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ACHARYA N.G.RANGA AGRICULTURAL UNIVERSITY

PRACTICAL MANUAL

B. Sc (Ag.)

Course No. 371

DISEASES OF FIELD CROPS AND THEIR MANAGEMENT

Prepared by

**DR. M. JOHNSON
ASSOCIATE PROFESSOR AND HEAD
DEPARTMENT OF PLANT PATHOLOGY
AGRICULTURAL COLLEGE,
MAHANANDI- 518 502**

**DR. P. KISHORE VARMA,
ASSISTANT PROFESSOR,
DEPARTMENT OF PLANT PATHOLOGY
AGRICULTURAL COLLEGE,
ASWARAOPET- 507 301**

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Signature of course in-charge

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INTRODUCTION

Modern agriculture is influenced by increasing human population and the consequent pressure for increased agricultural productivity. In addition, plant pests are increasing worldwide due to globalization and a ready exchange of pests, weeds and disease material with increasing costs to nations. Plant diseases cause significant and economic losses in crops every year. Early detection and diagnosis of plant pathogens can provide more accurate forecasts of disease and improve the precision of fungicide application. Symptoms produced by plant pathogens upon infection are of utmost importance in the identification of the disease at field level. Various pathogens like fungi, bacteria, viruses, phytoplasmas, spiroplasmas, fastidious vascular bacteria, viroids, phanerogamic parasites, etc., are capable of inciting various types of symptoms and signs which form the foremost basis for assessing the cause of a disease.

Symptoms may be classified as local or systemic, primary or secondary, and microscopic or macroscopic. Local symptoms are physiological or structural changes within a limited area of host tissue, such as leaf spots, galls, and cankers. Systemic symptoms are those involving the reaction of a greater part or all of the plant, such as wilting, yellowing, and dwarfing. Primary symptoms are the direct result of pathogen activity on invaded tissues. Secondary symptoms result from the physiological effects of disease on distant tissues and uninvaded organs. Microscopic disease symptoms are expressions of disease in cell structure or cell arrangement seen under a microscope. Macroscopic symptoms are expressions of disease that can be seen with the unaided eye. Specific macroscopic symptoms are classified under one of three major categories: necrotic, hypoplastic, and hyperplastic or hypertrophic. These categories reflect abnormal effects on host cells, tissues, and organs that can be seen without a hand lens or microscope. Main disease symptoms and signs produced by plant pathogens are presented in the following tables.

Symptom	Description	Example
Abscission	Early dropping of leaves, flowers, or small fruits	Early blight of tomato
Anthracnose	Dark, sunken, necrotic spots or patches on leaves, twigs, flowers and fruits, with raised borders	Sorghum anthracnose
Blast	Sudden blighting or death of young leaves, buds, flowers, or fruits	Paddy blast

Blight	Rapid and extensive necrosis of leaves, flowers, twigs or the whole plant giving a burnt appearance	Blossom blight of castor
Blister	Raised wrinkled areas on upper surface of leaf with depressions on the corresponding lower surface	Tobacco mosaic virus
Canker	A definite, dead, often sunken or swollen and cracked area on a stem, limb, trunk, tuber, or root surrounded by living tissues	Root rot of cotton
Chlorosis	Yellowing of normal green tissue due to partial or complete failure of chlorophyll to develop	Aster yellows
Curl	Distortion and crinkling of leaves or shoots resulting from unequal cell growth of opposite sides	Tobacco leaf curl
Damping off	Disease of nursery beds and young seedlings resulting in reduced seed germination and poor stand of seedlings	Damping off of tobacco
Die-back	Progressive death of twigs, branches shoots or roots from tip backwards	Root rot
Dry rot	Firm spongy to leathery or hard decay of stem (branch), trunk, root, rhizome, corm, bulb, or fruit	Dry root rot of citrus
Etiolation	Extended growth typically through production of growth promoting substances	Bakanae disease of rice
Enation	Outgrowths on the lower side of the leaves	Tobacco leaf curl
Epinasty	Downward or outward curling and bending of a leaf or petiole	Fusarium wilt of cotton
Hyperplasia	Overdevelopment or overgrowth of plant cells, tissues, or organs due to increase in number of cells	Mustard white rust
Hypertrophy	Increase in cell size	Safflower rust

Hypoplasia	Underdevelopment of plant cells, tissues, or organs	Viral diseases of plants
Mildews	Diseases where there is a visible mould growth over the plant surface and particularly evident on leaves	Mustard Downy mildew, Blackgram powdery mildew, Areolate mildew of cotton
Necrosis	Death of areas of plant tissue	
Rusts	Powdery sporing pustules on the leaves or stems, usually yellow, orange or brown in colour	Brown rust of wheat, yellow rust of wheat, black stem rust of wheat
Rosetting	Shortening of internodes of shoots and branches, producing a bunchy growth habit	Groundnut rosette
Shot hole	Dead spotting of leaves with diseased tissue dropping out, leaving small holes	Myrothecium leaf spot of blackgram
Smuts	Black, powdery spore masses are produced involving the transformation of some part of the plant	Whip smut of sugarcane, grain smut of sorghum
Streak	Necrosis along veins	Bacterial leaf streak of rice
Stripe	Narrow, elongated, parallel, necrotic lesions especially in leaf diseases of cereals and grasses	Helminthosporium stripe of barley
Wilt	Temporary or permanent drooping of leaves, shoots, or entire plants caused by water loss from tissues exceeding water supply	Redgram wilt

Signs: Besides symptoms, the diagnostician recognizes signs characteristic of specific diseases. Signs are either structures formed by the pathogen or the result of interaction between pathogen and host—e.g., bacterial ooze, pathogen structures like sclerotia, perithecia, etc. formed on the infected tissues. Most frequently encountered signs of pathogen presence and examples of organisms producing them are presented in the following table

Signs of pathogen presence in infected plants		
Acervulus	a flat or saucer shaped bed of short conidiophores with conidia growing under the epidermis or cuticle of host	Cotton anthracnose, Red rot of sugarcane

	plant	
Downy mildew	Dull white, superficial growths of mycelia, sporangiophores and sporangia on under surface of leaves	Downy mildew of bajra
Cleistothecium	completely closed ball like structure with asci distributed at different levels	Many powdery mildew causing fungi
Exudate or ooze	droplets of bacteria or fungal spores usually mixed with host cell decomposition products, found on surfaces of lesions	Bacterial blight of rice, Tundu disease of wheat, Sorghum ergot
Perithecium	Flask shaped sexual fruiting body with an ostiole in which the asci are arranged in a definite layer called hymenium	Sugary disease of sorghum
Powdery mildew	White, powdery, superficial growths of mycelia and conidiophores on surfaces of leaves, stems, flowers, and fruit	Powdery mildew of blackgram and greengram
Pycnidium	Flask shaped dark coloured asexual fruiting body that produces large numbers of conidia and usually partially buried in diseased tissue	Macrophomina root rot of cotton
Sclerotium	brown to black, compact, hard resting body of certain fungi with a rind like covering	Sugary disease of sorghum, stem rot of groundnut
Sorus (Pustule)	a compact mass of spores, or a cluster of sporangia (spore-bearing structures), produced in or on the host by fungi	Black stem rust of wheat, White rust of mustard, Grain smut of sorghum
Sporodochium	a cushion-shaped stroma covered with conidiophores bearing asexual spores; found scattered in leaf, stem, and fruit lesions	Myrothecium leaf spot of cotton, Redgram wilt

Microscopic examination of samples

Examination of diseased plant material under a low power stereoscopic microscope enables the characteristics of disease lesions to be determined. Although some features can be seen under a hand lens, magnifications of upto

x100 are necessary to enable fungal material such as conidiophores, pycnidia, perithecia etc., to be removed and mounted on a slide for more detailed microscopy. Other features such as the presence of bacterial ooze can also be determined.

The use of a compound microscope with magnifications upto x1000 is required to enable detection of pathogens inside plant tissue and for identification of pathogenic fungi on plant surfaces. Small pieces of plant tissue are removed by careful dissection, surface scraping or sectioning and is placed on a glass microscopic slide in a drop of water and covered with a cover slip for identification of plant pathogens.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
RICE

1) RICE BLAST

C.O: *Pyricularia oryzae* (Syn: *P. grisea*)

(Sexual stage: *Magnaporthe grisea*)

Diagnostic 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 and nodes.

- **Leaf blast:** Spindle shaped spots with grey centre and dark brown margin appears on leaves and leaf sheath. Severely infected nursery and field show a burnt appearance.
- **Node blast:** Irregular black areas encircle the infected nodes which may break up leading to the death of all plant parts above the point of infection.
- **Neck blast:** At the flower emergence, the fungus attacks the peduncle which is engirdled, and the lesion turns to brownish-black. 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.

Disease cycle

PSI: Mycelium and conidia in the infected straw and seeds. *Panicum repens*, *Digitaria marginata*, *Brachiaria mutica*, *Leersia hexandra*, *Dinebra retroflexa* serve as collateral hosts in tropics.

SSI: Conidia dispersed through wind

Management

- Use of seeds from a disease free crop
- Remove and destroy the weed hosts in the field bunds and channels.
- Split application of nitrogen and judicious application of nitrogenous fertilizers
- Treat the seeds with Carbendazim or Tricyclazole at 2 g/kg seed
- Spray the main field with Tricyclazole @0.06% or Isoprothiolane@0.1% or Carbendazim@0.1%
- Grow resistant varieties MTU 9992, Sravani, Jaya, Vijaya, Ratna, NLR 9672 & 9674 in different tracts of Andhra Pradesh.

2) Brown spot

C.O: *Helminthosporium oryzae* (Syn: *Drechslera oryzae*)

(Sexual stage: *Cochliobolus miyabeanus*)

Diagnostic symptoms

- The fungus attacks the crop from seedling in nursery to milky stage in main field.
- Symptoms appear as oval to circular lesions (spots) on the coleoptile, leaf blade, leaf sheath, and glumes, being most prominent on the leaf blade and glumes.
- Several spots on leaves coalesce and the leaf dries up.
- Dark brown or black spots also appear on glume which reduces the grain quality and weight.
- Deficiency of potassium predisposes the plants to heavy infection.

Disease cycle

PSI: Conidia in plant debris and seed coat. *Digitaria sanguinalis*, *Leersia hexandra*, *Echinochloa colonum*, *Pennisetum typhoides*, *Setaria italica* and *Cynodon dactylon* serves as collateral hosts

SSI: Wind borne conidia

Management

- Use disease free seeds.
- Remove and destruction of collateral hosts and infected debris in the field.
- Application of recommended doses of fertilizers
- Use of slow release nitrogenous fertilizers is advisable.
- 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.
- Grow disease tolerant varieties viz., Jaya, Ratna, Tellahamsa and Kakatiya.

3) Sheath rot

C.O: *Sarocladium oryzae* (Syn: *Acrocylindrium oryzae*)

Diagnostic symptoms

- Sheath rot occurs usually at the booting stage of the crop.
- Oblong or irregular greyish brown spots appear on the flag leaf.
- Spots enlarge with grey centre and brown margins covering major portions of the leaf sheath.
- The affected sheath and panicles rot with abundant whitish powdery fungal growth inside the leaf sheath.
- Young panicles may remain within the sheath or emerge partially.
- Infected grain discolours and shrivels.

Disease cycle

PSI: Externally seed borne

SSI: Wind borne conidia

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) reduce the sheath rot incidence.

4) Stem rot

C.O: *Sclerotium oryzae* (Sexual stage: *Leptosphaeria salvinii*)

Diagnostic symptoms

- Small black lesions are formed on the outer leaf sheath near the water line and they enlarge and reach the inner leaf sheath also.
- Affected tissues rot with profuse mycelial growth and abundant sclerotia in the rotting tissues.
- The culm collapses and plants lodge.

