actinomycetes antagonists <i>Streptomyces griseous</i>	Antibiotics Aureofungin Griseofungin
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CLASSIFICATION OF FUNGICIDES BASED ON METHOD OF APPLICATION

1. Seed protectants: Ex. Captan, thiram, carbendazim, carboxin etc.
2. Soil fungicides (preplant): Ex. Bordeaux mixture, copper oxy chloride, Chloropicrin, Formaldehyde, Vapam, etc.
3. Soil fungicides: Ex. Bordeaux mixture, copper oxy chloride, Captan, PCNB, thirametc.
4. Foliage and blossom: Ex. Captan, ferbam, zineb, mancozeb, chlorothalonil etc.
5. Fruit protectants: Eg. Captan, maneb, carbendazim, mancozeb etc.
6. Eradicants: EX. Lime sulphur
7. Tree wound dressers: Ex. Boreaux paste, chaubattia paste, etc.
8. General purpose sprays and dust formulations.

Method of applications:

1. Broadcaast
2. Furrow application
3. Soil drenching
4. Fumigation

HOST PLANT RESISTANCE (IMMUNIZATION)

Advantages of resistant varieties:

1. Resistant varieties can be the most simple, practical, effective and economical method of plant disease management.
2. cost effective
3. do not pollute environment.

Types of resistance:

1. Genetical **resistance**:
2. Biochemical **resistance**:

Host plant resistance is introduced in 3 ways

1. Selection and Hybridization: Disease tolerant low yielding variety is selected and hybridized with high yielding disease intolerant variety to obtain disease tolerant high yielding variety.

2. Genetic engineering and Tissue culture: Genetic changes are done in plants to develop virus resistant, insect resistant, herbicide tolerant, disease tolerant, stress resistant, nutrient enriched plants.

3. Induction of Acquired resistance: Due to some microorganisms and chemicals plants acquire resistance. When phosphates & carbonates are sprayed on leaves, resistant genes are activated.

4. Spraying of Systemic fungicides and Antibiotics

IPDM strategy in rice:

1. Selection of healthy seed
2. Selection of resistant cultivars
3. Removal and destruction of collateral hosts
4. Balanced fertilization
5. Rouging of diseased plants
6. Seed treatment with carbendazim or tricyclazole at 2g/Kg seed
7. Need based foliar application of [carbendazim@0.1%](#) or [Tricyclazole@0.06%](#) for the management of blast.
8. Need based foliar application of validamycin for the management of sheath blight and sheath rot.
9. Soil application of carbofuran granules or foliar spray of any systemic fungicide is to manage insect vectors, thereby decreasing the spread of viral diseases.

IPDM in sugarcane:

1. Collection and destruction of infected crop debris
2. Hot water treatment of setts (52⁰C for 30 min)
3. Hot air treatment of setts (54⁰C for 2-3 hrs)
4. Balanced irrigation and fertilization
5. Avoid selection of seed material from Ratoon crop
6. Need based spray of systemic insecticides to minimize the spread of viral and phytoplasmal diseases
7. Selection of disease resistant or tolerant cultivars

Lecture 16 & 17
DISEASES OF RICE (*ORYZA SATIVA*)
Blast- *Pyricularia oryzae*

Symptoms

The fungus attacks the crop at all stages from seedlings in nursery to heading in main field. The typical symptoms appear on leaves, leaf sheath, rachis, nodes and even the glumes.

Leaf blast: On the leaves, the lesions start as small water soaked bluish green specks, soon enlarge and form characteristic spindle shaped spots with grey centre and dark brown margin. The spots join together as the disease progresses and large areas of the leaves dry up and wither. Similar spots are also formed on the sheath. Severely infected nursery and field show a burnt appearance.

Node blast: In infected nodes, irregular black areas that encircle the nodes can be noticed. The affected nodes may break up and all the plant parts above the infected nodes may die

Neck blast: At the flower emergence, the fungus attacks the peduncle which is engirdled, and the lesion turns to brownish-black. This stage of infection is commonly referred to as rotten neck/neck rot/neck blast/panicle blast. In early neck infection, grain filling does not occur and the panicle remains erect like a dead heart caused by a stem borer. In the late infection, partial grain filling occurs. Small brown to black spots also may be observed on glumes of the heavily infected panicles.

Fungus survives on plant residues, seeds, weeds. Air dispersal of pathogen. Fungus grows if favourable weather conditions prevail for a week and crop is destroyed. Closer planting, high N application favors disease spread. Light rainfall with Min temp 20-22^oc, 90%RH is favorable.

Management

Use of seeds from a disease free crop

Grow resistant varieties like Simhapuri, Tikkana, Sriranga, Phalguna, Swarnadhan, Swarnamukhi, MTU 1005, Swathi, IR 64, Sravani, Jaya, Vijaya, Ratna,

Remove and destroy the weed hosts in the field bunds and channels.

Split application of nitrogen and judicious application of nitrogenous fertilizers

Spray the field with Edifenphos@0.1% or Tricyclazole@0.06%

Brown Spot or Sesame leaf spot - *Helminthosporium oryzae*

Symptoms

The fungus attacks the crop from seedling to milk stage. Symptoms most prominent on leaf blade and glumes as spots. several spots coalesce and the leaf dries up. The seedlings die and affected nurseries can often be recognized from a distance by their brownish scorched appearance. Dark brown or black spots also appear on glumes. It causes failure of seed germination, seedling mortality and reduces the grain quality and weight. Deficiency of potassium predispose the plants to heavy infection.

Management

Use disease free seeds, Field sanitation. Crop rotation, Adjustment of planting time,

Proper fertilization, Use of slow release nitrogenous fertilizers is advisable.

Good water management, Use of soil amendments

Grow disease tolerant varieties viz., Bala, IR-20, Jaya, Ratna, Tellahamsa and Kakatiya.

Treat the seeds with Thiram or Captan at 4 g/kg and with Mancozeb @0.3%

Spray the crop in the main field twice with **Mancozeb@0.2%**, once after flowering and second spray at milky stage.

Bacterial leaf blight-*Xanthomonas oryzae*

Symptoms

The bacterium induces either wilting of plants or leaf blight. Wilt syndrome known as **Kresiek** is seen in seedlings within 3-4 weeks after transplanting. The bacterium enters through the hydathodes and cut wounds in the leaf tips, becomes systemic and cause death of entire seedling. The disease is usually noticed at the time of heading. In grown up plants water soaked, translucent lesions appear usually near the leaf margin. The lesions enlarge both in length and width with a **wavy margin** and turn straw yellow within a few days, covering the entire leaf. Milky or opaque dew drops containing bacterial masses are formed on young lesions in the early morning leaving a white encrustation. The affected grains have discoloured spots surrounded by water soaked areas. If the cut end of leaf is dipped in water, bacterial ooze makes the water turbid.

Favourable Conditions

Clipping of tip of the seedling at the time of transplanting, heavy rain, heavy dew, flooding, deep irrigation water, severe wind, temperature of 25-30°C and application of excessive nitrogen,

Management

Grow resistant cultivars like MTU 9992, Swarna, Ajaya, IR 20, IR 42, IR 50, IR 54, TKM 6, Mashuri, IET 4141, IET 1444, IET 2508, Chinsura Boro, etc.

Affected stubbles are to be destroyed by burning or through ploughing

Judicious use of nitrogenous fertilizers

Avoid clipping of tip of seedling at the time of transplanting.

Avoid flooded conditions or drying of the field (not at the time of flowering)

Avoid flow of irrigation water from infected to healthy field

Remove and destroy weed hosts.

Soaking seeds for 8 hrs in Agrimycin (0.025%) followed by hot water treatment for 10 minutes at 52-54°C eradicates the bacterium in the seed

Spray Streptomycin (250 ppm) along with copper oxychloride (0.3%)

Sheath blight-*Rhizoctonia solani*

Symptoms

The fungus affects the crop from **tillering** to **heading** stage. Initial symptoms are oval or elliptical or irregular greenish grey spots on leaf sheaths near water level which coalesce causing death of the whole leaf, and in severe cases all the leaves of a plant may be blighted in this way.

The infection extends to the inner sheaths resulting in death of the entire plant. Older plants are highly susceptible. Five to six week old leaf sheaths are highly susceptible. Plants heavily infected in the early heading and grain filling growth stages produce poorly filled grain, especially in the lower part of the panicle.

spread through irrigation water. High relative humidity (96-97 per cent), high temperature (30-32°C), closer planting and heavy doses of nitrogenous fertilizers favor disease.

Management

Avoid excess doses of fertilizers.

Adopt optimum spacing.

Eliminate weed hosts.

Apply organic amendments.

Avoid flow of irrigation water from infected fields to healthy fields.

Deep ploughing in summer and burning of stubbles.

Spray Propiconazole@0.1% or Hexaconazole@0.2% or [Validamycin@0.2%](#)

Sheath rot-*Sarocladium oryzae*

Symptoms

Sheath rot occurs usually at the **booting** stage. Initial symptoms are noticed only on the upper most leaf sheath. The flag leaf sheath show oblong or irregular greyish brown spots. The young panicles may remain within the sheath or emerge partially. The affected sheath and panicles rot and abundant whitish powdery fungal growth is formed inside the leaf sheath. The grain discolours and shrivels.

Favourable Conditions

Closer planting, high doses of nitrogen, high humidity and temperature around 25-30°C. Injuries made by leaf folder, brown plant hopper and mites increase infection. **Spread** Mainly through air-borne conidia and also seed-borne.

Management

Apply recommended doses of fertilizers.

Adopt optimum spacing.

Spray twice with Carbendazim @0.1% or Benomyl@0.05% or Mancozeb@0.2% or Chlorothalonil@0.2% at boot leaf stage and 15 days later.

Soil application of gypsum in 2 equal splits (500 kg/ha) reduces incidence.

Tungro disease

Symptoms

Infection occurs both in the nursery and in the main field. Plants are markedly **stunted**.

Leaves show **yellow to orange discoloration** and interveinal chlorosis. Young leaves are often mottled with pale green to whitish interveinal stripes and the old leaves may have rusty streaks of various sizes. The plants may be killed if infected early. Tillering is reduced with poor root system. The infected plants have few spikelets and panicles are small with discoloured grains. spread by green leaf hoppers.

Management

Summer deep ploughing and burning of stubbles.

Destroy weed hosts of the virus and vectors.

Grow disease tolerant cultivars like MTU 9992, 1002, 1003, 1005, Suraksha, Vikramarya, Bharani, IR 36, vedgiri.

Control the vectors in the nursery by application of carbofuran granules @170 g/cent, 10 days after sowing and @10kg/ac in main field

Spray Monochrotophos@2.2 ml/lt or Phosphamidan @1ml/lt or Ethophenphos@1.5ml/lt or Neem oil @3 per cent in the main field 15 and 30 DAT to control leaf hoppers.

LECTURE 18
DISEASES OF SORGHUM (*SORGHUM BICOLOR*)
Anthracnose or red leaf spot-*Colletotrichum graminicola*

Symptoms

The fungus causes both leaf spot (anthracnose) and stalk rot (red rot) in sorghum. The disease appears as small spots on both surfaces of the leaf. The centre of the spot is white in colour encircled by red, purple or brown margin. Stalk and inflorescence infection can be characterized externally by the development of circular cankers. Infected stem when split open shows discoloration.

Management

Destruction of infected plant debris and collateral hosts like sudan grass, Johnson grass

Crop rotation with non-host crops

Grow resistant varieties like SPV 162, CSV 17, CSH10, SPV475, Texas Milo and Tift sudan etc.

Treat the seeds with Captan or Thiram @3 g/kg.

Spray the crop with Mancozeb @0.25% or carbendazim@0.1%

Rust-*Puccinia purpurea*

Symptoms

The fungus affects the crop at all stages of growth. The intensity of rust infection is generally severe after flag leaf stage . The first symptoms are small **reddish brown flecks** on the lower surface of the leaf . Pustules appear on both surfaces of leaf as purplish spots . The pustules are elliptical and lie between and parallel with the leaf veins. Pustules are surrounded by a reddish or yellow halo. In highly susceptible cultivars, the pustules occur so densely that almost the entire leaf is destroyed. The pustules may also occur on the leaf sheaths and on the stalks of inflorescence.

Management

Grow resistant varieties like CSH 5, SPV 13, 81, 126, PSH 1, CSV 17, etc.

Remove and destroy the alternate hosts-weeds

Spray the crop with Mancozeb @0.25%, Dusting of sulphur@25 kg/ha

Ergot or Sugary disease-*Claviceps sorghi* or *Sphacelia sorghi*

Symptoms

The disease is confined to individual spikelets. The first symptom is the secretion of honey dew from infected florets attracting large number of insects and ants which help in spreading the disease. Under favourable conditions, grain is replaced by hard black sclerotia. white spots can be seen on the soil surface, denoting the drops of honey dew.

Management

Adjust the date of sowing so that the crop does not flower during the periods of high rainfall and high humidity.

Grow resistant varieties like SPV 191, CSH 5, SPH 1 and CS3541.

Deep summer ploughing

Soaking seeds with 2% saline solution will aid to remove floating ergot infested seeds.

Seed treatment with fungicides such as Captan or Thiram@4g/kg seed

Spray **Ziram** or Mancozeb @0.2% at emergence of earhead(5-10 per cent flowering stage) followed by a spray at 50 per cent flowering and repeat after a week, if necessary.

Control of ergot with fungicides such as Propiconazole or Tebuconazole has proved to be cost effective in seed production plots.

Downy Mildew or Leaf shredding-*Peronosclerospora sorghi*

Symptoms

The first few leaves that show symptoms are only partially infected with green or yellow colouration. Abundant **downy whitish growth** is produced on the lower surface of the leaves, spreads over a major portion of the upper surface. As the plant grows, **white streaks** appear on both the surfaces of the leaves. The tissues then tear along the streaks causing shredding of the leaves which is the most characteristic symptom. The tissue then turns brown in colour. The affected parts are stunted and sterile. More prevalent in waterlogged soils. affected panicle has partially filled or fully unfilled grains.

Management

Destroy affected plants by burning before oospore formation reduce the inoculum potential

Crop rotation with other crops like pulses and oilseeds.

Grow tolerant varieties like CSH 2, CSV 5, SPV 101, 165 and 190.

Seed treatment with Metalaxyl @4g/kg seed

Spray Metalaxyl @0.2% or Mancozeb @0.25%

Leaf blight or leaf stripe-*Exserohilum turcicum*

Symptoms

The leaf blight pathogen also causes seed rot and seedling blight. Initially disease appears in the form of small narrow elongated spindle shaped spots later become bigger. On older plants, the typical symptoms are **long elliptical necrotic lesions**, straw coloured in the centre with dark margins. Many lesions may develop and coalesce on the leaves, destroying large areas of leaf tissue, giving the crop a distinctly burnt appearance leading to premature drying of leaves.

Management

Use disease free seeds, Rotation with non susceptible crops

Collect and destroy infected plant debris, Treat the seeds with Captan or Thiram at 3 g/kg.

Spray the crop with **Mancozeb@0.25%** at the age of 40 days and the spraying have to be repeated twice at 15 days interval

Grain smut/Kernel smut/Covered smut/Short smut-*Sphacelotheca sorghi*

Symptoms

The disease becomes apparent only at the time of grain formation in the ear. The **individual grains** are replaced by **smut sori**(covered with white layer which often persist unbroken upto threshing) which can be localized at a particular part of the head or occur over the entire inflorescence. Ratoon crops exhibit higher incidence of disease. temperature below 29⁰c, >80% humidity in air favor occurrence of disease

Management

Use disease free seeds, Follow crop rotation. sowing before onset of severe cold weather.

Grow resistant varieties like T 29/1, PJ 7K, PJ 23K, Nandyal and Bilichigan.

Treat the seed with fine sulphur powder @0.5% or Captan or Thiram @0.3%.

Collect the smutted ear heads and burn them.

Lecture 19
DISEASES OF MAIZE (ZEA MAYS)
Turcicum Leaf blight- *Helminthosporium turcicum*

Symptoms

Disease is characterized by long **elliptical** grayish green or tan lesions on the leaves. The fungus affects the maize plant at young stage. The spots coalesce to form bigger spots and gives blighted appearance. Lesions may be extended to husk.

Management

Crop rotation,
Spray [Mancozeb@0.25%](#)

Post flowering stalk rot

Cephalosporium wilt -Cephalosporium acremonium/ C.maydis

Symptoms

Infection caused by *C. acremonium* becomes apparent in dough stage. One of the first symptoms is the purpling of leaves and stalks. The most characteristic symptom is the **restricted blackening of vascular bundles** through several internodes in the stalk with shredding of the internodal pith region. Barren plants, excessive tillering and multiple ears are the other symptoms.

Symptoms caused by *C. maydis* appear only after flowering stage and plants start wilting basipetally giving a dull green appearance of the leaves which later dry up. The lower internode turns discoloured, become reddish brown, shrunken and soft, and subsequently becomes dry and hollow. When diseased stalks are split open, reddish brown vascular bundles are seen.

Management

Crop sanitation, Crop rotation, Avoid water stress at flowering
Seed treatment with Thiram or captan@3g/kg seed
Grow resistant varieties like DHM-103, DHM 105, Hi-Starch and Ganga Safed-2.

Charcoal rot-*Macrophomina phaseolina*

Symptoms

Charcoal rot commonly attacks plants approaching maturity in rabi crops when temperatures are high. water soaked lesions on the roots that later turn black. As the plant matures, the infection extends into the lower portions of the stem leading to premature ripening, shredding and breaking of the crown. Split open stalks have numerous black sclerotia giving a charred appearance.

Management

Field sanitation, crop rotation .Avoid high nitrogen usage and potash deficiency
Irrigate the crops at the time of earhead emergence to maturity.

Banded leaf and sheath blight-*Rhizoctonia solani*

Symptoms

Large, discoloured areas alternating with irregular dark bands are typical symptoms of the disease. Severe infection leads to blotching of the leaf sheath as well as leaves. The symptoms under favourable conditions extend upto silk, glumes and kernels. Symptoms also appear on stalk and the internodes break at the point of infection. High nitrogen, cloudy weather, drizzling , high humidity in air, 23-25⁰c temperature favor disease. spread by weeds, water and cropresidues

Management

Clean cultivation, Destruction of crop debris, Detrashing of leaves near to soil.
Spray carbendazim or propiconazole@0.1%

Lecture 20

DISEASES OF BAJRA OR PEARL MILLET (*PENNISETUM TYPHOIDES*)

Downy mildew or Green ear-*Sclerospora graminicola*

Symptoms

The first symptoms can appear in seedlings at three to four leaf stage. The affected leaves show patches of light green to light yellow colour on the upper surface of leaves and the corresponding lower surface bears **white downy growth** of the fungus. The **yellow discoloration** often turns to streaks along veins. The infected plants tiller excessively and are dwarfed. As the disease advances, the streaks turn brown and the leaves shred at the tips only. Ears fail to form or if formed, they are completely or partially malformed into twisted green leafy structures; hence the name **green ear** disease. The infection converts the various floral parts into green linear leafy structures.

Management

Selection of seed from healthy crop, Summer deep ploughing, Rogue out infected plants
Collect diseased plants especially before oospores are formed and burn them.

Prolonged crop rotation

Grow resistant varieties like WCC 75, PHB 10, ICMH 451 ICTP 8203, Mallikarjuna, HB-1, HB 5 and PHB 14

Grow tolerant varieties like MBH 118, CM 46, Balaji composite, Nagarjuna composite, Visakha composite, New vijaya composite, RBS 2, etc.

Treat the seeds with Metalaxyl @6g/kg or Thiram or Captan@4g/kg.

Spray Mancozeb@0.25% or Metalaxyl @0.2% starting from 30 days after sowing in the field.

Rust-*Puccinia penniseti*

Symptoms

Symptoms first appear mostly on lower leaves as minute, round raised reddish brown pustules. The pustules may also be formed on stem and peduncles. In severe infections, whole leaf may wither completely presenting a scorched appearance to the field. cool weather high humidity in air favor disease spread.

Management

Removal and destruction of alternate hosts

Spray thrice at 15 days interval with Wettable Sulphur@0.3% or [Mancozeb@0.2%](#) starting from 21 days after planting

Grow resistant varieties like RT 814-3, PT 826/4, PT 829/5, etc.

Ergot or Sugary disease-*Claviceps fusiformis* or *C. microcephala*

Symptoms

Exudation of small droplets of light pinkish or brownish sticky fluid (honey dew) from the infected spikelets which trickles onto the upper leaves making them sticky. This attracts several insects. In the later stages, the infected ovary turns into small dark brown sclerotial bodies larger than the seed and with a pointed apex which protrude from the florets in place of grain. Insects and air help in disease spread.

Management

Adjust the sowing date so that the crop does not flower during September when high rainfall and high relative humidity favour the disease spread.

Collection of seeds from healthy field. Deep summer ploughing.

Immerse the seeds in 10 per cent common salt solution and remove the floating sclerotia.

Eradication of collateral hosts

Grow resistant varieties like PHB 10, 14; Co 2, 3 and Bajra 24.

Spray with [Ziram@0.2%](#) or [Carbendazim@0.1%](#) or [Mancozeb@0.2%](#) at boot leaf and flowering stage

RAGI / FINGER MILLET (*Eleusine coracana*)

Blast-*Pyricularia grisea*

Symptoms

Infection may occur at all stages of plant growth. Young seedlings may be blasted or blighted in the nursery bed as well as developing young plants in the main field. There are three stages in disease development.

Leaf blast: It is more severe in tillering phase. Spindle shaped spots on the leaves with gray centres surrounded by reddish brown margins.

Node blast: Infection on stem causes nodes break at the point of infection. All the parts above the infected node die.

Neck blast: At flowering stage, the neck just below the earhead is affected and turns sooty black in colour and usually breaks at this point. In early neck infections, the entire earhead becomes chaffy and there is no grain set at all. If grain setting occurs, they are shrivelled and reduced in size.

Management

Destruction of collateral hosts and infected plant debris

Spray with [Carbendazim@0.2%](#) or [Edifenphos@0.1%](#),

first spray immediately after symptom appearance and second spray at flowering stage.

Lecture 21 DISEASES OF COTTON

1) **Bacterial leaf blight:** *Xanthomonas campestris pv. malvacearum* **symptoms**

The bacterium attacks all stages from seed to harvest. Seedling blight, Vein necrosis, Black arm (breaking of the stem which hangs as a dry black twig), Boll rot

Management

Remove and destroy the infected plant debris, Rogue out the volunteer cotton plants and weeds. Delint the cotton seeds with concentrated sulphuric acid at 125ml/kg of seed. Soak the seeds in 1000 ppm Streptomycin sulphate overnight or treat the seed with hot water at 52-56°C for 10-15 minutes.

Spray with Streptomycin sulphate 500 ppm along with COC@0.3%.