Disease cycle

PSI: Sclerotia in plant stubbles and soil

SSI: Sclerotia through irrigation water

Management

- Use recommended doses of fertilizer.
- Deep ploughing in summer and burning of stubbles and infected straw
- Draining off the irrigation water and allow the soil to dry
- Avoid flow of irrigation water from infected fields to healthy fields.
- Use of resistant or non-lodging varieties

5) Sheath blight

C.O: *Rhizoctonia solani* (Sexual stage : *Thanetophorus cucumeris*)

Diagnostic symptoms

- The fungus affects the crop from tillering to heading stage.
- Five to six week old leaf sheaths are highly susceptible
- Oval or elliptical or irregular greenish grey spots are noticed on leaf sheaths near water level
- Spots enlarge with an irregular blackish brown or purple brown border with grayish white centre
- Lesions coalesce with each other to cover entire tillers from the water line to the flag leaf leading to the death of whole leaf
- Under severe infection the infection extends to the inner sheaths resulting in death of the entire plant
- Plants heavily infected in the early heading and grain filling growth stages produce poorly filled grain, especially in the lower part of the panicle

Disease cycle

PSI: Sclerotia in soil

SSI: Sclerotia spread through irrigation water

Management

- Avoid excess doses of nitrogenous fertilizers
- Adopt optimum spacing
- Eliminate weed hosts on field bunds
- Avoid flow of irrigation water from infected fields to healthy fields
- Deep ploughing in summer and burning of stubbles.
- Seed treatment with *Pseudomonas fluorescens* @ 10g/kg of seed followed by seedling dip @ 2.5 kg of product/ha dissolved in 100 litres and dipping for 30 minutes.
- Soil application of *P.fluorescens* @ of 2.5 kg/ha after 30 days of transplanting (This product should be mixed with 50 kg of FYM/Sand and then applied).
- Spray Propiconazole@0.1% or Hexaconazole@0.2% or Validamycin@0.2% from 45 days after transplanting at 10 days interval for 3 times depending upon the intensity of disease.
- Grow disease tolerant varieties like Shiva (WGL 3943)

6) False smut

C.O: *Ustilagoidea virens* (P.S: *Claviceps oryzae* - sativa)

Diagnostic symptoms

- Individual grains are transformed into yellow or greenish spore balls of velvety appearance which are small at first and 1 cm or longer at later stages.
- At early stages the spore balls are covered by a membrane which bursts with further growth.
- Ovaries are transformed into large velvety green masses with the fructification of the pathogen
- Usually only a few spikelets in a panicle are affected.

Disease cycle

PSI: Ascospores produced from overwintered sclerotia

SSI: Air borne chlamydospores which do not free easily from the spore balls due to the presence of sticky material

Management

Spray copper oxychloride@0.3% or [carbendazim@0.1%](#) at panicle emergence stage

7) Bacterial leaf blight

C.O: *Xanthomonas oryzae* pv. *oryzae*

Diagnostic symptoms

- The bacterium induces either wilting of plants (Kresek) in seedling stage or leaf blight in grown up plants

- Bacterium infects seedlings systemically and results in wilting of few leaves or death of the entire seedling (Kresek)
- 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 hours. They dry up on the surface leaving a white encrustation.
- If the cut end of leaf is dipped in water, bacterial ooze makes the water turbid
- The affected grains have discoloured spots surrounded by water soaked areas

Disease cycle

PSI: Bacteria over-wintering in seed (husk and endosperm), soil, plant stubbles and debris

SSI: Bacteria spread through irrigation water, rain storms and typhoons

Management

- Destroy affected stubbles by burning or through deep ploughing
- Judicious use of nitrogenous fertilizers
- Avoid clipping of tip of seedling at the time of transplanting.
- Avoid flooded conditions or dry the field (not at the time of flowering)
- Avoid flow of irrigation water from infected to healthy field
- Remove and destroy weed hosts.
- Soak the seeds for 8 hrs in Agrimycin (0.025%) followed by hot water treatment for 10 minutes at 52-54 °C to eradicate the bacterium in the seed
- Spray Streptocycline (250 ppm) along with copper oxychloride (0.3%)

8) Bacterial leaf streak

C.O: *Xanthomonas oryzae* pv. *oryzicola*

Diagnostic symptoms

- Fine translucent streaks appear between the veins of the leaf which enlarge lengthwise and advance over larger veins laterally and turn brown.
- Yellow halo appears around the lesions in highly susceptible varieties
- On the surface of the lesions, bacteria ooze out and form small yellow band-like exudates under humid conditions
- Under severe infection the leaves may dry up

Disease cycle

PSI: Bacteria in the infected seed

SSI: Bacteria spread through irrigation water, rain storms and typhoons

Management

- Destroy affected stubbles by burning or through deep ploughing
- Judicious use of nitrogenous fertilizers
- Avoid clipping of tip of seedling at the time of transplanting.
- Avoid flooded conditions or dry the field (not at the time of flowering)
- Avoid flow of irrigation water from infected to healthy field

- Soak the seed in Streptocycline (250 ppm) followed by hot water treatment at 52 °C for 30 minutes to eradicate seedling infection.
- Spray Streptocycline (250 ppm) along with copper oxychloride (0.3%)
- Use tolerant varieties like IR 20, Krishna and Jagannath

9) Rice Tungro

C.O: Waikavirus: Rice Tungro Spherical Virus (ss RNA)

Badnavirus: Rice Tungro Bacilliform Virus (ds DNA)

Diagnostic symptoms

- Infection occurs both in the nursery and in the main field.
- Plants are markedly stunted
- Yellow to orange discolouration of leaves with interveinal chlorosis
- Yellowing starts from the tip of the leaf and may extend to the lower part of the leaf blade.
- Young leaves are often mottled with pale green to whitish interveinal stripes and the old leaves may have rusty streaks of various sizes
- Tillering is reduced with poor root system
- Infected plants have few spikelets and panicles are small with discoloured grains
- The plants may be killed if infected early

Test for Diagnosis of Tungro disease

Tungro infected plants can be chemically identified by **Iodine Test**.

- Cut ten cm long rice leaf tip in the early morning before 6 A.M.
- Dip the leaf tip for 30 minutes in a solution containing 2g Iodine and 6 g Potassium Iodide in 100 ml of water
- Appearance of dark blue streaks confirms the tungro disease

Disease cycle

PSI: Wild rice, stubbles of infected plants and weed hosts like *Eleusine indica*, *Echinochloa colonum*, *Echinochloa crusgalli* serve as a primary source of inoculum

SSI: Viral particles dispersed through leaf hoppers *Nephotettix virescens*, *N. nigropictus*, *N. parvus*, *N. malayanus* and *Recilia dorsalis*

Management

- Destroy affected stubbles by burning or through deep ploughing
- Destroy weed hosts of the virus and vectors.
- Apply carbofuran granules (170 g/cent) in nursery (10 DAS) to control vector
- Spray Monochrotophos@2.2 ml/lit or Phosphamidan @1ml/lit or Ethophenphos@1.5ml/lit or Neem oil @3 per cent in the main field 15 and 30 days after transplanting to control leaf hoppers.
- Grow disease tolerant cultivars like MTU 9992, 1002, 1003, 1005, Suraksha, Vikramarya and Bharani

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
SORGHUM

1) Anthracnose

C.O: *Colletotrichum graminicola*

Diagnostic symptoms

- The fungus causes both leaf spot (anthracnose) and stalk rot (red rot)
- Small red coloured spots with white center appear on both surfaces of the leaf
- Numerous small black dots are seen on the white centres which are the fruiting bodies (acervuli) of the fungus
- Many lesions coalesce and kill large leaf portions
- Elongate elliptical, red or purple regions with black acervuli are seen in the midrib region
- Circular cankers are produced on the infected stalk and inflorescence
- Infected stem when split open shows continuous or discontinuous discoloration with acervuli

Disease cycle

PSI: Fungus survives on seed and in plant debris. Fungus has wide host range and survives on Johnson grass, Sudan grass, maize, barley and wheat.

SSI: Air borne conidia

Management

- Destroy infected plant debris and collateral hosts
- Treat the seeds with Captan or Thiram @3 g/kg.
- Spray the crop with Mancozeb @0.25% or carbendazim@0.1%
- Grow resistant varieties like SPV 162 and CSV 17

2) Rust

C.O: *Puccinia purpurea*

Diagnostic symptoms

- The fungus affects the crop at all growth stages with high intensity at flag leaf stage
- Small reddish brown flecks appear on the lower surface of the leaf
- Elliptical interveinal pustules (uredosori) appear on both surfaces of leaf which rupture to release reddish powdery masses of uredospores
- Reddish or yellow halo is observed around the pustules
- Teliospores develop later in the old uredosori or in teliosori, which are darker and longer than the uredosori.
- The pustules may also occur on the leaf sheaths and on the stalks of inflorescence.

Disease cycle

PSI: Teliospores in infected plant debris. *Oxalis corniculata* is the alternate host on which pycnial and aecial stages are produced.

SSI: Wind borne uredospores

Management

- Remove and destroy the alternate host *Oxalis corniculata*.
- Spray the crop with Mancozeb @0.25%
- Dusting of sulphur@25 kg/ha
- Grow resistant varieties like CSH 5 and CSV 17

3) Sugary disease

C.O: *Claviceps sorghi* or *Sphacelia sorghi*

Diagnostic symptoms

- The disease is confined to individual spikelets.
- Secretion of honey dew (creamy sticky liquid) from infected florets that attracts large number of insects and ants is the characteristic symptom of the disease
- Infected ear head turns black in appearance due to the colonization by the fungus *Cerebella sorghivulgaris*
- Infected grain is replaced by long (1-2cm), straight or curved, cream to light brown, hard sclerotia under high humid conditions
- White spots can be seen on the soil surface at the base of the affected plants, denoting the drops of honey dew which had fallen on the soil

Disease cycle

PSI: Sclerotia or ergots in soil germinate producing ascospores

SSI: Conidia disperse through air, rain splashes and insects

Management

- Adjust the date of sowing so that the crop does not flower during the periods of high rainfall and high humidity
- Soak the seeds in 2% saline solution to remove 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 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.
- Grow resistant varieties like SPV 191 and CSH 5

4) Grain mold

C.O: *Fusarium*, *Curvularia*, *Alternaria*, *Aspergillus*, *Cheatomium*, *Rhizopus*, *Helminthosporium* and *Phoma*

Diagnostic symptoms

- Infected grains are covered with pink or black mycelial growth of the fungus, if wet weather conditions prevail during grain filling stage of the crop.
- Infected grains disintegrate during threshing process
- Varieties with compact ear heads are highly susceptible

Disease cycle

PSI: Fungi survive as parasites as well as saprophytes in the infected plant debris

SSI: Wind borne conidia

Management

- Adjust the sowing time.
- Seed disinfestation with Thiram@0.3% will prevent seedling infection
- Spray Mancozeb (0.25%) or captan (0.2%) or captan 2g + Aureofungin 200ppm per liter, in case of intermittent rainfall during earhead emergence, a week later and during milky stage.
- Grow resistant varieties like GMRP 4, GMRP 9, GMRP 13 and tolerant varieties like CSV 15

5) Leaf blight

C.O: *Helminthosporium turcicum* or *Trichometasphaeria turcica*

Diagnostic symptoms

- Long elliptical necrotic lesions appear on leaves with straw coloured centre and dark margins
- The straw coloured centre becomes darker with the sporulation of the fungus
- 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.

Disease cycle

PSI: Conidia persist on seed, in soil and plant debris

SSI: Wind borne conidia

Management

- Use disease free seeds.
- Collect and destroy infected plant debris
- Treat the seeds with Captan or Thiram at 4 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
- Tift-Sudan is resistant to this disease

6) Grain smut

C.O: *Sphacelotheca sorghi* or *Sporisorium sorghi*

Diagnostic symptoms

- The disease becomes apparent only at the time of grain formation in the ear.

- Individual grains are replaced by smut sori which can be localized at a particular part of the head or occur over the entire inflorescence.
- Smut sori are dirty white to gray in colour, oval or cylindrical and are covered with a tough white cream to light brown skin (peridium) which often persists unbroken upto threshing.
- The glumes are unaltered and may be found adhering to the sides of the sorus. Ratoon crops exhibit higher incidence of disease.

Disease cycle

PSI: Externally seed borne and systemic disease

SSI: Wind borne chlamydospores

Management

- Use disease free seeds.
- 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.
- Grow resistant varieties like Nandyal and Bilichigan.