Grow resistant varieties like HG-9 and Sujatha

2) **Fusarium wilt:** *Fusarium oxysporum f.sp. vasinfectum* **symptoms**

The disease affects the crop at all stages. Discolouration of young leaves from the margins towards midrib, gradually turn brown & drop off, Browning or blackening of vascular tissues. Black streaks or stripes may be seen extending upwards to the branches and downwards to lateral roots.

Management

Treat the acid-delinted seeds with Chlorothalonil at 4 g/kg or Carbendazim@2g/kg seed. Remove and burn the infected plant debris in the soil.

Multiply *Trichoderma viride* (2kg) in 50 kg of FYM for 15 days and then apply to the soil.

Apply heavy doses of FYM or other organic manures at 10 t/ha.

Spot drench with 0.05 per cent Benomyl or Carbendazim.

Grow disease resistant varieties like Varalakshmi, Vijaya, Pratap, Jayadhar, Jyothi and G 22

3) **Verticillium wilt:** *Verticillium dahliae* **symptoms**

The symptoms are seen when the crop is in squares and bolls.

Leaf margins and areas between veins turn yellowish, necrotic and fall off.

Infected stem and roots, when split open, show a pinkish brown discolouration (Tiger stripe)

Management

Treat the delinted seeds with Carboxin@4g/kg or Carbendazim at 2 g/kg

Remove and destroy the infected plant debris

Apply heavy doses of FYM or compost at 10t/ha

Spot drench with 0.05 per cent Benomyl or Carbendazim.

Grow disease resistant varieties like Sujatha and Suvin

4) **Macrophomina root rot:** *Rhizoctonia bataticola* **symptoms**

sudden and complete wilting of plants in patches in concentric circles at the time of maturity

rotting of entire root system except tap root and few laterals

Management

Apply FYM@100 t/ha or neem cake at 2.5t/ha.

Treat the seeds with *Trichoderma viride* @ 4g/kg or *Pseudomonas fluorescens*@10g/kg of seed

Treat the seeds with Carboxin or Thiram at 4 g or Carbendazim at 2g/kg

Spot drench with 0.1% Carbendazim or 0.05% Benomyl

5) Grey/ areolate mildew: *Ramularia areola*

symptoms

The entire leaf surface is covered by white to grey powdery growth

The affected leaves dry up from margin, turn yellowish brown and fall off prematurely

Management

Remove and burn the infected crop residues

Rogue out the self-sown cotton plants during summer months.

Avoid excessive application of nitrogenous fertilizers/manures

Spray twice with Carbendazim@0.1% at weekly intervals

Grow the resistant varieties like Sujatha and Varalakshmi

6) Anthracnose: *Colletotrichum capsici*

symptoms

Small reddish circular spots are produced on the cotyledons and primary leaves

Girdling of the stem at collar region resulting in death of seedlings. In mature plants, stem splitting and shredding of bark. Small water soaked, circular, reddish brown depressed spots appear on the bolls which is the characteristic symptom of the disease. The infected bolls cease to grow and burst and dry up prematurely

Management

Remove and burn the infected plant debris, bolls in the soil and weeds

Treat the delinted seeds with Carbendazim or Carboxin@2g/kg or Thiram or Captan at 4g/kg

Spray the crop at boll formation stage with Mancozeb@0.25% or COC@0.3% or

Carbendazim@0.1%

7) Leaf spots: *Alternaria macrospora*

symptoms

Small brown, round spots surrounded by a purple margin appear on older leaves with concentric zonations, Several spots coalesce together to form blighted areas under humid conditions

Management

Remove and destroy the infected plant residues

Spray Mancozeb@0.25% or Copper oxychloride@0.3% at the initiation of the disease.

8) Rust: *Phakopsora gossypii*

symptoms

Bright yellow orange pustules with purple borders appear under surface of the lower leaves which eventually turn brown

Severe infections may cause defoliation and reduction in the size of the bolls

Management

Remove and destroy infected plant debris, Spray Mancozeb@0.25%

DISEASES OF SUGARCANE (*SACCHARUM OFFICINARUM*)

Red rot-*Colletotrichum falcatum*

Symptoms

The first external symptoms appear as discolouration of the young leaves. The margins and tips of the leaves wither and the leaves droop. The discolouration and withering continues from the tip to the leaf base until the whole crown withers away in four to eight days. Symptoms observed by longitudinally splitting the internodes are reddening of the internal tissues. The presence of cross-wise white patches interrupting the reddened tissues are the important diagnostic character of the disease. Split open stems emit a characteristic acidic-sour odour. As the disease advances the entire stem rots and the stalk becomes hollow and covered with white mycelial growth. Later the rind shrinks longitudinally with minute black, velvety fruiting bodies protruding out of it. Minute red spots also appear on the upper surface of leaves and centre of the mid-rib. The lesions are initially blood red with dark margins and later on with straw coloured centres. Often the infected leaves may break at the lesions and hang down, with large number of minute black dots. yield and sugar % decreases. Spreads by setts

Management

Removal and destruction of infected plant debris, stubbles and trash.

Deep tillage to incorporate the left over debris.

Adopt crop rotation by including rice and green manure crops.

Select the setts from the disease free fields or disease free area.

Avoid ratooning of the diseased crop.

Avoid flow of irrigation water from diseased to healthy plants.

Soak the setts in 0.1% Carbendazim solution for 20 minutes before planting.

Hot water treatment of setts at 52°C for 30 min or 50°C for 2 hours followed by steeping in 0.1% carbendazim solution.

Setts can be treated with aerated steam at 52°C for 4 to 5 hours and by moist hot air at 54°C for 2 hours.

Grow resistant varieties like CO 6907, CO 7219, CO 8013, CO 8021, CO 7706, CO A 7602, CO A 89082, CO A 89085, 87 A 397, CO T 8201, etc.

Whip Smut-*Ustilago scitaminea*

Symptoms

The affected plants are stunted and the central shoot is converted into a **long whip-like, dusty black** structure. In early stages, this structure is covered by a thin, white papery membrane. On maturity it ruptures and millions of tiny black smut spores are liberated and disseminated by wind. All the shoots arising from the diseased clump produce whip like structures. The primary spread of the disease is through **diseased** setts, secondary spread is through the smut spores developed in the whips, aided by air. The fungus also survives on **collateral hosts**. Mono-culturing, continuous ratooning and dry weather during tillering stage favours the disease.

Management

Plant healthy setts taken from disease free area.
Remove and destroy the smutted clump.
Discourage ratooning of the diseased crops having more than 10 per cent infection.
Follow crop rotation with green manure crops or dry fallowing.
Grow redgram as a companion crop between 2 rows of sugarcane.
Treat the setts in hot water at 50°C for 2 hours.

Grassy shoot-*Phytoplasma*

Symptoms

The disease symptoms are usually seen two months after planting. The disease is characterized by the production of numerous lanky tillers from the base of the affected shoots. Leaves become yellow and narrow. The plants appear bushy and 'grass like' due to reduction in the length of internodes, premature and continuous tillering. The affected clumps are stunted and in many instances exhibit premature proliferation of axillary buds. In a diseased clump one or two thin, weak and small canes are produced.

Management

Plant disease free setts. Remove and burn the infected clumps periodically.
Avoid ratooning in problem areas
Hot Water Treatment (HWT) of setts at 52°C for 30min.
Control vector by spraying Malathion or Dimethoate@2ml/lt

Lecture 22

DISEASES OF GROUND NUT (*Arachis hypogea*)

Tikka leaf spots

Early leaf spot: *Cercospora arachidicola* **Late leaf spot:** *Phaeoisariopsis personata*

Symptoms

The tikka disease occurs as two types of leaf spots, caused by two species of *Cercosporidium*.

Early leaf spot : Symptoms usually appear within 35 DAS on the leaflets as elongated, elliptical spots with definite border. The leaf spots are irregularly circular , reddish brown or dark brown on the upper surface and are surrounded by a bright yellow halo. On the under surface, spots are light brown to tan coloured. Several spots coalesce and result in drying of the leaves.

Late leaf spot : Leaf spots appear after 35 DAS. The spots on leaves are circular with bright yellow halo around mature spots, usually **darker** than early leaf spots. On the under surface of the leaves the halo is not seen. Severely diseased leaves dry up and results in heavy defoliation. Loss of photosynthetic tissue leads to reduction in yield and quality of nuts.

Favourable Conditions

Prolonged high relative humidity for 3 days, low temperature (25-30°C) with dew on leaf surface, heavy doses of nitrogen and phosphorus fertilizers and deficiency of magnesium in soil favours the disease. Air dispersal

Management

Remove and destroy the infected plant debris.
Eradicate the volunteer groundnut plants.
Crop rotation with millets. Avoid monocropping
Treat the seeds with Captan or Thiram at 4g/kg or Carbendazim@0.2%
Spray Carbendazim@0.1% or Mancozeb@0.2% or Chlorothalonil@0.2% and if necessary, repeat after 15 days.
Grow resistant varieties like Vemana (early and late leaf spots), Naveen, Tirupathi-3

(early leaf spot only).

Rust-*Puccinia arachidis*

Symptoms

The disease is usually found when the plants are about 6 weeks old. Small, minute pale yellow to light brown pustules appear on the lower surface of leaves. Corresponding to the uredosori, small, necrotic, brown spots appear on the upper surface of leaves. The rust pustules may be seen on petioles and stem. In severe infection lower leaves dry and drop prematurely. The severe infection leads to production of small and shriveled seeds.

Management

Avoid mono-culturing of groundnut.

Remove volunteer groundnut plants and collateral hosts.

Spray Chlorothalonil or Tridemorph@0.2%.

Bud necrosis -*Tomato spotted wilt virus*

Symptoms

First symptoms are visible 2-6 weeks after sowing as **ring spots** on leaves. Stem also exhibits **necrotic streaks**. As the plant matures, it becomes generally stunted with short internodes and **short auxillary shoots**. Leaflets formed on these auxillary shoots show a wide range of symptoms including reduction in size, distortion of the lamina, mosaic mottling and general chlorosis. In advanced conditions, the **necrosis of bud** occurs. Drastic reduction in flowering is noticed and seeds produced are abnormally small and wrinkled with the dark black lesions on the testa and reduced germination capacity. The virus is transmitted by thrips. Early sown crop (first half of June) shows lower incidence of PBNB than late sown crop (late June)

Management

Uprooting and burning of diseased plants.

Grow resistant varieties like Kadiri 3, Kadiri 4, Vemana, ICGS-11, etc.

Maintain optimum plant population and adopt spacing of 15x15cm

Intercropping with **Bajra**.

Spray [monochrotophos@1.6ml/lt](#) or dimethoate@2ml/lt for vector control

LECTURE 23
DISEASES OF CASTOR (*RICINUS COMMUNIS*)
Wilt-*Fusarium oxysporum f.sp. ricini*

Symptoms

The disease appears in patches. Plants are attacked at all growth stages. When seedlings are attacked, cotyledonary leaves turn to dull green colour, wither and die. Necrosis of leaves starts from margins spreading to interveinal areas and later to the entire leaf. All lower leaves droop and drop off. Subsequently plants die. Sometimes superficial cracks are noticed on the stem. Split open stems show brownish discolouration and white cottony mycelia growth much prominently in the pith region. The fungus is seed borne.

Management

Select disease free seeds for planting. Rain water should not stand in field.
Rogue out and burn disease affected plants and crop debris regularly
Follow crop rotation for 2-3 years with non-host plants like pearl millet, finger millet or other cereals. tolerant varieties-Jyoti, GCH4, Jwala
Follow intercropping with redgram
Seed treatment with Thiram@3g/kg seed.
Multiplication of 2 kg *T. viride* formulation by mixing in 50 kg FYM. Sprinkle water and cover with polythene sheet for 15 days and then apply between rows of the crop.
Cultivate wilt resistant varieties, viz., Jyothi, Jwala and hybrids, viz., DCH 32, DCH 177, DCH 519, GCH 4, GCH 5 and GCH 6.

Root rot/Charcoal rot-*Macrophomina phaseolina*

Symptoms

Sudden wilting of plants in patches under high soil moisture stress coupled with high soil temperatures is a common symptom. Within a week, the leaves and petiole droop down and within a fortnight the infected plants dry up. Dark brown lesions are seen on the stem near the ground level. The taproot shows signs of drying and root bark sheds off easily. Fruiting bodies (pycnidia) of the fungus are seen as minute black dots on woody tissues and in pith region. In severe infection entire branch or top of the branch withers away. Such branches die-back. Diseased plants flower prematurely. Incidence at maturity causes spike blight. Seed development is affected.

Management

Burn crop debris containing the sclerotia of the fungus.
Seed treatment with *Trichoderma viride*@4g/kg seed or carbendazim@1g/kg seed.
Crop rotation with cereals
Provide irrigation at critical stages of crop growth
Soil drenching with carbendazim@0.1%, 2-3 times at 15 days interval.
Grow tolerant and resistant varieties / hybrids like Jwala, GCH-4, and GCH-6.

Grey mold/Grey rot/Blossom blight-*Botrytis ricini*

Symptoms

Symptoms of the disease can be seen on leaves, stem, flowers and capsules, being prominent on spikes. Initially water soaked lesions form on the male flowers at the base of the spike. These flowers rot and are covered by grey coloured fungal growth. Subsequently the disease spreads upward infecting all flowers and capsules which are covered by the fungus thereby involving the entire spike. This is followed by development of cottony white growth which later converts into grey colour due to sporulation. The infected capsules rot.

Management

Adjust sowing time in such a way that crop maturation occurs during dry season

Adopt wider spacing (90 x 60cm), Remove diseased spikes and destroy them

Grow varieties like Jwala with non-spiny capsules and less compact inflorescence.

Seed treatment with carbendazim@3g/kg

Spray carbendazim / Thiophanate methyl @0.1% before the onset of cyclonic rains based on weather forecast followed by second spray soon after rains have receded.

Application of 20kg urea and 10kg of murate of potash after removal of diseased panicles may be useful for the growth of panicles that subsequently develop.

LECTURE 24
DISEASES OF GINGELLY (*SESAMUM INDICUM*)
Alternaria leaf spot-*Alternaria sesami*

Symptoms

Initially small, circular, reddish brown spots (1-8mm) appear on leaves which enlarge later and cover large area with concentric rings. The lower surface of the spots are grayish brown in colour. In severe blighting defoliation occurs. Dark brown lesions can also be seen on petioles, stem and capsules. Infection of capsules results in premature splitting with shriveled seeds.

Management

Resistant varieties-TC16, SI 156

Treat the seeds with Captan or Thiram@0.25%

Spray twice with Mancozeb@0.25% or Thiophanate methyl@0.25% or Carbendazim@0.1%

Powdery mildew-*Leveillula taurica*

Symptoms

Initially greyish-white powdery growth appears on the upper surface of leaves. When several spots coalesce, the entire leaf surface may be covered with powdery coating. In severe cases, the infection may be seen on the flowers and young capsules, leading to premature shedding. The severely affected leaves may be twisted and malformed. Seen in mid Aug when crop is 45-50 days old.

Management

Remove the infected plant debris and destroy.

Spray Wettable sulphur@0.2% or dust Sulphur at 25 kg/ha and repeat after 15 days.

Grow resistant varieties like Rajeshwari, SI-1926, KRR-2, etc.

Phyllody-*Phytoplasma*

Symptoms

The disease manifests itself mostly during flowering stage, where the floral parts are transformed into green leafy structures, which grow profusely. The plants bear cluster of leaves and malformed flowers at the tip. The flower is rendered sterile. The plant is stunted and abnormal branching gives a bushy appearance. The infected plants generally do not bear capsules, if formed they do not yield quality seeds.

Management

Remove all the reservoir and weed hosts. Delay sowing.

Resistant varieties-Rajeswari, chandana, hima, YLM66

Avoid growing sesamum near cotton, groundnut and grain legumes.

Rogue out the infected plants periodically.

Spray 2-3 times with Monocrotophos (0.03%) or Dimethoate@0.2% at flowering stage reduces the vector population.

Root rot or stem rot or charcoal rot-*Macrophomina phaseolina*

Symptoms

The disease symptom starts as yellowing of lower leaves, followed by drooping and defoliation. The stem portion near the ground level shows dark brown lesions and bark at the collar region shows shredding. The sudden death of plants is seen in patches. The stem portion can be easily pulled out leaving the rotten root portion in the soil. The infection when spreads to pods, they open prematurely and immature seeds become shrivelled and black in colour.

Management

Treat the seeds with *Trichoderma viride* at 4g/kg or *Pseudomonas fluorescens* 10 g/kg or treat the seeds with carbendazim@0.1% or Thiram at 4g/kg.

Apply FYM or green leaf manure at 10t/ha or neem cake 250 kg/ha.

Spot drench with Carbendazim at 0.5 g/liter.

Intercropping sesame with moth bean at 1:1 ratio is effective in managing the disease.

Soil solarization with transparent polythene mulch of 50µ for 6 weeks during hot summer after ploughing and irrigation

Bacterial leaf spot-*Pseudomonas sasami* or *Ralstonia syringae* pv. *sesami*

Symptoms

The disease appears as watersoaked yellow specks on the upper surface of the leaves. They enlarge and become angular as restricted by veins and veinlets. The colour of spot may be dark brown to purple with shiny oozes of bacterial masses. Under high rainfall or high humid conditions spots coalesce and ultimately defoliation occurs.

Management

Keep the field free of infected plant debris. Seed treatment with hot water at 52°C for 10 minutes.

Steep the seed in Agrimycin 100 (250 ppm) or streptomycin (0.055) for 30 minutes.

Spray twice with Streptomycin sulphate or Oxy-tetracycline hydrochloride at 100g/ha at 15 days interval.

LECTURE 25
DISEASES OF SUNFLOWER (*HELIANTHUS ANNUUS*)
Leaf blight-*Alternaria helianthi*

Symptoms

The fungus produces brown, circular to oval spots on the leaves, but the spots can also be seen on the stem, sepals and petals. The spots are often surrounded by a chlorotic zone with necrotic center. The spots later enlarge in size with concentric rings and become irregular in shape. Under high atmospheric humidity, several spots coalesce to show bigger irregular lesions leading to drying and defoliation. The disease sometimes cause rotting of flower heads and affects the quality of seeds by reducing the germination percentage.

Management

Remove and destroy infected plant debris.

Rogue out weeds at periodical intervals.

Treat the seeds with Thiram or Carbendazim at 3 g/kg.

Spray twice or thrice with zineb or Mancozeb at 0.2% or carbendazim@0.1% at 10 days interval starting from first appearance of the disease or 35 DAS.

Rust-*Puccinia helianthi*

Symptoms

Small, reddish brown pustules 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 leaves become yellow and dry.

Management

Remove and burn the infected plant debris in the field.

Remove the volunteer sunflower plants. Crop rotation for 3 years

Grow tolerant variety like BSH-1.

Spray Mancozeb or Zineb@0.2%, 2-3 times at 10 days interval. The first spray should be given as soon as the disease is noticed or 35 DAS.

Downy mildew *Plasmopara halstedii*

Symptoms

Various kinds of symptoms are being produced by the pathogen like damping off, systemic infection, local lesions and basal rot or stem gall etc. In systemic infections plants are severely stunted. Chlorosis starts through midribs causing ultimately abnormally thick, down ward curled leaves that show prominent yellow and green epiphyllous mottling. A hypophyllous downy growth of the fungus develops. Flower heads of affected plants remain sterile. Local foliar lesion symptoms are characterized by small angular greenish yellow spots on leaves. Development of basal gall symptoms occur independently of the infection that results in systemic infection. In infected plants flower heads are erect.

Management

Follow spacing of 60x30cm or 45x30cm, Rogue out infected plants and destroy

Cropping sequence of sunflower followed by groundnut reduces the disease. Seed treatment with [Metalaxyl@0.6%](#) followed by foliar spray with [Metalaxyl@0.2%](#) is effective. Hybrids like LSH-1, LSH-3, KBSH-1, Jwalamukhi, etc had high degree of resistance.

Sclerotial wilt/Collar rot-*Sclerotium rolfsii*

Symptoms

Initial symptoms of the disease appear 40 days after sowing. Infected plants can be spotted from a distance by their sickly appearance, later the entire plant withers and dies. White cottony mycelium and mustard seed sized sclerotial bodies are formed on the affected stem near soil level. Alternate periods of high soil moisture and water stress conditions favor the disease.

Management

Collection and destruction of plant debris

Seed treatment with captan or carboxin@0.3%

Drench the base of the plant with cheshunt [compound@0.3%](#)

Addition of soil amendments like oat straw and finely grounded castor and neem cakes reduces disease incidence.

Use of antagonistic fungi such as *T. harzianum*.

Lecture 26 Redgram

Wilt-*Fusarium oxysporum f. sp. udum*

Symptoms

The diseases may appear from early stages of plant growth (4-6 week old plant) upto flowering and podding. Patches of dead plants in the field when the crop is flowering or podding are the first indications of wilt. The most characteristic symptom is a **purple band** extending upwards from the base of the main stem. Vascular tissues exhibit brown discolouration in the region of purple band. Partial wilting of the plant associated with infection of lateral roots is a definite indication of *Fusarium* wilt and distinguishes from Phytophthora blight that kills the whole plant due to tap root infection.

Management

Follow crop rotation with tobacco, sorghum or castor. deep summer ploughing.

Avoid successive cultivation of redgram in the same field.

Adopt mixed cropping of sorghum in the field.

Avoid waterlogged soils.

Soil solarization in summer to reduce the inoculum of pathogen.

Collect and destroy the diseased stubbles.

Grow resistant / tolerant varieties like Asha (ICPL 87119), Maruti (ICP 8863), Lakshmi (ICPL 85063), Durga (ICPL 84031), PRG 100, PRG 158, Muktha, Prabhat and Sharada.

Seed treatment with Thiram @0.3% or Carbendazim @0.2%

Treat the seeds with *Trichoderma viride* at 4 g/kg.

Multiply 2 Kg *T. viride* formulation in 50 kg of FYM and apply to soil.

Phytophthora blight / Stem blight-*Phytophthora drechsleri f. sp. cajani*

Symptoms

Phytophthora blight resembles damping off in that it causes seedlings to die suddenly. Infected plants have water soaked lesions on their leaves and brown to black, slightly sunken lesions on their stems and petioles. Infected leaves loose turgidity, and become desiccated. Lesions girdle the affected main stems or branches which break at this point and foliage above the lesion dries up. When conditions favour the pathogen, it is common for many plants to die. Pigeonpea plants that are infected by blight, but not killed often produce large galls on their stems especially at the edges of the lesions. The pathogen infects the foliage and stems but not the root system.

Soils with **poor drainage**, low lying areas, heavy rain during July-September favours the disease. Pigeonpeas are usually not infected after they are 60 days old.

Management

Avoid sowing redgram in fields with low-lying patches that are prone to water logging.

Adjust the sowing time so that crop growth should not coincide with heavy rainfall.