7) Charcoal rot

C.O: *Macrophomina phaseolina*

Diagnostic symptoms

- Sudden wilting and death of the diseased plant occurs during moisture stress conditions resulting in lodging
- If the infected stalk is split open, the pith is found to be disintegrated with longitudinal shredding of the tissue into fibers
- The stalk is weak, hollow inside and break easily at the ground level
- Small black sclerotial bodies are seen in the infected tissues
- Premature ripening takes place and the heads are poorly developed

Disease cycle

PSI: Pathogen survives in soil, plant debris and many cultivated and wild plants

SSI: Sclerotial bodies spread through irrigation water and during ploughing

Management

- Thin plant population should be maintained in problematic areas (60,000 plants/ha)
- Collect and burn infected plants along with the trash
- Avoid moisture stress at flowering stage
- Grow resistant varieties like E-36-1, CSV 5, and SPV 126

8) Downy mildew

C.O: *Peronosclerospora sorghi*

Diagnostic symptoms

- Green or yellow colouration of the infected leaves on the upper surface
- Abundant downy whitish growth is produced on the lower surface of the leaves

- As the plant grows, white streaks appear on both the surfaces of the leaves
- Infected leaf tissues turn brown and tear along the streaks causing shredding of the leaves which is the most characteristic symptom (leaf shredding)
- Numerous oospores are found in the shredded leaves

Disease cycle

PSI: Oospores present in the soil and dormant mycelium in the seed

SSI: Wind borne sporangia

Management

- Destroy affected plants by burning before oospore formation
- Crop rotation with pulses and oilseed crops
- Seed treatment with Metalaxyl (Apron 35 SD) @4g/kg seed
- Spray Metalaxyl (Ridomyl MZ) @0.2% or Mancozeb @0.25%
- Grow tolerant varieties like CSH 2, CSV 5 and SPV 101

9) Phanerogamic parasite, Striga

C.O: Striga asiatica and Striga densiflora

Diagnostic symptoms

- Small plant with bright green leaves appears in a cluster of 10-20/host plant
- It is a partial root parasite and appears mainly in rainfed sorghum
- Yellowing and wilting of host leaves
- Infected plants are stunted in growth and may die prior to seed setting upon early infection

Disease cycle

PSI: Seeds remain viable in soil for many years

SSI: Seed disseminated through soil and irrigation water

Management

- Hand weeding of the parasites before flowering
- Mix ethrel with the soil and destroy the germinated striga plants manually
- Spray Fernoxone (sodium salt of 2, 4-D) or Agroxone (MCPA) at 450g/500 liters of water or Praquat@1kg/ha
- 1% Tetrachloro dimethyl phenoxy acetate can be used for instant killing of Striga, if water is in scarce

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
PEARL MILLET AND WHEAT

DISEASES OF PEARL MILLET

1) Downy mildew or Green ear

C.O: *Sclerospora graminicola*

Diagnostic symptoms

- Infected leaves show patches of light green to light yellow colour on the upper surface of leaves and bears white downy growth on the corresponding lower surface
- The yellow discolouration often turns to brown streaks along veins and the leaves shred at the tips only
- In affected plants, ears are completely or partially malformed into twisted green leafy structures; hence the name green ear disease.
- The infection converts various floral parts, including glumes, palea, stamens and pistil into green linear leafy structures of variable length.
- As the disease advances, the green leafy structures become brown and dry bearing masses of oospores

Disease cycle

PSI: Oospores in soil and on the seed

SSI: Sporangia disseminated by air and water

Management

- Selection of seed from healthy crop
- Collect and destroy diseased plants before oospores
- Treat the seeds with Metalaxyl (Apron 35SD)@6g/kg or Thiram or Captan@4g/kg.
- Spray Mancozeb@0.25% or Metalaxyl (Ridomil MZ)@0.2% starting from 30 days after sowing in the field.
- Grow resistant varieties like WCC 75, Mallikarjuna, HB-1 and HB 5

2) Rust

C.O: *Puccinia penniseti*

Diagnostic symptoms

- Minute, round raised reddish brown pustules appear on lower surface of leaves
- Uredosori occur in groups on both surfaces of leaf, leaf sheath, stem and peduncle

- Dark brown to black teliospores are produced late in the season in the uredosori or teleutosori
- Whole leaf may wither completely presenting a scorched appearance to the field

Disease cycle

PSI: Teliospores in infected plant debris. *Solanum melongena* is the alternate host on which pycnial and aecial stages are produced

SSI: Wind borne uredospores

Management

- Removal and destruction of alternate host
- Spray thrice at 15 days interval with Wettable Sulphur@0.3% or Mancozeb@0.2% starting from 21 days after planting

3) Sugary disease

C.O: *Claviceps fusiformis* or *C. microcephala*

Diagnostic symptoms

- Exudation of small droplets of light pinkish or brownish sticky fluid (honey dew) from the infected spikelets
- Infected ovary turns into small dark brown sclerotial bodies larger than the seed with a pointed apex which protrude from the florets in place of grain

Disease cycle

PSI: Sclerotia in soil. *Cenchrus ciliaris* and *C. setigerus* acts as collateral hosts

SSI: Conidia and ascospores dispersed through insects and air

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.
- Immerse the seeds in 10 per cent common salt solution and remove the floating sclerotia
- Eradication of collateral hosts
- Spray with [Ziram@0.2%](#) or [Carbendazim@0.1%](#) or [Mancozeb@0.2%](#) at boot leaf and flowering stage
- Grow resistant varieties like PHB 10 and PHB 14

4) Smut

C.O: *Tolyposporium penicillariae*

Diagnostic symptoms

- Infected florets are transformed into large oval shaped sacs (sori) containing black powder (smut spores)
- Sori are dark brown and larger than normal healthy grains which break easily releasing millions of black smut spore balls

Disease cycle

PSI: Smut spore balls survive in seed and soil

SSI: Wind borne chlamydospores

Management

- Remove and destroy affected earheads
- Treat the seed with Thiram or Captan@3g/kg seed
- Spray Carboxin or Zineb@0.2%

DISEASES OF WHEAT

1) Black stem rust

C.O: *Puccinia graminis tritici*

Diagnostic symptoms

- Oblong, reddish brown uredo-pustules are seen on lower surface of leaves which burst open to expose a mass of brown uredospores
- Entire leaf blade and other affected parts will have a brownish appearance even from a distance
- Linear or oblong, dark brown to black teleutopustules are produced late in the season with epidermal fringes on the infected stem which account for the name black rust
- The diseased plants are stunted and produce small spikes and shrivelled grains, or no grain at all under severe infection

Disease cycle

PSI: Teliospores in plant debris. *Berberis vulgaris* (Barbery) is the alternate host on which pycnial and aecial stages are produced. *Briza minor*, *Bromus patula*, *Brachipodium sylvaticum* and *Avena fatua*, serve as collateral hosts on which the fungus survive in the off-season

SSI: Wind borne uredospores

Management

- Eradication of self sown wheat plants, alternate host and weed hosts
- Avoid late sowing
- Balanced application of nitrogenous fertilizers
- Treat the seed with Plantavax@0.1%
- Spray twice or thrice with Zineb@0.25% or Mancozeb@0.25% or Plantavax@0.1% , at 15 days interval.
- Grow resistant varieties like Kalyanasona, Sonalika, Choti Lerma, Lerma Rojo, Safed lerma, NP 700 & 800.

2) Brown rust

C.O: *Puccinia recondite*

Diagnostic symptoms

- Minute, round, orange or brown uredopustules appear on the leaves and rarely on the leaf sheath and stem which are irregularly distributed
- Late in the season, the telial stage may be found in the same pustule
- The telia are small, oval to linear, black and covered by the epidermis
- Severe rusting of leaves causes reduction in yield

Disease cycle

PSI: Teliospores in plant debris. *Thalictrum javanicum* and *T. flavum* serve as alternate hosts on which pycnial and aecial stages are produced. In Russia, *Isopyrum fumaroides* is known to act as a natural alternate host.

SSI: Wind borne uredospores

Management

- Treat the seed with Plantavax@0.1%
- Spray twice with RH-124, or [Zineb@0.25%](#) or Mancozeb@0.25% at 15 days interval
- Grow resistant varieties like Sonalika, NP 700 & 800, Lerma Rojo and Safed Lerma.

3) Yellow rust

C.O: *Puccinia striiformis*

Diagnostic symptoms

- Bright yellow uredopustules appear in linear rows between the veins of the leaf
- Uredosori are mostly sub-epidermal and are remained covered by the epidermal layer and break only at the time of crop maturity
- Elongated, black, sub-epidermal teleutosori appear late in the season arranged in linear rows.
- Teleutopustules do not break through epidermis for a long time remaining as black crust

Disease cycle

PSI: Fungus overwinter on volunteer wheat plants. *Agropyron semicostatum*, *Bromus catharticus*, *Bromus japonicus* and *Hordeum murinum* serve as collateral hosts

SSI: Wind borne uredospores

Management

- Removal and destruction of weed hosts
- Spray plantavax@0.1% or Propiconazole@0.1%
- Grow resistant varieties like Lerma Rojo, Safed Lerma, Sonalika and Choti Lerma

4) Loose smut

C.O: *Ustilago nuda tritici* or *Ustilago segatum tritici*

Diagnostic symptoms

- The symptoms are evident only at the time of emergence of the panicle from boot leaf.
- All the spikelets in a panicle transform into a mass of black powdery spores
- The infected panicle emerges two days earlier than healthy panicle

- Smut spores are covered with a silvery membrane which ruptures exposing the mass of black spores leaving the bare rachis

Disease cycle

PSI: Dormant mycelium in the seed (Internally seed borne)

SSI: Wind borne chlamydospores and sporidia

Management

- Hot water treatment (Jensen, 1908): Soak the seed in cold water for 4 hours and then immerse the seed in hot water at a temperature of 132 °F or 52°C for about 10 minutes. Dry the seed in shade before sowing.
- Solar seed treatment (Luthra and Sattar, 1934): Soak the seed in water for 4 hours (8 AM to 12 Noon) and expose the seed to the hot sun for 4 to 5 hours (from 12 Noon to 5 PM) on cement or rocky surface. This can be practiced in the areas where the summer temperatures are high (42-44°C)
- Anaerobic seed treatment (USA): Soak the seeds for 2-4 hours in water between 60-70°F and keep the moist seeds in air tight containers for 65-70 hours and there after dry the seed.
- Treat the seed with systemic chemicals like vitavax@0.2% or Benlate@0.2%
- Grow resistant varieties kalyanasona, PV 18, WG 307 and HD 450.

5) Karnal bunt

C.O: *Neovossia indica*

Diagnostic symptoms

- Few grains in a spike are infected
- Infection mostly starts from the embryonal end and spreads along the grain suture. Grain is reduced to black shiny sac of teliospores under severe infection.
- As the grains mature the outer glumes spread and the inner glumes expand, exposing the bunted grains
- The bunt balls are first enclosed by the pericarp but when it bursts the masses of bunt spores are exposed
- The bunt affected plants emits a foul smell due to the presence of a chemical, Trimethyl amine

Disease cycle

PSI: Teliospores in soil and plant debris

SSI: Wind borne primary and secondary sporidia

Management

- Use disease free seed for sowing
- Judicious application of nitrogenous fertilizers
- Treat the seed with copper carbonate or Thiram@3g/kg seed
- Spray carbendazim@0.1% or carboxin@0.2% or Mancozeb@0.25%
- Grow tolerant varieties, viz., WL 1562 and HD 2281

6) Leaf blight

C.O: *Alternaria tritricina*

Diagnostic symptoms

- Reddish brown oval spots with bright yellow margin appear on older leaves
- Several spots coalesce favourable conditions causing drying of leaves
- Heavily infected fields display a burnt appearance even from a distance

Disease cycle

PSI: Conidia in plant debris and seed

SSI: Wind borne conidia

Management

- Soak the seeds in water for 4 hrs followed by 10 min. dip in hot water at 52°C.
- Spray the crop with Mancozeb@0.25% or Propiconazole@0.1%

7) Soil borne mosaic

C.O: Soil borne wheat mosaic virus (ss RNA)

Diagnostic symptoms

- Irregular patches of yellow or pale green areas appear on young leaves
- Moderate to severe stunting of affected plants
- Reduced tillering and lower kernel weight

Disease cycle

PSI: Virus survive in dry soil for atleast 8 years

SSI: Spread through the zoospores of the fungus *Polymyxa graminis*

Management

- Fumigation of soil does kills the vector, but is not practical in most cases
- Grow resistant varieties like Agripro Cooper and Coker 9312

8) Tundu or Yellow slime disease

C.O: *Clavibacter tritici* + *Anguina tritici* (Nematode)

Diagnostic symptoms

- Twisting of the stem, distortion of the ear head and rotting of the spikelets with a profuse oozing of yellow liquid from the affected tissues
- The earhead becomes chaffy and the kernels are replaced by dark nematode galls which contain the bacterium
- The infected plants produce more tillers than the healthy ones
- Early emergence of ears in the nematode infected plants which is about 30 to 40 days earlier than the healthy ones

Disease cycle

PSI: Seed contaminated with nematode galls

SSI: Bacterial ooze disseminated through rain splashes and nematode juveniles

Management

- Sow gall free seeds. Separate the galls from the seed by floating in brine at 160 g of sodium chloride in liter of water.
- Spray the crop with streptocycline, 1g in 10 liters of water

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
FINGER MILLET AND MAIZE

DISEASES OF FINGER MILLET

1) Blast

C.O: *Pyricularia grisea*

Diagnostic symptoms

- Infection may occur at all stages of plant growth. There are three stages in disease development.
- Leaf blast: The disease is characterized by spindle shaped spots with gray centres surrounded by reddish brown margins appear on the leaves
- Node blast: Infection on stem causes blackening of the nodal region and the 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 rain set at all. If grain setting occurs, they are shrivelled and reduced in size.