Grow resistant varieties like BDN 1, ICPL 150, ICPL 288, ICPL 304, KPBR 80-1-4.

Seed treatment with 4g *Trichoderma viride* formulation + 6g metalaxyl (Apron 35SD) per kg seed
Spray Metalaxyl (Ridomyl MZ) at 0.2%.

Sterility Mosaic-*Sterility mosaic virus*

Symptoms

The disease attack can be seen in all stages of crop growth. Plants appear as **bushy, pale green without flowers or pods**. Leaves are small and show mosaic pattern, vein-clearing. In severe cases, leaves become smaller and **cluster** near tip because of shortened internodes and stimulation of axillary buds. The plants are generally stunted and do not produce pod. Plants infected at early stages (upto 45 days) show near complete sterility. As plants become older (after 45 days), their susceptibility to the disease decreases and such plants show partial sterility. If pods develop, the seeds may be small, shrivelled and immature.

Management

Rogue out infected plants in early stages of disease development

Grow tolerant genotypes like ICPL 87119 (Asha), ICPL 227, Jagruti and Bahar

Spray Dicofol 3ml or Sulphur 3g in one liter of water to control mite vector in early stages of disease development

Bacterial leaf spot and stem canker-*Xanthomonas campestris pv. cajani*

Symptoms

Leaf infection can occur at all stages of plant growth, stem infection usually occurs in younger plants. In India the disease usually appears in the rainy season during July and August. It can be seen on lower leaves of plants that are about one month old as small necrotic spots surrounded by bright yellow halos. Later, rough, raised, cankerous lesions appear on the stem. Cankers can cause stems to break, but the broken part usually attaches to the plant. Stems often break at the point where the primary leaves are attached. Often, the affected plants do not break, and the stem cankers increase in size until they are 15-25 cm long. In cases of severe infection the affected branches dry.

Management

Remove the infected plant debris and destroy.

Spray antibiotics like Streptocycline @ 100ppm, 2-3 times at 10 days interval.

Lecture 27
BLACK GRAM (*Vigna mungo*) and GREEN GRAM (*Vigna radiata*)
Powdery mildew-*Erysiphe polygoni*

Symptoms

Small, irregular powdery spots appear on the upper surface of the leaves. These spots gradually increase in size and become circular covering the lower surface also. When the infection is severe, both surfaces of the leaf are completely covered by whitish powdery growth. In severe infections, foliage becomes yellow causing premature defoliation. The disease becomes severe during flowering and pod development stage. The white powdery spots completely cover the petioles, stem and even the pods. Often pods are malformed and small with few ill-filled seeds. The disease causes forced maturity of infected plants which results in heavy yield losses.

Management

Remove and destroy infected plant debris.

Spray twice with Carbendazim or Thiophanate methyl or Tridemorph @0.1%, one immediately after disease appearance and the second after 15 days.

Grow tolerant black gram cultivar like Krishnayya, LBG623, TM962 and green gram cultivars like

JGUM 1, TARM 1, Pusa 9072, WGG 48 and WGG 62.

Rust-*Uromyces phaseoli typica*

Symptoms

The disease is mostly seen on leaves, rarely on petioles, stem and pods. The fungus produces small, round, reddish brown uredosori mostly on lower surface. They may appear in groups and several sori coalesce to cover a large area of the lamina. In the late season, teliosori appear on the leaves which are linear and dark brown in colour. Intense pustule formation causes drying and shedding of leaves.

Management

Remove and destroy the infected plant debris.

Spray Mancozeb@0.3% or Tridemorph@0.1% or Wettable sulfur@0.3%, immediately on the set of disease and repeat after 15 days.

Grow tolerant black gram cultivar like LBG 648.

Cercospora leaf spot-*Cercospora canescens*

Symptoms

Small, circular spots develop on the leaves with grey centre and reddish brown margin. The several spots coalesce to form brown irregular lesions. Under favourable conditions, severe leaf spotting and defoliation occurs at the time of flowering and pod formation. The brown lesions may be seen on petioles, branches and pods in severe cases. Powdery growth of the fungus may be seen on the centre of the spots.

Management

Remove and burn infected plant debris.

Spray [Mancozeb@0.25%](#) or [Carbendazim@0.1%](#)

Grow tolerant black gram varieties like UG 135,TPU 4,TPU 5,TPU 11,TPU 12,AKU 4 and SP 21.

Corynespora leaf spot-*Corynespora cassicola*

Symptoms

when the crop reaches flowering stage lesions begin as dark reddish brown circular spots usually on the upper leaf surface. They expand with marked, narrow concentric banding to become larger spots. The concentric rings are made up of dead tissue. In advanced stages, the spots coalesce to form patches and shot holing and severe defoliation. Yields decrease drastically.

Management

Remove and burn infected plant debris.

Spray [Mancozeb@0.25%](#) or [Carbendazim@0.1%](#)

Grow tolerant black gram varieties like LBG 167.

Dry root rot-*Rhizoctonia bataticola*

Symptoms

symptom starts with yellowing and drooping of the leaves. The leaves later fall off and the plant dies within week. Dark brown lesions are seen on the stem at ground level and bark shows shredding symptom. The affected plants can be easily pulled out leaving dried, rotten root portions in the ground.

Management

Treat the seeds with Carbendazim or Thiram at 4 g/kg or pellet the seeds with *Trichoderma viride* at 4 g/kg or *Pseudonomas fluorescens* @ 10g/kg of seed.

Apply FYM or green leaf manure (*Gliricidia maculate*) at 10 t/ha or neemcake at 250 kg/ha.

Bacterial leaf spot-*Xanthomonas phaseoli*

Symptoms

The spots first appear as superficial eruptions and gradually invade the tissues giving **corky or rough appearance**. When the disease is severe spots coalesce and leaves turn yellow and fall off prematurely. The lower surface of the leaf appears red in colour due to the formation of raised spots. The stem and pods also get infected.

Management

Grow tolerant green gram varieties like LGG 407, LGG 444, JAL 781, NDM 88-14 and ML 537.

Soak the seed in 500 ppm streptomycin solution for 30 minutes before sowing.

Spray twice with paushamycin or plantomycin 100 mg in combination with 3 g of COC per liter at an interval of 12 days.

Yellow mosaic-*Mungbean yellow mosaic virus*

Symptoms

Initially small yellow patches or spots appear on young leaves. The next trifoliate leaves emerging from the growing apex show irregular yellow and green patches alternating with each other. The yellow discoloration slowly increases and newly formed leaves may completely turn yellow. Infected leaves also show necrotic symptoms. The infected plants

normally mature late and bear a very few flowers and pods. The pods are small and distorted. The early infection causes death of the plant before seed set.

Management

Rogue out the diseased plants upto 40 DAS

Remove the weed hosts periodically.

Increase the seed rate (25 kg/ha).

Grow resistant black gram varieties like Teja, T-9, PU31, LBG 752, Pant-30 and Pant-90.

Grow resistant green gram varieties like LGG 407, LGG 460, WGG37 and ML 267.

Cultivate the crop during rabi season.

Follow mixed cropping by growing two rows of maize (60 x 30 cm) or sorghum (45 x 15 cm) for every 15 rows of black gram or green gram.

Grow seven rows of sorghum as border crop

Treat seeds with Imidacloprid 70 WS @ 5ml/kg to control vector (whitefly).

Give one foliar spray of systemic insecticide (Dimethoate @ 750 ml/ha) on 30 DAS.

Lecture 28

BENGAL GRAM (*Cicer arietinum*)

Wilt-*Fusarium oxysporum f.sp. ciceri*

Symptoms

The disease occurs at two stages of crop growth, seedling stage and flowering stage. The field symptoms of wilt are death of seedlings or adult plants in patches. Seedlings collapse and lie flat on the ground retaining their dull green colour. When split open or cut transversely, brown to black discolouration of the internal tissues can be seen. Grown up plants show typical symptoms of wilting, i.e., drooping of petioles, rachis and leaflets. All the leaves turn yellow and then light brown. Vascular discolouration is observed on longitudinal splitting of stem. Sometimes only a few branches are affected, resulting in partial wilt.

Management

Treat the seeds with Carbendazim or Thiram at 2 g/kg or treat the seeds with *Trichoderma viride* at 4 g/kg or *Pseudonomas fluorescens* @ 10g/kg of seed.

Apply heavy doses of organic manure or green manure. Follow 6-year crop rotation with non-host crops. Grow resistant cultures like Kranthi (ICCC 37), Swetha (ICCV-2), ICCV 10, Avrodhi, G 24, C 214, BG 244, Pusa 212 and JG 315.

Ascochyta blight-*Ascochyta rabiei*

Symptoms

The disease is usually seen around flowering and podding time as patches of blighted plants in the field. On leaves, small water-soaked necrotic spots appear that enlarge rapidly under favourable conditions leading to blighting of leaves. Pycnidia are observed on the blighted parts. On leaflets, the lesions are round or elongated, with grey centres surrounded by brownish margin. Similar spots on the stem and pods have **pycnidia** arranged in **concentric circles** as minute black dots. The stem and petioles usually break at the point of infection due to girdling. If the main stem is girdled at the collar region, the whole plant dies.

Management

Grow resistant/tolerant varieties like Gaurav, C 235, G 543, GG 588, GG 688, BG 261 and GNJ 214.

Remove and destroy the infected plant debris in the field.

Follow crop rotation with cereals.

Deep sowing of seeds, i.e., 15cm or deeper.

Intercropping with wheat, barley and mustard.

Treat the seeds with Thiram 2g or Carbendazim 2 g /kg.

Exposure of seed at 40-50°C reduced the survival of *A. rabiei* by about 40-70 per cent.

Spray with [Carbendazim@0.1%](#) or [Chlorothalonil@0.3%](#).

Lecture 29,30,31 CITRUS

1) Gummosis: *Phytophthora palmivora*

Symptoms

Disease starts as water soaked large patches on the basal portions of the stem near the ground level. First symptoms are dark staining of bark which progresses into the wood. Bark in such parts dries, cracks in lengthwise vertical strips. Bark at the base is destroyed resulting in girdling and finally death of the tree. Later profuse exudation of gum from the bark of the trunk occurs. Infection extends to crown roots. Prior to death, plant usually blossoms heavily and dies before the fruits mature. more in heavy soils with improper drainage, frequent irrigations, standing water at base of trunk

Management

Preventive measures:

Selection of proper site with adequate drainage and high budding (30 to 46 cm or above).

Double ring method of irrigation.

Avoid irrigation water from coming in direct contact with the trunk.

Avoid injuries to crown roots or base of stem during cultural operations.

Use resistant sour orange rootstocks for propagating economic varieties(jambheri)

Painting Bordeaux paste or with ZnSO₄, CuSO₄, lime (5:1:4) to a height of about 60 cm above the ground level at least once a year.

Curative measures:

Scrape the diseased portion with a sharp knife.

Protect the cut surface with Bordeaux paste followed by spraying of Bavistin 1g/l reduces the spread.

Soil drenching with 0.2% metalaxyl and 0.5% *Trichoderma viride* commercial formulation is also effective.

2) Tristeza or quick decline: Citrus Tristeza Virus (CTV)

Symptoms: Tristeza affected trees look chlorotic and sickly in the early stages. Gradually the leaves drop and the defoliated twigs show die-back. such trees die gradually but sometimes healthy trees die suddenly. Vein clearing in young leaves of acid lime is seen when viewed against light (characteristic symptom). In sweet orange, the specific symptom is **honeycombing**, fine pits on bark in the portion of trunk below the bud union. Diseased trees usually **blossom heavily**. Trees with stem pitting are stunted and set less fruits. The fruits are of smaller size and of poor quality. As the fruits develop, the tree wilts partly or completely. It is transmitted by the aphid and cuscuta. The virus is not seed borne.

Management:

For A.P, Maharashtra and Karnataka, **Rangapur lime** is recommended as a root stock resistant to Tristeza. Periodic sprays of insecticides like Monocrotophos 0.05 % reduce s the secondary spread of the disease in the orchard.

Citrus canker: *Xanthomonas axonopodis pv. citri*

Acid lime is highly susceptible to canker.

Symptoms:

symptoms are most conspicuous on leaves, twigs and fruits. The lesions appear as minute water soaked round, yellow spots which enlarge slightly and turn brown, eruptive and corky. Canker lesions on the fruit do not possess the yellow halo as on leaves. Several lesions on fruit may coalesce to form a patch. The market value of the fruits is reduced by the canker spots. In severe infection defoliation and die-back symptoms seen. Citrus leaf miners (*Phyllocnistis citrella*) helps in the dissemination of the pathogen. Spread by rain splashes.

Management

Prune out and burn all canker infected twigs before monsoon

Use canker tolerant varieties like “Tenali selection” and “Balaji”

Select seedlings free from canker for planting in main field

Spray Streptocycline (1g) + Copper oxy chloride (30g) in 10 litres of water in citrus nurseries and in main field for leaf canker & Fruit infection

Control leaf miner when young flush is produced.

Zinc deficiency: More in alkaline soils. Symptoms seen in young leaves. Interveinal chlorosis, reduction in leaf size, reduction in length of branches, drying of branches also. Young leaves become bushy and erect. If soil P^H is >6.0 zinc in the soil becomes unavailable to plants.

Therefore application of zinc to such soils is not of use. Spray 0.2% ZnSo₄ on young leaves. Ziram 0.2% also can be used to correct deficiency.

Iron deficiency: small veins in the leaf remain green and leaves turn yellow/white. No reduction in leaf size. Iron deficiency is seen if calcium is more in soil and in high P, Zn, Cu, Mn conditions. Spray Annabhedi 0.25%+0.1% citric acid to correct iron deficiency.

LECTURE 32

Mango

1. Powdery mildew: *Oidium mangiferae* (*Erysiphe polygoni*)

Symptoms:

Generally the infection recognized by whitish or grayish powdery growth starts from the inflorescence and spreads downwards covering the floral axis, tender leaves and stem. Leaves become twisted and defoliate. Infected floral parts are severely damaged and drop off. If the fruits are set, they do not grow in size and may drop before attaining pea size. Fruits are sometimes malformed, discolored due to severe attack. Cloudy weather, high humidity, low night temperature spread disease. Air dispersal.

Management

Can be controlled with two preventive sprays with wettable sulphur 0.3% once before the flowers open and 2nd after the fruit set.

Dusting twice or thrice with fine sulphur will check the disease.

Spraying with Karathane 0.1% before flowering and after fruit set (peanut stage).

Resistant varieties: Neelum, Zardalu, Banglora, Torapari-khurd and Janardhan pasand

DISEASES OF GRAPE

1. Powdery mildew: *Uncinula necator* (*I.S: Oidium tuckeri*)

Symptoms

Early berry infection results in shedding of affected berries. Powdery growth is visible on older berries and the infection results in the cracking of skin of the berries. Floral infection results in shedding of flowers and poor fruit set. Powdery growth on both surface of the leaves- curling.

Management

Clean cultivation of vines or removal and destruction of all diseased parts

Spray wettable sulphur @0.3% or karathane or calixin @0.1%

Downy mildew: *Plasmopara viticola*

Symptoms

Irregular, yellowish, translucent spots on the upper surface of the leaves correspondingly on the lower surface, dirty white, powdery growth of fungus appears. Premature defoliation.

Dwarfing of tender shoots. Hite growth of fungus on berries which subsequently becomes leathery and

shrivels. Infected berries turn hard, bluish green and then brown. Later infection of berries results in soft rot symptoms. Normally, the fully grown or maturing berries do not contact fresh infection as stomata turn non-functional. No cracking of the skin of the berries.

Optimum temperature : 20-22°C, Relative humidity : 80-100 per cent

Management

Collect and burn fallen leaves and twigs

Sanitation of the orchard

Vine should be kept high above ground to allow circulation of air by proper spacing

Pruning (April- may & Sep- Oct) and burning of infected twigs

Grow resistant varieties like Amber Queen, Champa, Champion, **Red Sultana**

The disease can be effectively managed by giving 3-5 prophylactic sprays with 1% B.M or metalaxyl + mancozeb 0.3 to 0.4% or Azoxystrobin

Anthracnose / Birds eye disease: *Elsinoe ampelina*

It is especially serious on new sprouts during rainy season. Occur from June to October

Symptoms

Young shoots and fruits are more susceptible than leaves. Circular, greyish black spots or red spots with yellow halo appear. Later the centre of the spot becomes grey, sunken and fall off resulting in 'shot hole'. Black, sunken lesions appear on young shoots. Cankorous lesions on older shoots. Girdling and death of shoots occur. Infection on the stalk of bunches and berries result in the shedding of bunches and berries respectively. Sunken spots with ashy grey centre and dark margin on fruits (Birds eye symptom). Mummification and shedding of berries. No infection can take place in the absence of rain. Wind associated with warm atmosphere (temp.) and heavy rains favour the disease spread. More in Low lying and badly drained soils. Anab-e-shahi is susceptible.

Management

Removal of infected twigs

Selection of cuttings from disease free areas and dipping them in 3% **FeSO₄ solution** for ½ an hour before planting.

Spraying Bordeaux mixture 1% or COC@ 0.2% or [carbendazim@0.1%](#).

Lecture33
DISEASES OF GUAVA

1. Wilt – *Fusarium oxysporum f.sp. psidii*, *Macrophomina phaseolina*, *Cephalosporium sp.*, *Gliocladium roseum* and *Verticillium alboarum*.

Symptoms

The affected plants show yellow colouration with slight leaf curling at the terminal branches, becoming reddish at the later stage and subsequently premature shedding of leaves. Twigs become bare and fail to bring forth new leaves or flowers and eventually dry up. Fruits of all the affected branches remain underdeveloped, become hard, black and stony. A few plants also show partial wilting, which is very common symptom of wilt. The finer roots show black streaks which become prominent on removing the bark. The roots also show rotting at the basal region and the bark is easily detachable from the cortex. Bark splitting can be seen in wilted plants in later stages. The disease can be categorized into slow wilt and sudden wilt. In slow wilt, plant takes several months or even a year, to wilt after the appearance of initial symptoms and in sudden wilt, infected plant wilts in 15 days to one month.

Management

Proper sanitation of orchard.

Wilted plants should be uprooted, burnt and a trench of 1.0-1.5m should be dug around the trunk. Treat the pits with formalin and cover the pit for three days and then transplant the seedlings after two weeks.

While transplanting seedlings avoid damage to the roots.

Maintain proper tree vigour by timely and adequate manuring, inter-culture and irrigation.

Intercropping with turmeric or marigold.

Soil solarization with transparent polythene sheet during summer months.

Application of oil cakes like neem cake, mahua cake, kusum cake supplemented with urea.

Apply 6kg neem cake + 2kg gypsum per plant.

Judicious amendments of N and Zn.

Resistant variety: **Apple guava**

Drench with 0.2% Benomyl or Carbendazim, four times a year and spray twice with Measystox and Zinc sulphate.

Disinfestation of soil with Metam-sodium at 252 ml/10m² area to control nematodes.

Lecture 34
DISEASES OF PAPAYA

1. Powdery mildew: *Oidium caricae*

Symptoms

white mycelium develops on both the leaf surfaces. Lesioned areas become chlorotic and sometimes surrounded by a dark margin. Flower stalks and fruits are also affected. Stems of young seedlings are affected when grown under reduced light conditions. Severe attack leads to death of top portion of the seedlings

Management

Spray wettable Sulphur@0.3% at 10 days interval

Spray systemic fungicides like Bayleton@0.1% or carbendazim@0.1% at monthly intervals

2. Foot rot / stem rot: *Pythium aphanidermatum, Rhizoctonia solani*

Symptoms

Water soaked patches on the stem at the ground level. Patches enlarge and girdle the base of the stem. Diseased tissues turn brown or black and rot. Terminal leaves turn yellow, droop and wilt

Fruits shrivel and drop off. Entire plant topples over and dies. Internal tissues of bark appear dry and give **honey comb appearance**. Roots deteriorate and may be destroyed

Management

Seedlings should be raised in well drained nursery area

Uproot the diseased seedlings and burn

ST with captan@4g/kg seed or chlorothalonil@2g/kg seed (*R. solani*)

Drench the base of stem with COC@0.25% or metalaxyl@0.1% or Bordeaux mixture@1.2%

3. Mosaic: *Papaya mosaic virus or Papaya ringspot virus or Carica virus I*

Symptoms

Mottling and puckering of leaves, especially the young ones. The lamina is reduced and malformed and are often modified into tendril like structures. Older leaves fall down and a small tuft of younger leaves is left at the top with upright position. The stem, petiole and fruits develop elongated water soaked areas showing concentric or circular rings. Fruit size is severely reduced with deformed shape. Aphids spread the disease

Management

Disease free seedlings, Rouging and destruction of diseased plants

Vector control, *Carica cauliflora* is resistant

Weekly sprays with 1% groundnut oil

4. Leaf curl: *Tobacco leaf curl virus* or *Nicotiana virus 10*

Symptoms

Severe curling of leaves accompanied by vein clearing and reduction of leaf lamina. Leaf margins are rolled inward in the form of inverted cup. Leaves become leathery, brittle and petioles are twisted. Diseased plants fail to flower or bear fruits. In advanced stage, defoliation and growth is arrested. Whitefly, *Bemesia tabaci* and grafting spread virus

Management

Disease free seedlings, Rouging and destruction of diseased plants
Vector control with [monochrotophos@0.05%](#) or [Dimethoate@0.2%](#) or [metasystox@0.1%](#)

**LECTURE 35 &36
DISEASES OF BANANA**

1) Yellow Sigatoka leaf spot - *Mycosphaerella musicola* Black sigatoka – *Mycosphaerella fijiensis*

Symptoms

Small spindle shaped spots with greyish centre and yellowish halo running parallel to veins of young leaves. Spots coalesce and whole leaf blade dries up. On the upper surface of the spots, fructifications of the fungus appear as black specks. If the fruit is nearing maturity at the time of heavy infection, the flesh ripens unevenly and individual bananas appear undersized and their flesh develops a buff pinkish colour, and store poorly.

Management

Removal and destruction of affected leaves followed by spraying with BM (1%) +linseed oil (2%).crop rotation with maize, vegetables once after 3 seasons. spacing 2.5m between rows and plants.

Prevent water accumulation around the plant and go for periodical weeding.

Spray chlorothalonil@0.2% or carbendazim or thiophanate methyl@0.1% or mancozeb@0.25% along with spreading agent such as teepol or sandovit added at the rate of 1ml/lit of water.

2) Moko disease / Bacterial wilt- *Ralstonia solanacearum* (*Pseudomonas* or *Burkholderia*)

Symptoms

Symptoms start on rapidly growing **young plants**. The youngest three to four leaves turn pale green or yellow and collapse near the junction of lamina and petiole. Characteristic discoloration of vascular strands, wilting and blackening of suckers. Vascular discoloration is concentrated near the **centre** of the pseudostem. Greyish brown bacterial ooze is seen when the affected pseudostem is cut transversely. A firm brown dry rot within fruits (characteristic symptom)

Management

Grow resistant varieties like **poovan** and monthan.