Disease cycle

PSI: seed-borne conidia and also through diseased plants, stubbles and weeds

SSI: Wind borne conidia

Management

- Destroy collateral hosts and infected plant debris
- Treat the seeds with Captan or Thiram@3g/kg or Carbendazim at 2 g/kg.
- Spray twice with Carbendazim@0.2% or Iprobenphos (IBP)@0.1%, first spray immediately after symptom appearance and second spray at flowering stage.
- Grow resistant varieties like Ratnagiri, Padmavati, Gowtami and Godavari

2) Smut

C.O: *Melanopsichium eleusinis*

Diagnostic symptoms

- Few scattered grains in a head are transformed into globose galls of 5-15 mm diameter, greenish at first and turning black at maturity
- The sorus ruptures releasing black mass of spores.

Disease cycle

PSI: Chlamydospores in the infected seed and soil

SSI: Wind borne sporidia

Management

- Collect and destroy affected earheads
- Spray Carboxin@0.1%

3) Mosaic

C.O: Sugarcane mosaic virus

Diagnostic symptoms

- Prominent symptoms are noticed from 4-6 weeks after planting
- Leaves become chlorotic, mottled, plants stunted and
- Inflorescence may become sterile and ears, if formed are chaffy.
- Plants wither prematurely under severe infection

Disease cycle

PSI: Viral particles in infected plants. Maize, sugarcane and sorghum also serve as host for Sugarcane mosaic virus

SSI: Virus transmitted by aphid vectors, viz., *Rhopalosiphum maydis*, *Aphis gossypii* and *Myzus persicae*.

Management

- Apply phosphatic fertilizers
- Rogue out infected plants and destroy
- Spray monochrotophos@1.5ml/lit or dimethoate@2ml/lit to control the vector

DISEASES OF MAIZE

1) Turcicum leaf blight

C.O: ***Helminthosporium turcicum***

Diagnostic symptoms

- Long elliptical tan coloured lesions appear on the leaves measuring 2.5 to 25 cm in length and upto 4 cm in width.
- Lesions are straw to grayish brown colour in the centre with dark brown margins which coalesce to form bigger spots and gives blighted appearance to leaves
- The surface is covered with olive green velvety masses of conidia and conidiophores
- Under high humidity the whole leaf area becomes necrotic and plant appears as dead. Lesions may be extended to husk

Disease cycle

PSI: Fungus survives as conidia in plant debris, seed and collateral hosts. The fungus is externally seed borne. Pathogen also infects Sudan grass, Johnson grass, sorghum, wheat, barley, oats and sugarcane

SSI: Wind borne conidia

Management

- Treat the seeds with Captan or Thiram at 4 g/kg or Mancozeb@2.5g/Kg seed
- Spray Mancozeb@0.25% or Propiconazole@0.1%

2) Post flowering stalk rot (Black bundle disease and late wilt)

C.O: *Cephalosporium acremonium*/ *Cephalosporium maydis*

Diagnostic symptoms

C. acremonium

- Purpling of leaves and stalks at dough stage
- Restricted blackening of vascular bundles can be observed in the stalk with shredding of the internodal pith region
- Barren plants, excessive tillering and multiple ears are the other diagnostic symptoms

C. maydis

- Dull green appearance of the leaves after flowering stage which later dry up
- The lower internode turns discoloured, become reddish brown, shrunken and soft, and subsequently becomes dry and hollow
- Split opened stalks reveals reddish brown vascular bundles

Disease cycle

PSI: Pathogens survive in soil, plant debris and seed

SSI: Wind borne conidia

Management

- Avoid water stress at flowering
- Treat the seed with Thiram or captan@3g/kg seed
- Grow resistant varieties like DHM-103 and DHM 105

3) Charcoal rot

C.O: *Macrophomina phaseolina* (Sclerotial stage: *Rhizoctonia bataticola*)

Diagnostic symptoms

- Charcoal rot commonly attacks plants approaching maturity
- Brown, water soaked lesions on the roots that later turn black in colour
- Gray streaks develop on the stem surface of lower internodes leading to premature ripening, shredding and breaking of the crown
- Split open stalks have numerous black sclerotia on vascular strands

Disease cycle

PSI: Sclerotia in soil

SSI: Sclerotia through irrigation water

Management

- Irrigate the crops at the time of earhead emergence to maturity.
- Treat the seeds with Carbendazim or Captan at 2 g/kg.
- Grow disease resistant varieties, viz., DHM 103, DHM 105 and Ganga Safed 2.

4) Banded leaf and sheath blight

C.O: *Rhizoctonia solani*

Diagnostic symptoms

- Large, discoloured areas alternating with irregular dark bands appear on leaves and leaf sheaths
- Severe infection leads to blotching of the leaf sheath as well as leaves which may extend to silk, glumes and kernels under favourable conditions
- Symptoms also appear on stalk and the internodes break at the point of infection

Disease cycle

PSI: Sclerotia in soil

SSI: Sclerotia through irrigation water

Management

- Collect and destroy crop debris
- Spray Hexaconazole@0.2% or propiconazole@0.1%

5) Downy mildew

C.O: *Peronosclerospora sorghi* / *P. philippinensis*

Diagnostic symptoms

- Chlorotic streaks on the upper surface of leaves with white downy growth on the corresponding lower surface
- Affected leaves often tear linearly along the streaks causing leaf shredding
- Stunted and bushy appearance of plants
- The downy growth is also seen on bracts of green unopened male flowers in the tassel
- Partial or complete malformation of the tassel into a mass of narrow, twisted leafy structures
- Proliferation of axillary buds on the stalk of tassel as well as the cobs is very common (Crazy top)

Disease cycle

PSI: Oospores in soil and plant debris. *Sorghum bicolor* and *Sorghum halapense* serves as collateral hosts

SSI: Wind borne sporangia

Management

- Collect and destroy plant debris
- Remove and destroy collateral hosts
- Treat the seed with Metalaxyl (Apron 35SD) at 4g/kg
- Spray the crop, 3-4 times, with Metalaxyl MZ (Ridomil MZ)@0.2% starting from 20th day after sowing.
- Grow resistant hybrids like DHM-1, DHM-103, DMR-5 and Ganaga II.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
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SUGARCANE

1) Red rot

C.O: *Colletotrichum falcatum* (Sexual stage: *Glomerella tucumanensis*)

Diagnostic symptoms

- Margins and tips of the leaves wither and the leaves in the crown droop within four to eight days
- Elliptical lesions with dark red margins and straw coloured centers with minute black dots appear on midrib which breaks at the point of infection
- Slit opened canes reveals reddening of internal tissues with cross-wise white patches which are the typical symptoms of red rot
- Split open stems emit a characteristic acidic-sour odour
- Infected stalk becomes hollow and covered with white mycelial growth
- The rind shrinks longitudinally with minute black, velvety fruiting bodies protruding out of it

Disease cycle

PSI: The fungus is sett-borne. The fungus also persists in the soil on the diseased clumps and stubbles as chlamydospores and dormant mycelium

SSI: Conidia through irrigation water and cutting tools

Management

- Remove and destroy infected plant debris, stubbles and trash.
- Deep tillage to incorporate the left over debris.
- 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
- Grow resistant varieties like CO 6907, CO 7219 and CO 8013

2) Whip smut

C.O: *Ustilago scitaminea*

Diagnostic symptoms

- The central shoot is converted into a long whip-like, dusty black structure
- In early stages, whip like structure is covered by a thin, white papery membrane which ruptures on maturity releasing millions of tiny black smut spores

- The smutted clumps produce mummified arrows in which lower portion consists of normal inflorescence with typical flowers and the upper portion of the rachis is converted into a typical smutted whip
- The ratoon crop is severely affected

Disease cycle

PSI: Chlamydospores in infected setts, soil and plant debris

SSI: Chlamydospores and sporidia dispersed through air

Management

- Plant healthy setts taken from disease free area.
- Remove and destroy the smutted clump (Collect the whips in a thick cloth bag/polythene bag and immerse in boiling water for 1 hr to kill the spores)
- Treat the setts in hot water at 50°C for 2 hours
- Grow resistant varieties like Co 6806 and Co 62175

3) Wilt

C.O: *Cephalosporium sacchari*

Diagnostic symptoms

- Symptoms are visible in the canes of 4-5 months age
- Infected canes wither in groups
- The affected plants are stunted with yellowing and withering of crown leaves
- The midribs of all leaves in a crown generally turn yellow, while the leaf lamina may remain green
- Reddish discolouration of pith region of stalk with longitudinal red streaks passing from one internode to another
- Stem develop hollowness in the core or pith with spindle shaped cavities tapering towards the nodes develop in each internode
- Infected canes emit a disagreeable odour, with lot of white mycelial threads of the fungus covering the cavity
- Weight of the cane is reduced due to hollow canes

Disease cycle

PSI: Fungus in infected seed setts and soil

SSI: Conidia dispersed through wind, rain and irrigation water

Management

- Select the seed material from the disease-free plots
- Avoid the practice of ratooning in diseased fields
- Burn the trash and stubbles in the field
- Treat the setts in hot water at 50°C for 2 hours followed by dipping in 0.05% Carbendazim for 15 minutes
- Dip the setts in 40ppm Boron or Manganese for 10 minutes
- Grow resistant varieties like CO 617 and BP 17.

4) Ring spot

C.O: *Leptosphaeria sacchari*

Diagnostic symptoms

- Reddish brown oval or spherical spots with straw coloured centers are seen on the foliage
- In the central straw coloured portion many pin head sized fruiting bodies (perithecia) develop in concentric rings
- Leaves collapse and dry prematurely under severe infection

Disease cycle

PSI: Perithecia in infected seed setts and plant debris

SSI: Ascospores disseminated through wind, rain and irrigation water

Management

- Select the seed material from the disease-free plots
- Judicious use of nitrogenous fertilizers
- Burn the trash and stubbles in the field
- Spray thrice with Copper oxy chloride@0.4% or carbendazim@0.1% or Mancozeb@0.3% at 7 days interval starting from disease initiation

5) Grassy shoot

C.O: Phytoplasma

Diagnostic symptoms

- The disease symptoms are usually seen two months after planting.
- Numerous lanky tillers are produced from the base of the affected shoots
- Bushy appearance of the plant due to the reduction in the length of internodes and premature proliferation of axillary buds
- In a diseased clump one or two thin, weak and small canes are produced
- In plant crop, young leaves of diseased plants are white (Albino) and the buds on such canes are usually white, papery and abnormally elongated

Disease cycle

PSI: Pathogen in the planting material. Sorghum serves as a natural collateral host

SSI: Transmitted through aphids (*Aphis maidis*, *Rhopalosiphum maidis*) and leaf hopper (*Proutista moesta*)

Management

- Plant disease free setts
- Remove and burn the infected clumps periodically
- Avoid ratooning in problematic areas
- Hot Water Treatment of setts at 52°C for 30min or Aerated Steam Therapy at 50°C for 1 hr followed by steeping in fungicidal solution of carbendazim@0.05% for 15 minutes.
- Control vector by spraying Malathion or Dimethoate@2ml/lt

6) Mosaic

C.O: Sugarcane Mosaic Virus

Diagnostic symptoms

- Chlorotic or yellowish stripes alternating with normal green portion of the leaf appears on younger foliage
- Chlorotic area considerably increases over the normal green area and yellow stripes appear on the leaf sheath and stalks as the infection increases
- Elongated necrotic lesions are produced on the stalks and stem splitting occurs
- The necrotic lesions also develop on the internodes and the entire plant becomes stunted and chlorotic

Disease cycle

PSI: Sett borne disease. The virus also infects maize and sorghum

SSI: The disease mainly spreads through sap and aphids, viz., *Rhopalosiphum maidis*, *Toxoptera gramineum* and *Melanaphis sacchari*

Management

- Rogue out the diseased clumps periodically
- Select setts from the healthy fields as the virus is sett-borne
- Treat the setts in hot water as follows: 52°C for 20 minutes on the first day, 57.3°C for 20 minutes on the second day and 57°C for 20 minutes on the third day or Aerated Steam Therapy at 56°C for 3 hrs.
- Control vector by spraying malathion or dimethoate @ 2 ml/lit

7) Ratoon stunt

C.O: *Liesonia xyli* (Xylem limited fastidious bacteria)

Diagnostic symptoms

- Diseased clumps display stunted growth, reduced tillering, thin stalks with shortened internodes and yellowish foliage (mild chlorosis)
- When mature canes are split open, vascular bundles appear discoloured
- In young canes, pink colour is seen in the form of minute pin head like areas near the nodes
- The disease reduces the length, girth and the number of canes per clump.

Disease cycle

PSI: Sett borne disease. Maize, sorghum, Sudan grass and *Cynodon* serve the collateral hosts of the pathogen

SSI: Disease spreads through cane harvesting implements and seed setts

Management

- Select the setts from disease free field
- Remove and burn the clumps showing the disease
- Sterilization of cutting knives with lysol or any other antiseptic solution
- Hot air treatment of setts at 54°C for 8 hours or hot water treatment at 50°C for 2 hrs or aerated steam treatment at 50°C for 1 hour

8) Rust

C.O: *P. melanocephala*, *P. kuehnii*

Diagnostic symptoms

- Minute, elongated, yellow spots (uredia) appear on lower surface of young leaves which subsequently appear on upper surface also
- The pustules turn brown on maturity and are also seen on leaf sheath
- Late in the season, dark brown to black telia appear on the lower surface of leaves
- The disease affects cane yield and reduces juice quality

Disease cycle

PSI: Uredospores survive in infected stubbles in soil and on collateral hosts like *Erianthus fulvus* and *Saccharum spontaneum*

SSI: Wind borne uredospores

Management

- Remove and destroy collateral hosts
- Spray Tridemorph@0.1% or Mancozeb@0.3%, twice or thrice based on disease severity

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF TOBACCO

1. Black shank

C.O: *Phytophthora parasitica* var. *nicotianae*

Diagnostic Symptoms

- The pathogen may affect the crop at any stage of its growth.
- The disease infects chiefly the roots and base of the stem.
- In the transplanted crop, the disease appears as minute black spot on the stem and often girdling occurs.
- The upward movement leads to development of necrotic patches on the stems, shrink and stem shrivels and plant wilts.
- When the affected stem is split open, the pith region is found to be dried up in disc-like plates showing black discoloration.
- On the leaves large water soaked spots appear during humid weather, which enlarge to blight the leaves.
- Seedlings in the nursery show **black discoloration of the stem** near the soil level and blackening of roots, leading the wet rot in humid condition and seedling blight in dry weather with withering and drying of tips.

Disease cycle

P.S.I: The primary infection is by means of oospores and chlamydospores in the soil.

S.I.- by sporangia or zoospores disseminated by wind or water.

Management

- Collect and burn plant residues and debris.
- Select disease free seedlings for transplanting.
- Remove and destroy the affected plants in the field.
- Spot application of Bordeaux mixture@0.2% or copper oxy [chloride@0.2%](#) or [metalaxyl@0.2%](#) in planting points offer good protection.
- Burn the seed beds with paddy husk or groundnut shell at 15-20 cm thick layer.
- Provide adequate drainage in the nursery.
- Leaf blight and black shank phases of the disease can be effectively managed by two
- Sprays of [metalaxyl@0.2%](#) or 3-4 sprays of copper oxy [chloride@0.2%](#).

2. Damping off

C.O: *Pythium aphanidermatum*

Diagnostic Symptoms

- The fungus may attack the seedling at any stage in the nursery.
- Sprouting seedlings are infected and wither before emergence from the soil (Pre-emergence damping off).
- Water soaked minute lesions appear on the stems near the soil surface, soon girdling the stem, spreading up and down in the stems and within one or two days stem may rot leading to toppling over of the seedlings (Post-emergence damping off).
- The young seedlings in the nursery are killed in patches.
- A thick weft of mycelium may be seen on the surface of the soil.

Disease cycle

P.S.I: is from the soil-borne oospores

SSI-through sporangia and zoospores transmitted by wind and irrigation water

Management

- Raised seed beds of 15-45 cm height should be formed.
- Avoid overcrowding of seedlings by using optimum seed rate of 3-3.5 kg/ha (1 to 1.5g/2.5m²)
- Provide adequate drainage facility and avoid excess watering of the seedlings.
- Burn the seed beds with paddy husk or dry twigs before sowing.
- Drench the seed bed with 0.4% per cent Bordeaux mixture or 0.2 per cent Copper oxychloride, two days before sowing.
- Spray the nursery beds twice with 0.4% Bordeaux mixture or 0.2 Copper oxychloride or Metalaxyl or Mancozeb at 20 and 30 days after germination.
- Soil incorporation of *Trichoderma viride* or *T. harzianum* in seed beds one week before sowing and thereafter BM should be sprayed at 0.4 per cent.

3. Frog eye spot

C.O: *Cercospora nicotianae*

Diagnostic Symptoms

- The disease appears mostly on mature lower leaves as small ashy grey spots with brown border.
- The typical spots has a white center, surrounded in succession by grey and brown portions, surrounded by a dark brown to black margin, resembling the eyes of a frog.
- Several spots coalesce to form large necrotic areas, causing the leaf to dry up from the margin and wither prematurely.
- Both yield and quality are reduced greatly.

- The disease may occur in the seedlings also, leading to withering of leaves and death of the seedlings.

Disease cycle

P.S.I: from plant debris in the soil.

S.S.I: through wind-borne conidia.

Management

- Remove and burn plant debris in the soil.
- Avoid excess nitrogenous fertilization.
- Adopt optimum spacing.
- Regulate irrigation frequency.
- Spray the crop with 0.2 per cent Bordeaux mixture (20g copper sulphate + 20g lime in 10 liters of water) or Thiophanate Methyl or carbendazim or benomyl@0.1% or Zineb @ 0.2%. Spray 2-3 times of systemic fungicides or 4-6 times with non-systemic fungicides at weekly interval.

4. Brown spot

C.O: *Alternaria alternata*

Diagnostic Symptoms

- Brown spots with concentric circles are formed on leaves.
- Many spots may coalesce resulting in leaf blight.

Disease cycle

P.S.I: infected crop debris as dormant mycelium.

S.S.I: mainly by air-borne conidia.

Management

- Remove and burn plant debris in the soil.
- Spray once or twice with fungicides like 0.4% Bordeaux mixture or zineb@0.2% or Copper oxy chloride@0.2% or [Mancozeb@0.25%](#)

5. Mosaic

C.O : Tobacco Mosaic Virus (TMV) or Nicotiana virus I

Diagnostic Symptoms

- The disease appears as light discoloration along the veins of the youngest leaves.
- Soon the leaves develop a characteristic light and dark green pattern, the dark green areas are usually associated with the veins.
- The dark green areas later develop into irregular blisters due to more rapid growth.
- The plants that become infected early in the season are usually very much stunted with small, chlorotic, mottled and curled leaves.
- In severe infections, the leaves are narrowed, puckered, thin and malformed beyond recognition.
- Later, dark brown necrotic spots develop under hot weather and this symptom is called "Mosaic burn" or "Mosaic scorching".

Disease cycle

P.S.I: The virus has a wide host range, affecting nearly 50 plant species belonging to nine different families.

S.S.I: The virus is sap-transmissible and enters the host through wounds. The virus is not seed transmitted in tobacco but tomato seeds transmit the virus.

Management

- Remove and destroy infected plants.
- Keep the field free of weeds which harbour the virus.
- Wash hands with soap and running water before or after handling the plants or after weeding.
- Prohibit smoking, chewing and snuffing during field operations.
- Spray the nursery and main field with leaf extracts of *Bougainvillea* or *Basella alba* at 1 litre of extract in 150 litres of water, two to three times at weekly intervals.
- Adopt crop rotation by growing non-host plants for two seasons.
- Spray tannic acid 1% at 30th, 40th and 50th day after planting
- Grow resistant or tolerant varieties like CTRI special (M.R), Jayasree (M.R), Virginia Tobacco 1158, Prabhat, Gautami, Blankat 1, Godavari special, TMV RR-2, 3, 4, 6.

6. Leaf curl

C.O: Tobacco leaf curl virus or Nicotiana Virus 10 (*Ruga tabaci*)

Diagnostic Symptoms

- Disease usually appears in the field 4-6 weeks after transplanting and is characterized by downward curling of young leaves.
- Leaf margins turn downwards and come together at the bottom exposing the middle upper surface of the leaf blade.
- The thickened leaf blade usually exhibits vein clearing symptoms.
- As the disease advances the plant becomes dwarfed and most of the leaves curl.
- Inflorescence is greatly condensed and the veins of the calyx are thickened and turn green.
- Enations or leaf like outgrowths along the veins are also common.

Disease cycle

P.S.I: The virus has wide host range infecting 63 crops species belonging to fourteen families. The virus is not transmissible through sap or seed. It is graft-transmissible.

S.S.I: The whitefly, *Bemisia tabaci* is the vector responsible for transmission in the field.

Management

- Remove and destroy the infected plants.
- Rogue out the reservoir weed hosts which harbour the virus and whiteflies.
- Avoid growing solanaceous crops like tomato near tobacco fields.
- Spray chloropyriphos@2.5ml/lit or monocrotophos or Methyl demeton@1.5 ml/lit to control the vectors.

7. Phanerogamic parasite

C.O: Orobanche or Broom rape - *Orobanche cernua* var. *desertorum*

Diagnostic Symptoms

- The affected tobacco plants are stunted and show withering and drooping of leaves.
- Plants show wilting symptoms during day time which usually recover at nights.
- The young shoot of the parasite emerges from the soil at the base of the plants 5-6 weeks after transplanting.
- Normally, it appears as clusters of 50 shoots around the base of a single tobacco plant.
- The plants which are attacked very late exhibit no external symptoms but the quality and yield of leaves are reduced.

Disease cycle

P.S.I: from the seeds in the soil.

S.S.I: The seeds spread from field to field by irrigation water, animals, human beings and implements.

Management

- Rogue out the tender shoots of the parasite before flowering and seed set.
- Deep ploughing in the off-season helps in burying the seeds of the parasite deep into the soil
- Spray 0.1 per cent Allyl alcohol or 25 per cent Copper sulphate.
- Grow decoy or trap crops like chilli, mothbean, sorghum or cowpea to stimulate seed germination and kill the parasite.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
GROUND NUT

1. Tikka leaf spots

C.O: Early leaf spot: *Cercospora arachidicola*

(Sexual Stage: *Mycosphaerella arachidis*)

Late leaf spot: *Phaeoisariopsis personata*

(Sexual stage: *Mycosphaerella berkeleyi*) (Syn: *Cercosporidium personatum*)

Diagnostic Symptoms

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

Early leaf spot (*Cercospora arachidicola*):

- Symptoms usually appear within 35 DAS.
- The leaf spots are irregularly circular (1-10 mm in diameter), 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.

Late leaf spot (*Cercosporidium personatum*):

- Leaf spots due to *C. personatum* 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.
- The spots are deep black in colour with clusters of conidiophores bearing conidia, arranged in concentric manner.
- Severely diseased leaves dry up and results in heavy defoliation.
- In both the cases generally lower leaves are first attacked but later on the disease spreads to other leaves also.
- Both the fungi produce lesions also on petiole, stem and pegs.

Disease cycle

P.S.I: is by ascospores or conidia liberated from infected plant debris.

S.S.I: by windblown conidia. Rain splash also helps in the spread of conidia.

Management

- Remove and destroy the infected plant debris.
- Eradicate the volunteer groundnut plants.
- Crop rotation with millets
- 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).

2. Rust

C.O: *Puccinia arachidis*

Diagnostic Symptoms

- The disease attacks all aerial parts of the plant.
- Small, minute pale yellow to light brown pustules (uredosori) appear on the lower surface of leaves.
- Corresponding to the sori, small, necrotic, brown spots appear on the upper surface of leaves.
- The rust pustules may be seen on petioles and stem.
- Late in the season, brown teliosori, as dark pustules, appear among the necrotic patches.
- In severe infection lower leaves dry and drop prematurely. The severe infection leads to production of small and shriveled seeds.

Disease cycle

P.S.I: The pathogen survives as uredospores on volunteer groundnut plants. The fungus also survives in infected plant debris in soil. The uredospores also spread as contaminants of seeds and pods. The fungus also survives on the collateral hosts like *Arachis marginata* and *A. prostrata*.
S.S.I: mainly through wind-borne inoculum of uredospores. Rain splash and implements also help in dissemination.

Management

- Avoid mono-culturing of groundnut.
- Remove volunteer groundnut plants and collateral hosts.
- Spray Chlorothalonil or Tridemorph@0.2%.
- *Arachis glabarata* can be used in breeding programme.

3. Pepper leaf spot or leaf scorch

C.O: *Leptosphaerulina crassiasca*

Diagnostic Symptoms

Leaf spot: Minute, numerous, irregular to circular, dark brown to black spots appear on lower leaves. Such spots appear on both sides of the leaflet; but are more common on upper surfaces.

Leaf scorch: The most common symptom frequently develops on the tips and occasionally on the margins of the leaflets. The wedge shaped lesions have a bright yellow zone along the periphery of their advancing margins.

Disease cycle

P.S.I: Ascospores or Ascus
S.I: Wind borne ascospores

Management

- Remove and destroy the infected plant debris.
- Eradicate the volunteer groundnut plant
- 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.