Use of healthy planting material.

Exposure of soil to sunlight during dry hot weather.

Eradicate infected plants and suckers killing *in situ* by application of herbicides.

Disinfestation of tools with formaldehyde diluted with water in 1:3 ratio.

Crop rotation (3 years rotation with sugarcane or rice) & providing good drainage

Allow fallow period or flooding during off-season

Fumigation of infected site with Methyl Bromide or chloropicrin.

Spray systemic insecticide to prevent transmission of disease to healthy plants.

3) **Banana Mosaic / Infectious chlorosis/ Heart rot:** *Cucumber mosaic virus*

Symptoms

Typical mosaic-like or discontinuous linear streaking in bands extending from margin to midrib. Leaf size is reduced and leaves are malformed. Chlorosis of newly formed leaves. In severe cases rotting of heart leaf and leaf sheaths which progress into the pseudostem and plant dies.

Diseased plants do not reach maturity

Management

Use of disease free suckers for planting, Dry heat treatment of suckers at 40^o C for 1 day

Avoid growing cucurbits as intercrop

Vector control with Methyl demeton or dimethoate@ 0.2% at 3 – 4 weeks interval

Panama wilt- *Fusarium oxysporum f.sp. cubense*

Symptoms

Symptoms usually appear on atleast 5 months old banana plants. The earliest symptoms are faint yellow streaks on the petiole of oldest leaves that show progressive yellowing, break at the petiole and hang down along the pseudostem. Heart leaf alone remains upright. Varying degrees of longitudinal splitting along pseudostem are often observed. vascular discolouration of pseudostem appears first in the outer or oldest leaf sheath and extends upto the pseudostem. The fungus grows and blocks the vascular system resulting in wilting of the plant. Affected plants give characteristic odour of rotten fish. Affected plants do not produce bunches. Even if produced, fruits are malformed and ripen prematurely or irregularly.

Poorly drained soils, acidic, light textured soils and plants with Insect injuries, wounds and infestation of burrowing nematode, *Radopholus similis*, have greater incidence.

Spread as conidia through irrigation water or through root contact

Management

Use of disease free suckers for planting.

Avoid ill drained soils, and prefer slightly alkaline soils (7-7.5 pH) for cultivation

Flood fallowing for 6 to 24 months or crop rotation with rice.

Application of lime (1-2 kg/pit) to the infected pits after chopping of the plants parts.

Dipping of suckers in carbendazim (0.1%) solution before planting

Soil drench with 0.1% carbendazim or 0.01% Vapam(8.5g/l)

Growing resistant Cavendish varieties, viz., **Basrai** (Vamanakeli), **Poovan**

(Karpura chakkarakeli) **between June-August**

Bunchy top disease-Bunchy top virus

Symptoms

Prominent dark green streaks on the petioles and midrib along the leaf veins. Marginal chlorosis and curling of leaves. Petioles fail to elongate. Leaves are reduced in size, chlorotic, stand upright and become brittle and are crowded at the top (Bunchy top) and show dark green streaks near the midrib. Flowers display mottled and streaked discolouration. Plants show marked stunting

Management

Eradication of all infected suckers by spraying with kerosene or by injecting herbicide, 2, 4-D

Use of only certified banana suckers for planting

The new crop should be regularly inspected and the diseased plants destroyed as soon as noticed.

Vector (Banana aphid, *Pentalonia nigronervosa*) control with systemic insecticides, Viz., Phosphomidon @ 1ml/ltr or Methyl demeton 2ml/l

Lecture 37 & 38
DISEASES OF POMEGRANATE
1) Cercospora leaf spot – *Cercospora punicae*

Symptoms

Light zonate brown spots appear on the leaves and fruits. Black and elliptic spots appear on the twigs. The affected areas in the twigs become flattened and depressed with raised edge. Such infected twigs dry up. In severe cases the whole plant dies.

Management

Pruning and destruction of diseased twigs.

Application of thiophanate- methyl 0.1% or chlorothalonil 0.2% or mancozeb 0.2%

2) Anthracnose – *Colletotrichum gloeosporioides*

Symptoms

Small, regular to irregular dull violet or black spots surrounded by yellow margins on the leaves. Infected leaves turn yellow and drop off. Small irregular lesions on the fruit reduce market value

Management

Spray carbendazim@0.1% or Thiophanate-methyl @0.1% or mancozeb@0.2% fortnightly

3) Bacterial leaf spot - *Xanthomonas axonopodis pv. punicae*

Symptoms

Small irregular water soaked deep red spots on leaves. Leaves distorted and malformed. On the stem, the disease starts as brown to black spots around the nodes. Girdling and cracking of nodes. Branches break down. Brown to black spots on the pericarp of fruit with L or Y shaped cracks

Management

Clean cultivation and strict sanitation in orchard

Spray B.M @1% along with antibiotic

LECTURE 39 & 40 DISEASES OF CHILLI

1) Damping off – *Pythium aphanidermatum*,

Symptoms

Pre-emergence damping off: Seedlings disintegrate before they come out of soil surface which results in poor field emergence / poor seed germination.

Post-emergence damping off :Development of disease after seedlings have emerged out of soil surface but before the stems are lignified.

Lesion formation at collar region. Infected areas appear brown and water soaked. Plants shrivel and collapse as a result of softening of tissues. Infected stems become hard, thin and infected seedlings topple. Disease appear in patches both in nursery and field beds.

Management

Raise nursery in light soil with proper drainage

Burning farm trash on the surface of the beds.

Sowing seed on raised beds of 6-8” high (15cm)

Crop rotation, avoid use of undecomposed FYM

Using low seed rate of 650 g/cent.

Seed dressing with Thiram or captan @ 3 g/Kg.

Soil drenching with [metalaxyl@0.2%](#)

2) Die-back and fruit rot – *Colletotrichum capsici*

Symptoms

December - October in transplanted crop

Infection of growing tips leads to necrosis of branches from tip backwards

Shedding of flowers due to the infection at pedicel and tips of branches

Fruit symptoms

Ripe fruits are more liable for attack than the green ones. Small, circular, yellowish to **pinkish sunken spots** appear on fruits later attain elliptical shape. Severe infection result in the shrivelling and drying of fruits that become white or greyish and lose their pungency. The affected fruits may fall off subsequently. spread by air and seeds.

Management

Collect and destroy all infected plant parts

Collect seeds only from fruits without infection

Removal and destruction of Solanaceous weed hosts and infected plant debris

Seed treatment with captan or Thiram 3-4g/kg

Spray thrice with propiconazole 2ml/l or [mancozeb@0.25%](#). just before flowering, at fruit formation stage and 15 days after second spray.

3) Powdery mildew – *Leveillula taurica*

Usually seen from December - February

Symptoms

White powdery coating appears mostly on the lower surface and correspondingly on the upper surface yellow patches are seen. Sometimes the powdery coating can also be seen on the upper leaf surface, young fruits and branches. Severe infection results in the drying and shedding of affected leaves&flowers. Diseased fruits do not grow further and may drop down.

Management

Spraying wettable S@0.3% or Dinocap or Carbendazim or Tridemorph 0.1%.

4) Bacterial leaf spot: *Xanthomoas campestris pv. vesicatoria*

Symptoms

Lesions on leaf begin as circular, water soaked spots and become necrotic with brown center and chlorotic borders. Lesions are slightly raised on lower leaf surface. Severely spotted leaves turn yellow and drop. Raised brown lesions appear on fruits. Narrow elongated lesions or streaks may develop on stems. High humidity during July-Sep, 22-34⁰C favor disease

Management

Seeds should be collected from healthy fruits,

Seed treatment with copper oxychloride 2g/kg seed.

Spray twice with plantomycin (200ppm) along with 3gCOC per litre of water at 15 days interval

Lecture 41
DISEASES OF BHENDI

1) Yellow vein mosaic: *Bhendi Yellow vein mosaic virus or bhendi vein clearing virus*

Symptoms

Yellowing of veins in the leaf (vein clearing) is the characteristic symptom. In severe infections the younger leaves turn yellow, become reduced in size and the plant is highly stunted. Infection restricts flowering and fruits are not formed, if formed, turns smaller, harder and rough. Loss in fruit yield ranges from 50-100% based on disease incidence. More in rainfed crop. Spread by whitefly & jassid

Management

Tolerant varieties: Parbhani Kranti, Pusa savani, Janardhan, Haritha, Arka Anamika and Arka Abhay. Destroy wild plants/weeds on which virus survives

The disease spread can be restricted by spraying Monocrotophos, 1.5 ml/l.

2) Powdery mildew: *Erysiphe cichoracearum*

Symptoms

Grayish powdery growth occurs on the under as well as on the upper surface of the leaf, yellowing of leaves, flower drop causing severe reduction in fruit yield. More during Nov-Mar.

Management

spray wettable sulphur@0.3% or Dinocap@0.1% , three to four times at 15 days intervals.

Brinjal

Phomopsis fruit rot or blight – *Phomopsis vexans*

Symptoms

The plants are attacked at all stages of growth, producing damping-off symptoms in nurseries and collar rot on young plants. On leaves, circular to irregular, clearly defined grayish brown spots having light centers appear. The diseased leaves become yellowish in colour and may drop off. **Several black pycnidia** can be seen on older spots. The lesions on stem are dark brown, round to oval and have grayish centers where pycnidia develop. At the base of the stem, the fungus causes characteristic constrictions leading to canker development and toppling of plants. On fruits, small pale sunken spots appear which on enlargement cover entire fruit surface. These spots become watery leading to soft rot phase of the disease. dry rot and black

mummified fruits. Pathogen is seed borne and also survives in plant debris as mycelium and pycnidia. Conidia dispersed through rain splashes, irrigation water, agricultural tools and insects. High relative humidity coupled with higher temperatures favour disease development. 26°C, 55% R.H.

Management

Removal and destruction of diseased crop debris

Practicing crop rotation and summer ploughings helps in reducing initial inoculum.

Use of disease free seed

Hot water treatment of seed at 50°C for 30 minutes

Seed treatment with thiophanate methyl at 1g/kg seed

Spray twice with thiophanate methyl or **carbendazim@0.1%** at 20 days interval.

Lecture 42

DISEASES OF CUCURBITS

1) Downy mildew – *Pseudoperonospora cubensis*

Symptoms

Yellow, angular spots appear on upper surface of leaves. The corresponding lower surface of these spots shows a purplish downy growth in moist weather. The spots turn necrotic with age.

The diseased leaves become yellow and fall down. Diseased plants get stunted and die.

Fruits produced may not mature and have a poor taste.

Management

Destruction of cucurbitaceous weeds around field

Spray **metalaxyl@0.2%** or **chlorothalonil@0.2%**

Spray **zineb@0.3%** at 10 days interval

2) Powdery mildew: *Erysiphe cichoracearum*, *Sphaerotheca fuligena*

Symptoms

Whitish powdery growth on foliage, stems and young growing parts. Premature defoliation and death. Fruits remain undeveloped and are deformed.

Management

Spray **Calixin 0.1%** or **Karathane @0.2%**

LECTURE 43 & 44
DISEASES OF TOMATO
1) Early blight – *Alternaria solani*

Symptoms

Lowest leaves are attacked first and the disease progresses upwards. Small, isolated, scattered pale brown spots on the leaf. Fully developed spots are irregular, brown with **concentric rings** inside the spot. Spots coalesce to form large patches resulting in the leaf blight. In severe attacks the entire plant may be defoliated.