4. Stem rot

C.O: **Sclerotium rolfsii**

Diagnostic Symptoms

- Mostly collar region of stem is affected.
- Sudden wilting of branches occurs.
- Leaflets become chlorotic to light green and then turn brown. Subsequently the adjacent branches become infected and wilt.
- White mycelium and brown to dark brown sclerotia are seen on the affected stems in advanced stages of infection.
- Pegs, roots, pods and kernels are also affected.
- A web of white mycelium is seen on pods leading to rotting of pods. On the kernels, bluish-gray or ashy blue spots can be observed on the testa.

Disease cycle

P.S.I: The fungus is seed and soil borne.

S.S.I: occurs through sclerotia by implements and irrigation water.

Management

- Avoid mono-culturing of groundnut.
- Deep summer ploughing to incorporate plant debris deep into the soil and to expose the dormant structures of fungi to direct sunlight.
- Grow Bahia grass as a trap crop for stem rot in groundnut
- Seed treatment with **Thiram@0.3%** followed by *Trichoderma viride*@4g/kg seed
- Multiply *T.viride* in farm yard manure for 15 days (2kg *T.viride* formulation + 50kg FYM) and apply to soil before sowing.

5. Bud necrosis or Peanut spotted wilt or groundnut ring mosaic

C.O: **Tomato spotted wilt virus/Peanut bud necrosis virus (Tospovirus)**

Diagnostic Symptoms

- The newly emerging leaves are small, rounded or pinched inwards and rugose with varying patterns of mottling and minute ring spots.
- Necrotic spots and irregularly shaped lesions develop on leaves and petioles. Stem also exhibits **necrotic streaks.**
- As the plant matures, it becomes generally stunted with short internodes and short axillary shoots.
- Leaflets 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.
- Seeds produced are abnormally small and wrinkled with the dark black lesions on the testa.

Disease cycle

P.S.I: The virus perpetuates in the weed

S.S.I: The virus is transmitted by thrips, viz., *Thrips palmi*.

Management

- 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

6. Peanut Stem necrosis disease (PSND)

C.O: **Tobacco streak virus (Ilarvirus)**

Diagnostic Symptoms

- Symptoms appear on young leaves as necrotic lesions and **veinal necrosis**.
- The necrotic lesions on the stem later spread upwards killing the bud.
- Majority of the plants infected within a month after sowing die due to necrosis.
- Some early infected plants are killed leaving gaps in the field.
- The surviving plants show stunting, small, clumped leaves with or without chlorosis.

Disease cycle

P.S.I: The virus perpetuates in the weed hosts as **infected pollen grains**.

S.S.I: virus is transmitted by thrips viz., *Frankliniella schultzei*, *Scirtothrips dorsalis*, *Thrips palmi*, etc.

Management

- Grow resistant varieties like Kadiri 3, Kadiri 4, Vemana, ICGS-11, etc.
- Adopt spacing of 15x15 cm.
- Intercropping with Bajra.
- Spray [monochrotophos@1.6ml/lt](#) or dimethoate@2ml/lt

7. Kalahasti malady

C.O: **Tylenchorhynchus brevilineatus**

Diagnostic Symptoms

- Small, black or brownish yellow lesions appear on the pegs, pod stalks and on young developing pods.
- Pod stalks are much reduced in length and in advanced stages of the disease the entire pod surface becomes discoloured.
- Discolouration is also seen on roots.
- Affected plants are stunted and greener than normal foliage.
- The size of the seeds in the infected pods is reduced.
- The disease is severe in sandy soils or light soils.

Disease cycle

P.S.I: Nematodes present in the soil or on the pods.

S.S.I: Nematodes spread through irrigation water, rain water and during ploughing

Management

- Soil treatment with aldicarb and carbofuran is effective in reducing soil population.
- Use resistant varieties like Tirupathi-3 (TCGS 320), Kalahasthi (TCGS 1518) and Prasuna.
- Deep ploughing and leaving fallow during summer
- Apply neem cake @2.5t/ha or FYM@10t/ha or Poultry manure@5t/ha
- Apply carbofuran granules once in 4 years at 4 kg a.i. (133 kg) per hectare 25-30 days after sowing along with irrigation water.
- Apply Sebuphos 10G granules at 40kg/ha, 30 days after sowing in between rows followed by irrigation.
- The disease incidence is less in groundnut fields sown after rice or marigold.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
SAFFLOWER AND SUNFLOWER

DISEASES OF SAFFLOWER

1. Leaf blight

C.O: *Alternaria carthami*

Diagnostic Symptoms

- Dark brown lesions measuring 2-5mm in diameter are first found on hypocotyls and cotyledons.
- The disease is severe on leaves and occasionally attacks stem and flowers.
- The centre of the spot is light brown with a dark brown margin.
- Elongated black lesions can be seen on the petiole and stem.
- The fungal infection on flower buds leads to drying and shedding.
- Seeds also may be affected. Dark sunken lesions are produced on the testa.

Disease cycle

PSI: The fungus is externally seed-borne and also survives in plant debris.

SSI: The disease spread is through windblown conidia.

Management

- Collect and destroy infected plant debris
- Treat the seeds with Thiram or Captan at 3g/kg or Carbendazim@0.1%
- Hot water treatment of seed at 50°C for 30 minutes
- Spray Mancozeb or zineb@0.2% or carbendazim@0.1%.

2. Wilt

C.O: *Fusarium oxysporum f.sp. carthami*

Diagnostic Symptoms

- In seedling stage cotyledonary leaves show small brown spots either scattered or arranged in a ring on the inner surface and they may be shrivelled or rolled or curved.
- Symptoms become apparent when plants are in 6-10 leaf stage as yellowing of leaves followed by wilting, Epinasty and vascular browning.
- Symptoms develop in acropetal succession.
- Infected plants produce small sized flower heads which are partially blossomed.
- Most of the ovaries fail to develop seeds or they may form blackish, small, distorted chaffy seeds.

Disease cycle

PSI: The fungus survives in seed, soil and infected plant debris. The primary spread is by soil-borne chlamydospores and also by seed contaminant.

SSI: through irrigation water and implements.

Management

- Avoid growing safflower in low lying areas
- Collection and destruction of plant debris.
- Follow crop rotation with sorghum
- Grow wilt resistant / tolerant hybrids DSH 129, NARI-NH-1 and varieties A1, PBNS-40 and NARI-6 in endemic areas.
- Treat the seeds with Thiram or Captan at 3g/kg or carbendazim@0.1% or T. viride @10g/kg seed

3. Rust

C.O: **Puccinia carthami** (*Puccinia calcitrapae* var. *centaureae*)
or *P. verruca* or *Aecidium carthami*

Diagnostic Symptoms

- The pustules (uredosori) are chestnut brown in colour, erumpent and scattered throughout the leaves.
- Later in the season, black teliosori are formed on the same spots.
- Seedlings sometimes die suddenly without exhibiting symptoms in the aerial parts.
- Stem girdling occurs in older plants. The rust pustules also appear on tap root and lateral roots.

Disease cycle

PSI: The fungus remains on the seeds and infected crop debris in the soil, fungus also produces uredial and telial stages in the collateral host *Carthamus oxyacantha* and dormant teliospores in soil.

SSI: through wind-borne uredospores.

Management

- Grow resistant varieties like Sagaramuthyalu, Manjeera and APRR-3.
- Treat the seeds with Thiram or Captan@3g/kg or Carbendazim@2g/kg.
- Remove and destroy the plant debris in the soil.
- Rogue out the collateral host.
- Spray wettable sulphur or Mancozeb@0.2%

4. Mosaic

C.O: **Cucumber mosaic virus (CMV)**

Diagnostic Symptoms

- Young leaves show irregular yellow or light green patches alternating with normal green areas.

- Leaves may become blistered and distorted and infected plants are stunted.
- In few plants primary leaves are produced, forming a rosette of leaves exhibiting mosaic mottling and from the centre of this the axis bearing secondary leaves is produced.

Disease cycle

PSI: The virus can infect a number of wild and cultivated plants.

SSI: transmitted by aphid, *Myzus persicae*.

Management

- Rogue out and destroy infected plants
- Spray systemic insecticides like Monochrotophos 1.5ml or dimethoate 2ml for the control of aphid vectors.

DISEASES OF SUNFLOWER

1. Leaf blight

C.O: *Alternaria helianthi*

Diagnostic Symptoms

- The fungus produces brown spots on leaves, stem, sepals and petals.
- The lesions on the leaves are dark brown to black, circular to oval spots, ranging from 0.2 to 0.5mm in diameter.
- 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.

Disease cycle

P.S.I: survives on seed, host debris and weed hosts.

S.S.I: through windblown conidia.

Management

- Grow tolerant variety like BSH-1.
- Remove and destroy infected plant debris.
- Rogue out weeds at periodical intervals.
- Sow the crop early in the season (June sowing).
- Spacing of 60x30cm or 45x30cm reduces disease build up.
- Treat the seeds with Thiram or Carbendazim at 2 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.

2. Rust

C.O: *Puccinia helianthi*

Diagnostic Symptoms

- Small, reddish brown pustules (uredia) covered with rusty dust appear on the lower surface of bottom leaves.
- In severe infection, when numerous pustules appear on leaves, they become yellow and dry.
- The black coloured telia are also seen among uredia on the lower surface.

Disease cycle

P.S.I: survives in the volunteer sunflower plants and in infected plant debris in the soil as teliospores.

S.S.I: by wind-borne uredospores.

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.

3. Powdery mildew

C.O: *Erysiphe cichoracearum*

Diagnostic Symptoms

- White to grey powdery growth appears on upper surface of older but still green foliage.
- Occasionally powdery growth is also seen on stem and bracts.
- As the plant matures black pin head sized cleistothecia are visible in white mildew areas.
- The affected leaves curl, chlorotic, dry and defoliate.

Disease cycle

P.S.I: perennates through cleistothecia in the infected plant debris in soil. The ascospores from the cleistothecia cause primary infection.

S.S.I: through wind-borne conidia.

Management

- Remove and destroy infected crop debris.
- Spray wettable sulphur@0.3% or Calixin@0.1%

4. Head rot

C.O: *Rhizopus* sp. (Mostly *R. arrhizus*)

Diagnostic Symptoms

- The affected heads show water soaked lesions on the lower surface, which later turn brown.
- The discoloration may extend to stalk from head.

- The affected portions of the head become soft and pulpy and insects are also seen associated with the putrified tissues.
- The larvae (*Helicoverpa armigera*) and insects which attack the head pave way for the entry of the fungus which attacks the inner part of the head and the developing seeds.
- The seeds are converted into a black powdery mass. The head finally withers and droops down with heavy fungal mycelial growth.

Disease cycle

P.S.I: Survives as a saprophyte in host debris and other crop residues.

S.S.I: spread by windblown spores.

Management

- Treat the seeds with Thiram or Carbendazim at 2g/kg.
- Control the caterpillars feeding on the heads.
- Spray fenthion 1ml plus wettable sulphur 2g per liter of water at the time of head initiation.
- Spray the head with Mancozeb at 1kg/ha during intermittent rainy season and repeat after 10 days, if the humid weather persists.

5. Sclerotial wilt/Collar rot

C.O: *Sclerotium rolfsii*

Diagnostic Symptoms

- 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.

Disease cycle

P.S.I: survives as *sclerotia* in soil and plant debris.

S.S.I: occurs through sclerotia by implements and irrigation water.

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*.

6. Downy mildew

C.O: *Plasmopara halstedii*

Diagnostic 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.
- In infected plants flower heads are erect.

Disease cycle

P.S.I: through soil borne oospores.

S. S.I: through wind borne sporangia and zoospores.

Management

- Regulatory measures to prevent races (other than race 1) of pathogen into India.
- 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%](#) (Apron 35SD) followed by foliar spray with [Metalaxyl@0.2%](#) (Ridomyl MZ) is effective.
- Hybrids like LSH-1, LSH-3, KBSH-1, Jwalamukhi, etc had high degree of resistance.

7. Mosaic

C.O: **Virus**

Diagnostic Symptoms

- In infected plants, leaves show irregular yellow or light green patches alternating with normal green areas.
- Small, chlorotic circular spots develop on leaves which coalesce to form typical mosaic pattern.
- Cupping and malformation of leaves, poorly developed root system and reduction in pollen fertility are the other symptoms of the disease.

Disease cycle

The virus is transmitted through sap, seed and white flies, *Bemesia tabaci*.

The virus can survive in amaranthus.

Management

- Rouging of infected plants
- Spray Triazophos 1ml or Monochrotophos 1.5 ml per litre of water.

8. Sunflower necrosis virus (SND)

C.O: Tobacco streak virus

Diagnostic Symptoms

- Initially small, irregular, necrotic patches appear on leaf lamina more near to the midrib.
- As the necrosis advances it results into twisting of the leaf, later it extends through one side of the leaf lamina to the petiole and stem and finally terminates at shoot of the plant leading to paralytic symptom.
- Necrosis at bud formation stage makes the capitulum to bend and twist.
- The necrosis symptoms appear on bracts and capitulum also.
- The early infected plants become stunted, weak and die before flowering,.
- Necrosis affected flower heads fail to open and no seed filling takes place.

Disease cycle

Tobacco streak virus of Ilar group causes the disease. The virus can be transmitted through mechanical, sap inoculation from sunflower to other 22 hosts and vice versa. The virus is transmitted by thrips through infected pollen as carrier. Weed hosts particularly, *Parthenium*, *Ageratum*, *Commelina* and *Achyranthus* harbour the virus.

Management

- Removal of weeds plants from the field and adjoining areas of crop.
- Rouging of infected plants before flowering helps to destroy the virus source and spread of the disease.
- Avoid growing of chrysanthemum and marigold close to sunflower.
- Growing 5-7 rows of border crop all around sunflower with sorghum or Bajra
- Seed treatment with Imidachlorpid (Gaucho 70WS) @5g/kg followed by 2-3 sprays at 15 days interval starting from 25 days old seedlings to pre-seed setting stage with Imidachlorpid (Confidor 200SL)@0.05% control the insect vector.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
CASTOR AND SESAMUM

DISEASES OF SESAMUM (GINGELLY)

1. Alternaria leaf spot

C.O: **Alternaria sesami**

Diagnostic Symptoms

- Initially small, circular, reddish brown spots (1-8mm) appear on leaves
- The lower surface of the spots are greyish brown in colour.
- In severe blighting defoliation occurs on petioles, stem and capsules.
- Infection of capsules results in premature splitting with shriveled seeds.

Disease cycle

PSI: The fungus is seed-borne and also soil-borne as it remains dormant in the infected plant debris.

SSI: through wind-borne conidia.

Management

- Treat the seeds with Captan or Thiram@0.25% or Carbendazim@0.1%
- Hot water treatment at 53°C for 30 minutes gives good control of the disease.
- Spray twice with Mancozeb@0.25% or Thiophanate methyl@0.25% or Carbendazim@0.1%

2. Powdery mildew

C.O: **Leveillula taurica** or **Erysiphe cichoracearum**

(Conidial stage: *Oidiopsis taurica* or *Oidium acanthosperma*)

Diagnostic Symptoms

- Initially greyish-white powdery growth appears on the upper surface of leaves.
- 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.
- In the advanced stages of infection, the mycelial growth changes to dark or black because of development of cleistothecia.

Disease cycle

P.S.I: The ascospores from the cleistothecia cause primary infection.

S.S.I: through wind-borne conidia.

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.

3. Phyllody

C.O: **Phytoplasma**

Diagnostic Symptoms

- 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.
- Stamens also become leaf like to certain extent.
- Anthers become green and do not dehisce.
- Ovary is transformed into an elongated out growth resembling a shoot.
- The plant is stunted with reduced internodes and abnormal branching gives a bushy appearance.
- The infected plants generally do not bear capsules, but if capsules are formed they do not yield quality seeds.

Disease cycle

P.S.I: The pathogen has a wide host range and survives on many hosts.

S.S.I: Transmitted by jassid, *Orosius albicinctus* in a persistent manner.

Management

- Remove all the reservoir and weed hosts.
- Delay sowing in the endemic areas to reduce the vector population and thereby the disease.
- Avoid growing sesamum near cotton, groundnut and grain legumes.
- Rogue out the infected plants periodically.
- Sesamum mulayanum is the resistant source to the pathogen.
- Spray 2-3 times with Monocrotophos (0.03%) or Dimethoate@0.2% at flowering stage reduces the vector population.
- Spray 500ppm tetracycline at flowering.

4. Root rot or stem rot or charcoal rot

C.O: **Macrophomina phaseolina**

(Sclerotial stage: *Rhizoctonia bataticola*)

Diagnostic Symptoms

- The 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 near the soil level shows large number of black pycnidia.
- 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.
- The rotten root as well as stem tissues contains a large number of minute black sclerotia.
- The sclerotia may also present on the infected pods and seeds.

Disease cycle

P.S.I: through infected seeds which carry sclerotia and pycnidia. The fungus also spreads through soilborne sclerotia.

S.S.I: through the conidia transmitted by wind and rain water.

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 farm yard manure 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

5. Bacterial leaf spot

C.O: *Pseudomonas sasami* or *Ralstonia syringae* pv. *sesami*

Diagnostic Symptoms

- The disease appears as water soaked 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.

Disease cycle

P.S.I: The bacterium remains viable in the infected plant tissues. It is internally seed- borne

S.S.I: through rain splash.

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 streptocycline suspension (0.055) for 30 minutes.

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

DISEASES OF CASTOR

1. Wilt

C.O: *Fusarium oxysporum f.sp. ricini*

Diagnostic 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 subsequently.
- Diseased plants are sick in appearance. Necrosis of leaves starts from margins spreading to interveinal areas and subsequently to the entire leaf.
- All lower leaves droop and drop off leaving behind only a few top leaves.
- Subsequently plants die. Sometimes a cluster of purple coloured sporodochia develops on the stem and superficial cracks are noticed on the stem.
- Split open stems show brownish discolouration and white cottony mycelial growth much prominently in the pith region.

Disease cycle

P.S.I: occurs through infected seeds or through chlamydospores in soil.

S.S.I: by conidia disseminated by rain splash and irrigation water.

Management

- Select disease free seeds for planting
- 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.
- Follow intercropping with redgram
- Seed treatment with Trichoderma viride@4g/kg and Thiram@3g/kg seed or carbendazim@2g/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.

2. Root rot/Charcoal rot

C.O: *Macrophomina phaseolina*

Diagnostic 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. Young leaves curl inwards with black margins and drop off later.
- Such branches die-back. Diseased plants flower prematurely.
- Incidence at maturity causes spike blight. Seed development is affected.

Disease cycle

P.S.I: Pathogen survives in soil, plant debris and many cultivated and wild plants as sclerotia and pycnidia.

S.S.I: through sclerotial bodies.

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.

3. Grey mold/Grey rot/Blossom blight

C.O: *Botrytis ricini* (Sexual stage: *Sclerotinia ricini*)

Diagnostic Symptoms

- Initially water soaked lesions form on the male flowers at the base of the spike.
- These flowers rot and are covered by characteristic grey or ash coloured growth of the fungus.
- Development of cottony white growth which later converts into grey colour due to sporulation. The infected capsules rot.
- Yellowish drops of liquid exude from these portions which are covered by fluffy grey fungal growth.
- Infection at flowering results in flower rot and affects seed filling. Infected spikes become sterile without capsules.
- Infected capsules rot and shed off. Infection spreads to the seed also on which black sclerotia develop.
- Leaves which are in contact with the diseased spikes are also infected on which irregular light brown spots with marked borders consisting of greyish fungal growth develops.

Disease cycle

The fungus survives through sclerotia on infected seed and crop debris.

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 muriate of potash after removal of diseased panicles may be useful for the growth of panicles that subsequently develop.

4. Bacterial leaf spot

C.O: *Xanthomonas campestris* pv. *ricini*

Diagnostic Symptoms

- On cotyledons and leaves, water soaked, angular spots are produced.
- Leaf symptoms are first noticed at the tip which extends to center becoming irregularly angular, dark brown to jet black in colour.
- Diseased leaves become blighted and plants defoliate.
- Diseased areas consist of bacterial exudation as small beads on both the surfaces.
- Elongate dark lesions may also develop on petioles and young branches.
- The bacterium is seed borne.

Management

- Remove and destroy the infected plant debris.
- Hot water treatment of seeds at 50-60°C for 10 minutes.
- Spray streptomycin@500ppm or paushamycin@0.025% in combination with COC@0.3%

5. Seedling blight

C.O: *Phytophthora parasitica*

Diagnostic Symptoms

- The disease appears as circular, dull green patch on both the surface of the cotyledonary leaves.
- Under humid conditions, infection spreads to stem and causes withering and death of seedling due to destruction of growing tip.

- In mature plants, the infection initially appears on the young leaves and spreads to petiole and stem causing black discoloration and severe defoliation.
- On older leaves, spots are round to irregular and show alternate yellow and brown concentric zones with yellowish green halo on the upper surface.
- Affected leaves are blighted and shed prematurely. Under moist conditions, a whitish fungal growth is found on the under surface of the spots.

Disease cycle

P.S.I: The pathogen is soil borne and survive through resistant chlamydospores

S.S.I: spreads by zoospores carried by rain water.

Management

- Remove and destroy infected plant residues.
- Avoid low-lying and ill drained fields for sowing.
- Treat the seeds with Metalaxyl at 3g/kg or T. viride at 4g/kg.
- Soil drenching with Metalaxyl@0.2% or COC@0.3%
- Give need based spray of COC@0.3% to avoid further spread of the disease.

6. Rust

C.O: *Melampsora ricini*

Diagnostic Symptoms

- Minute, orange-yellow coloured, raised pustules appear on the lower surface of the leaves and the corresponding areas on the upper surface of the leaves are yellow.
- Often the pustules are grouped in concentric rings and coalesce together leading to drying of leaves.

Disease cycle

P.S.I: Self sown castor crops in the off season, can also survive on other species of Ricinus.

S.S.I: through air-borne uredospores.

Management

- Rogue out the self-sown castor crops and other weed hosts.
- Spray Mancozeb@0.25% or Tridemorph@0.1% or dust fine Sulphur powder at 25 kg/ha.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
MUSTARD

1. White rust

C.O: *Albugo candida* or *A. cruciferarum*

Diagnostic Symptoms

- In case of local infection isolated white/ creamy yellow raised pustules appear on under surface of leaves which later coalesce to form patches.
- Systemic infection causes hypertrophy and hyperplasia resulting in malformation and distortion of floral parts.
- Entire inflorescence is replaced by swollen sterile structure (Stag head).

Disease cycle

PSI: through oospores formed in affected host tissues.

SSI: through zoospores disseminated by rain or irrigation water.

Management

- Collect and destroy infected plant debris
- Rotation with non-cruciferous crops
- Early sowing of the crop (in first week of October)
- Seed dressing with Metalaxyl (Apron 35SD)@6g/kg seed followed by a single spray with Metalaxyl (Ridomyl MZ)@0.2%
- Grow resistant varieties like RC 781, PYSR 8 and PR 10 (or) tolerant varieties like Kranthi and Krishna

2. Downy mildew

C.O: *Peronospora parasitica*

Diagnostic Symptoms

- Greyish white irregular necrotic patches develop on the lower surface of the leaves.
- Prominent symptom is the infection of inflorescence causing hypertrophy of the peduncle or inflorescence (Stag head).
- The affected inflorescence does not produce any siliqua or seed.

Disease cycle

PSI: through oospores formed in affected host tissues and on weed hosts.

SSI: through wind borne sporangia.

Management

- Collect and destroy infected plant debris
- Rotation with non-cruciferous crops
- Early sowing of the crop (in first week of October)

- Seed dressing with Metalaxyl (Apron 35SD)@6g/kg seed followed by a single spray with Metalaxyl (Ridomyl MZ)@0.2%
- Grow resistant varieties like RC 781, PYSR 8 and PR 10

3. Powdery mildew

C.O: **Erysiphe cruciferarum**

Diagnostic Symptoms

- Symptoms appear as dirty white circular patches on both sides of lower leaves.
- The entire leaves, stems and siliquae are affected. The affected siliquae produce small and shrivelled seeds.

Disease cycle

PSI: through cleistothecia as ascospores or as mycelium on volunteer host

SSI: through wind borne conidia.

Management

- Collect and destroy infected plant debris
- Spray the crop with wettable [sulphur@0.2%](#) or [Dinocap@0.1%](#) or [tridemorph@0.1%](#)

4. Alternaria leaf spot

C.O: **Alternaria brassicae and A. brassicola**

Diagnostic Symptoms

- The disease start with formation of spots on leaves, stem and siliquae.
- The spots produced by A. brassicae are usually gray compared to black sooty velvety spots produced by A. brassicola.

Disease cycle

PSI: The pathogen survives in the infected crop debris as dormant mycelium.

SSI: by air-borne conidia.