Zonate lesions may also develop on **stems** and petioles, which break at the point of infection. Brown spots are also seen on **calyx**. Slightly dark, sunken, round to irregular lesions on fruit at the calyx end

Management

Maintain proper vigour of the plant, Use of disease free seed

Removal and burning of diseased crop debris

[Mancozeb@0.25%](#) or [chlorothalonil@0.2%](#) or Zineb@ 0.25% spray at weekly intervals

2) Tomato Mosaic – *Tomato mosaic virus*

Symptoms

The virus causes a light and dark green mosaic mottle with raised dark green area and distorted to a fan leaf or tendril like younger leaves. The plants are stunted. Some strains cause yellowing or leaf mottling which may also affect the fruit. Some other strains produce longitudinal necrotic streaks on stem or petioles. Such diseased plants are killed. Necrotic sunken lesions also appear on fruits and sometimes internal necrosis or browning of mature fruit occurs.

Management

All collateral hosts in the vicinity should be destroyed before planting new crop

Rogue out and destroy diseased plants

Virus free seed should be obtained and used for sowing

Soak the seeds in 10% Tri-sodium orthophosphate for 15 to 20 minutes prior to sowing

Heat treatment for 2-4 days at 70°C

Cross protection of tomato seedlings by inoculating with mild strains

Field workers should avoid using tobacco products while working in the field

3) Bacterial fruit canker: *Clavibacter michiganense subsp. michiganense*

Symptoms

Disease appears as **spots** on leaves, stems and fruits and as **wilting** of leaves and shoots. White blister like spots in the margins of leaves that become brown with age and coalesce, but do not fall off. Light coloured streaks on stems and petioles at the joints. Cracks develop in streaks and form cankers. Slimy bacterial ooze through the cracks in humid weather. **Birds eye** like appearance of spots, which have brownish centers and white halos. Vascular discolouration. Large cavities in pith and cortex which extend to outer surface of stem and cause cankers

Management

Extraction of seed through fermentation of pulp at room temperature for 72 hours eradicates the bacterium from the seed.

Hot water treatment of seed at 52°

Protective sprays with COC and streptomycin sulphate

Three year crop rotation, Soil solarization

4) Root knot nematode – *Meloidogyne sp.*

Symptoms

Formation of galls on host root system. Roots branch profusely starting from the gall tissue causing a '**beard root**' symptom. In severely infected plants the root system is reduced and the rootlets are almost completely absent. Uptake and transport of water and nutrients hampered. Plants wilt during the hot part of day, especially under dry conditions and are often stunted. Seedlings infected in nursery do not normally survive transplanting and those surviving have reduced flowering and fruit production

Management

Crop rotation with graminaceous hosts

Inclusion of non-preferred hosts like mustard, sesame, maize, wheat, etc., in the cropping system

Intercropping of marigold with tomato reduces nematode population

Nursery should be raised in nematode free sites or fumigated beds

Deep ploughing of infested fields during summer. Three summer ploughings at 10days interval reduces juvenile population

Flooding the field for prolonged periods

Use of biocontrol agents like *Paecilomyces lilacinus* (egg parasite)

Nursery bed treatment with metham sodium (Vapam)@25ml/m² or Carbofuran@0.39g a.i/m²

Bare root dip treatment in EC formulation of systemic pesticides like Dimethoate or Phenemiphos for 6-8 hours before transplantation

Grow resistant varieties like Hissar Lalit and PNR-7

Integration of three summer ploughings or use of treated nursery with spot application of carbofuran @1 kg a.i/ha at transplanting stage.

LECTURE 45 DISEASES OF COCONUT

1) *Ganoderma* basal stem rot– *Ganoderma lucidum*, *G. applanatum*

Symptoms

The fungus infects the roots and spreads upwards killing the entire root system. Older leaves droop and wither and remain suspended around the trunk for several months. Tree become barren due to suppression of inflorescence. Diseased tree dies slowly in about two years and often the stem cracks, giving out a dark brown ooze. Extensive rotting of roots and peeling of stem tissues. Drooping of buds and nuts also. More in light soils. Weather conditions from Nov-June favor spread of disease.

Management

Preventive measures

Dig isolation trenches of about 50cm wide and 1m deep, 2-3 m away from diseased palm to prevent spread of fungus

Trenches dug for replanting should be filled with FYM, 5kg neem cake and *Trichoderma viride*
Incorporate green manure crops like sunhemp and *Sesbania* for moisture retention and multiplication of antagonistic fungi

Avoid deep ploughing or digging which are likely to injure roots

Arrange separate irrigation to each tree to prevent spread of fungus

Apply FYM (200 kg) and neem cake (5-10 kg) to each tree during June – July

Also apply 2 kg superphosphate and 3 kg MOP in two splits, one in July and other in November

Apply 40 liters of 1% BM in basin of each tree, yearly once, during August –September

Curative measures

Destroy infected palms

Root feeding with tridemorph (6ml in 25 ml of water), 3-4 times an year, in early stages of infection, Control bark eating caterpillar

2) **Bud rot - *Phytophthora palmivora***

Symptoms

Severe on young palms upto 25yrs old. Yellowish green discoloration of the crown leaf. The basal tissues of the leaf rot quickly and can be easily separated from the crown. Spindle withers and droop down. Older leaves develop irregular, water soaked spots which are sunken in nature.

The leaves and sheath in the central spindle fall off leaving an outer whorl of green leaves. The withered central shoot can be pulled out very easily from the crown. The central crown may rot and in few months the tree may wilt. Young nuts fail to mature and fall. Severe in waterlogging areas and closely spaced plants. Attack in rainy season.

Management

Cutting and burning of badly infected palms. Adopt 8m spacing. Provide drainage channels. If the disease is detected early remove the infected portions and protect with Bordeaux paste. Spray copper fungicides (B.M@1% or COC@0.3%) after onset of monsoon to prevent infection. Keep a mixture of $\text{CuSO}_4 + \text{NaCl}$ (1: 3-5) parts in a cloth bag in the crown or above bud.

3) Stem bleeding – *Ceratocystis paradoxa*

Symptoms

Reddish brown ooze from the cracks near the base of the trunk. The fluid dries up to form black encrustations. The tissues, except vascular bundles, below infected patch show yellowish brown discoloration and decay. Large cavities are formed in diseased stem from which yellowish to whitish fluid oozes out. Excess moisture, high PH or alkalinity in soil favor disease occurrence. Spread is more in young palms.

Management

Avoid any mechanical injury to the stem. Cover the lower part of trunk with coal tar or Bordeaux paste to prevent the disease.

Chisel out affected tissues and dress the wound with hot coal tar or Bordeaux paste.

Apply 5 kg neem cake containing *Trichoderma* along with 50kg of organic manure to the basin during September.

LECTURE 46

DISEASES OF ROSE

1) Powdery mildew – *Sphaerotheca pannosa var. rosae*

Symptoms

The infected leaves show grayish powdery fungal growth. Rolling of leaf margins with the onset of sprouting season. Affected leaves become curled and distorted. Badly infected flower buds fail to open. Infected floral parts become discoloured, dwarfed and dried

Management

Collect and destroy infected plant debris

Four sprays with wettable Sulphur@0.3% or carbendazim@0.1% or Dinocap@0.1% at 10 days interval

Resistant varieties: Ashwini, Ambika, Angeles, American pride, Surabhi

2) Black spot – *Diplocarpan rosae* (Anamorph: *Marssonina rosae*)

Symptoms

Dark brown tar coloured spots with fringed borders. Spots coalesce forming large patches. Infected leaves turn brown and defoliate. Fungus may also attack stems and flowers. On stems, infected areas are blackened with blistered appearance dotted with pustules

Management

Affected parts should be collected and destroyed

Spray Tridemorph @0.025% or benomyl @0.1% at weekly intervals starting with the sprouting of the plants till new foliage appears.

Shade and extensive irrigation should be avoided.

Resistant varieties: Bebe bune, coronado, Grand opera, sphinx.

Radiance - escape infection due to waxy surface

3) Die-back – *Diplodia rosarum*

Symptoms

Infection starts from the pruned surface of the twigs. Infected twig becomes brown to dark brown or black and dries from tip downwards. Infection spreads from twig to main stem and roots and finally whole plant is killed.

Management

Diseased twigs should be carefully removed and destroyed

After pruning the cut end should be protected with chaubattia paste

Spray [Difolatan@0.2%](#) or [mancozeb@0.2%](#) or [Chlorothalonil@0.2%](#) in early Sep and late Oct
Resistant varieties: Blue moon, Red gold, Summer queen, etc.

Lecture 47

DISEASES OF TURMERIC

1) Rhizome rot – *Pythium aphanidermatum*, *P. graminicolum*

Symptoms

The disease occurs in patches. Infected plants show progressive drying up of the leaf first along the margins and later entire leaf. The root system is adversely affected leaving few decaying brown roots. Infection gradually spreads to rhizomes which begin to rot, become soft and turn brown.

Management

Crop rotation with non-hosts

Grow turmeric in light soils with good drainage

Use disease free rhizomes for planting

Rhizomes should be dipped in [Metalaxyl@2.5g/l](#) or Bordeaux mixture@1% solution for 40 minutes

Drench the soil at root region with captan@2 g or COC@2.5 g or metalaxyl@1 g per liter in the initial stages of the disease

Turmeric varieties, PCT-13 and PCT-14 are resistant to this disease.

2) Leaf spot – *Colletotrichum capsici*

Symptoms

Fungus attacks only leaves, elliptic to oblong spots of different sizes appear on both the surfaces, but more on upper surface and gradually increase in size. Mature spots have grayish center with dark brown margins surrounded by a yellow halo. Central portion of the spot becomes thin and papery. Several spots coalesce to form irregular necrotic patches

Management

Remove and destroy infected plant debris

Treat rhizomes with [COC@0.25%](#) solution

Spray [Carbendazim@0.1%](#) or [Mancozeb@0.25%](#). during Aug-Dec along with [sandovit@0.5 ml/lt](#)

Avoid excess shading

Tolerant varieties: TS-2, TS-4, TS-9, TS-88

Lecture 48

DISEASES OF ZINGER

1) Rhizome rot/soft rot – *Pythium sp.*

Symptoms

When infection takes place through contaminated seed, sprouts fail to grow resulting in pre-emergence damping off. If the disease strikes after sprouting leaves turn pale green. Yellowing is noticed on the top leaves followed by withering and drying of the dead area. Dead leaves ultimately drop off. On stem, a translucent brown lesion develops at collar region and later becomes water soaked and soft. Soft rot extends from the collar region to rhizomes which first become discoloured and gradually decompose, forming a watery mass of putrifying tissues enclosed by tough ring of rhizome. Roots arising from affected rhizome undergo rotting and softening.

Favourable conditions

Mimegralla flies play a role in the spread of the pathogen

Management

Crop rotation for 3-5 years with non-host crops, Avoid water stagnation

Collect the seed from disease free plots, Rhizome treatment with [Metalaxyl@0.2%](#)

Drench the field with [COC@0.3%](#) or [Metalaxyl@0.2%](#)

Control the Mimegralla insects by 0.05% methyl parathion

2) Leaf spot – *Phyllosticta zingiberi*

Symptoms

Initially disease appears as small, yellowish oval to elongated spots on the leaves. The spots enlarge; turn to white and papery at the centre with dark brown margin surrounded by a yellow halo. Spots are usually isolated but under humid conditions they coalesce with one another developing towards margin forming a big lesion.

Management

Growing zinger in partial shade reduces the disease incidence

Spray [Mancozeb@0.25%](#) or [COC@0.25%](#) during monsoon