Management

- Removal and destruction of infected plant debris
- Use disease free or treated seed (Mancozeb @2.5g/kg seed)
- Spray with mancozeb (@0.25%) or Iprodione (0.2%) at 10 days interval.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
COTTON

1) Bacterial leaf blight

C.O: *Xanthomonas campestris* pv. *malvacearum*

Diagnostic symptoms

- The bacterium attacks all stages from seed to harvest
- Withering and death of seedlings (Seedling blight)
- Angular leaf spots restricted by veins and veinlets are visible on leaves
- Blackening of the veins and veinlets (Vein necrosis)
- Dark brown to black lesions are seen on stem and fruiting branches which girdle the stem resulting in breaking of the stem which hang typically as a dry black twig (Black arm)
- Dark black and sunken irregular spots appear on the bolls which lead to shedding or premature bursting of bolls (Boll rot)
- Lint is stained yellow and infected seed is reduced in size

Disease cycle

PSI: Bacterium survives in infected plant debris, on volunteer crop plants and on fuzz of seed. Bacterium also infects *Jatropha curcas*

SSI: Bacteria spread through rain splash, irrigation water, insects and other implements

Management

- Remove and destroy the infected plant debris
- Rogue out the volunteer cotton plants and weed hosts
- 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 (Agrimycin 100) 500 ppm along with Copper oxychloride at 0.3%.
- Grow resistant varieties like HG-9 and Sujatha

2) Fusarium wilt

C.O: *Fusarium oxysporum* f.sp. *vasinfectum*

Diagnostic symptoms

- The disease affects the crop at all stages
- Discolouration of young leaves from the margins towards midrib
- The leaves lose their turgidity, gradually turn brown, droop and finally drop off leaving the stem alone standing in the field
- Browning or blackening of vascular tissues

- Black streaks or stripes may be seen extending upwards to the branches and downwards to lateral roots
- In transverse section, discoloured ring is seen in the woody tissues of stem
- The affected plants are stunted with fewer bolls which are very small and open prematurely

Disease cycle

PSI: Chlamydospores in soil

SSI: Macroconidia and microconidia through irrigation water

Management

- Treat the acid-delinted seeds with Carboxin or 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 Farm yard manure for 15 days and then apply to the soil
- Apply heavy doses of farm yard manure 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

C.O: *Verticillium dahliae*

Diagnostic symptoms

- The symptoms are seen when the crop is in squares and bolls.
- Mottling of leaves with pale yellowish irregular areas at the margins and between the principal veins
- The yellowish areas turn extensively necrotic and fall off leaving few leaves at the top of the stem
- Infected stem and roots, when split open, show a pinkish to pinkish brown discolouration of the woody tissue which is usually interrupted (Tiger stripe)
- The affected plants may bear a few smaller bolls with immature lint

Disease cycle

PSI: Microsclerotia in soil and plant debris. The fungus also infects hosts like brinjal, chilli, tobacco and bhendi

SSI: Conidia through irrigation water

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 farm yard manure 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

C.O: *Rhizoctonia bataticola*

Diagnostic symptoms

- Typical root rot symptom appears normally at the time of maturity of the plants Sudden and complete wilting of plants in patches in concentric circles
- Leaves droop suddenly and die within a day or two
- The affected plants when pulled reveal the rotting of entire root system except tap root and few laterals
- The bark of the affected plant shreds and the woody portions become black and brittle
- A large number of dark brown sclerotia are seen on the shredded bark

Disease cycle

PSI: Sclerotia in soil

SSI: Sclerotia disseminated by irrigation water, implements, and during cultural operations

Management

- Apply farm yard manure at 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

C.O: *Ramularia areola* (Sexual stage: *Mycosphaerella areola*)

Diagnostic symptoms

- Irregular to angular pale translucent lesions develop on the lower surface, usually bound by veinlets.
- Light green or yellow green specks appear on upper leaf surface
- Whitish grey or frosty powdery growth, consisting of conidiophores of the fungus, appears on the lower surface
- 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

Disease cycle

PSI: Conidia in infected crop debris, on volunteer plants and perennial cotton plants

SSI: Conidia dispersed through wind, rain splash and irrigation water

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

C.O: *Colletotrichum capsici*

Diagnostic 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, the fungus attacks the stem, leading to 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 lint is stained to yellow or brown, becomes a solid brittle mass of fiber
- The infected bolls cease to grow and burst and dry up prematurely

Disease cycle

PSI: Dormant mycelium in the seed or as conidia on the seed and plant debris. The fungus also survive on the weed hosts *Aristolachia bractiata* and *Hibiscus diversifolius*

SSI: Wind borne conidia

Management

- Remove and burn the infected plant debris and bolls in the soil
- Rogue out the reservoir weed hosts.
- 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 Copper oxychloride@0.3% or Carbendazim@0.1%

7) Leaf spots

C.O: *Alternaria macrospora*

Diagnostic 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
- In severe cases, the leaf stalk and bolls become infected with spherical or elliptical purple spots

Disease cycle

PSI: Mycelium and conidia in infected plant debris

SSI: Wind borne conidia

Management

- Remove and destroy the infected plant residues
- Spray Mancozeb@0.25% or Copper oxychloride@0.3% at the initiation of the disease. Four to five sprays may be given at 15 days interval

8) Rust

C.O: *Phakopsora gossypii*

Diagnostic symptoms

- Bright yellow orange pustules with purple borders appear under surface of the lower leaves which eventually turn brown in colour
- Spots may appear on any of the above ground parts including bracts and bolls
- Severe infections may cause defoliation and reduction in the size of the bolls
- On stems and petioles these pustules are usually elongated and are not much raised

Disease cycle

PSI: Teleutospores in infected crop debris

SSI: Wind borne uredospores

Management

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

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
REDGRAM, GREENGRAM AND BLACKGRAM

REDGRAM DISEASES

1. Phytophthora blight / Stem blight

C.O: *Phytophthora drechsleri* f. sp. *cajani*

Diagnostic Symptoms

- 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.
- 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.

Disease cycle

PSI: from oospores

SSI: by zoospores. Rain splash and irrigation water help for the movement of zoospores.

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 of seed.
- Spray Metalaxyl (Ridomyl MZ) at 0.2%.

2. Wilt

C.O: *Fusarium oxysporum* f. sp. *udum*

Diagnostic Symptoms

- 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 is a definite indication of *Fusarium* wilt and distinguishes from *Phytophthora* blight that kills the whole plant.
- Partial wilt is associated with lateral root infection, while total wilt is due to tap root infection.
- Foliar symptoms include loss of turgidity, interveinal clearing and chlorosis.

Disease Cycle

PSI: by soil-borne chlamydospores and also by seed contaminant.

SSI: through irrigation water and implements.

Management

Cultural:

- Follow long crop rotation with tobacco, sorghum or castor.
- Avoid successive cultivation of redgram in the same field.
- Adopt mixed cropping of sorghum in the field.
- Soil solarization in summer to reduce the inoculum of pathogen.
- Collect and destroy the diseased stubbles.

HPR:

- 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.

Chemical:

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

Bio-control:

- Treat the seeds with *Trichoderma viride* at 4 g/kg.
- Multiply 2 Kg *T. viride* formulation in 50 kg of Farm Yard Manure and apply to soil.

3. Sterility Mosaic

C.O: **Sterility mosaic virus**

Diagnostic Symptoms

- In the field, the diseased plants appear as bushy, pale green plants without flowers or pods.
- Leaves of these plants are small and show typical light and dark green mosaic pattern.
- Symptoms initially appear as vein-clearing on young leaves and 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) of crop growth show near complete sterility and yield loss upto 95 per cent.
- If pods develop, the seeds may be small, shrivelled and immature.

Disease cycle

PSI: self-sown redgram plants, perennial types of redgram (*Cajanus scarabaeoides* var. *scarabaeoides*) and the rationed growth of harvested plants serve as sources of infection

SSI: is transmitted by an Eriophyid mite *Aceria cajani*.

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

4. Bacterial leaf spot and stem canker

C.O: *Xanthomonas campestris* pv. *cajani*

Diagnostic Symptoms

- Infection 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.
- Leaf spots do not usually cause defoliation. Cankers can cause stems to break,
- Stems often break at the point where the primary leaves are attached.
- In cases of severe infection the affected branches dry.

Disease Cycle

The bacterial cells are disseminated through rain splash.

Management

- Remove the infected plant debris and destroy.
- Spray antibiotics like Streptocycline@100ppm, 2-3 times at 10 days interval

GREEN GRAM AND BLACK GRAM DISEASES

1. Powdery mildew

C. O: *Erysiphe polygoni*

Diagnostic Symptoms

- 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 white powdery spots completely cover the petioles, stem and even the pods.
- The plant assumes greyish white appearance.
- 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.

Disease cycle

PSI: from ascospores from perennating cleistothecia.

SSI: by the air-borne conidia. Rain splash also helps in the spread of the disease.

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 and green gram cultivars like JGUM 1, TARM 1, Pusa 9072, WGG 48 and WGG 62.

2. Rust

C.O: *Uromyces phaseoli typica* (Syn: *U.appendiculatus*)

Diagnostic Symptoms

- 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.

Disease cycle

The pathogen survives in the soil as teliospores and as uredospores in crop debris. Primary infection is by the basidiospores developed from teliospores.

Secondary spread is by wind-borne uredospores. The fungus also survives on other legume hosts.

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.

3. Cercospora leaf spot

C.O: *Cercospora canescens*

Diagnostic Symptoms

- Small, circular spots develop on the leaves with grey centre and reddish brown margin.
- The several spots coalesce to form brown irregular lesions, 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.

Disease cycle

PSI: survives on diseased plant debris in soil and on seeds.

SSI: by air-borne conidia.

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.

4. Corynespora leaf spot

C.O: **Corynespora cassicola**

Diagnostic Symptoms

- Symptoms develop on leaves when the crop reaches flowering stage.
- Lesions begin as dark reddish brown circular spots usually on the upper surface of the leaf.
- They expand with marked, narrow concentric banding to become larger spots.
- The concentric rings are made up of dead tissue.
- Shot holing and severe defoliation is a marked symptom in advanced stages of infection. Yields decrease drastically.

Disease cycle

PSI: seed borne and can survive on host debris for two years.

SSI: through air borne conidia.

Management

- Remove and burn infected plant debris.
- Spray [Mancozeb@0.25%](#) or [Carbendazim@0.1%](#)
- Grow tolerant black gram varieties like LBG 167.

5. Angular black spot

C.O: **Protomyces phaseoli or P. patelii (Syn: Erratomyces patelii)**

Diagnostic Symptoms

- Small light yellow spots appear on older leaves, enlarge gradually turning into angular black spots.
- When infection is severe, several such spots coalesce resulting in drooping, drying and defoliation.
- Yields are greatly reduced due to poor pod set and reduction in seed size.

Pathogen

In India and in the American tropics angular black spot disease on leaves of Vigna spp. is caused by *Protomyces patelii*. The fungus is related to smut fungi of the genus *Tilletia* because it produces relatively large, opaque teliospores which

have a partition layer in their wall and which germinate with holobasidia carrying needle-shaped basidiospores. In contrast to species of *Tilletia* and related genera, the teliospores are scattered in intercellular spaces in the mesophyll without rupturing it and develop mostly intercalary. Additionally taking into account the distinct host family, the agent of angular black spot disease of beans cannot be classified in any known genus. The new genus *Erratomyces* is proposed.

Protomyces produces finely punctate (rough) chlamydospores which are formed terminally on the mycelium and helps in survival of the fungus.

Management

- Grow tolerant green gram cultivars like LGG 407, LGG 450, LGG 421, WGG 295 and Pusa 105.
- Remove and destroy infected plant debris

6. Dry root rot

C.O: ***Rhizoctonia bataticola***

(Pycnidial stage : *Macrophomina phaseolina*)

Diagnostic Symptoms

- The disease symptom starts initially with yellowing and drooping of the leaves.
- The leaves later fall off and the plant dies within a 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.
- The rotten tissues of stem and root contain a large number of black minute sclerotia.

Disease cycle

PSI: The fungus survives in the infected debris and also as facultative parasite in soil. The primary spread is through seed-borne and soil-borne sclerotia.

SSI: The secondary spread is through pycnidiospores which are air-borne.

Management

- Treat the seeds with Carbendazim or Thiram at 4 g/kg or pellet the seeds with *Trichoderma viride* at 4 g/kg or *Pseudomonas fluorescens* @ 10g/kg of seed.
- Apply farm yard manure or green leaf manure (*Gliricidia maculate*) at 10 t/ha or neemcake at 250 kg/ha.

7. Bacterial leaf spot

C.O: **Xanthomonas phaseoli**

Diagnostic Symptoms

- The disease is characterized by many brown, dry, raised spots on the leaf surface.
- 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.

Disease cycle

PSI: The bacterium is seed borne and grows through perennial vines.

SSI: Rain splashes play an important role in development and spread of disease.

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 streptocycline 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.

8. Yellow mosaic

C.O: **Mungbean yellow mosaic virus**

Diagnostic 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. I
- nfected 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.

Disease cycle

PSI: The virus survives in the weed hosts and other legume crops.

SSI: The disease spreads through white fly, *Bemisia tabaci*.

Management

- Rogue out the diseased plants upto 40 days after sowing.
- Remove the weed hosts peiodically.
- Increase the seed rate (25 kg/ha).

- Grow resistant black gram varieties like Teja, LBG 752, Pant-30 and Pant-90.
- Grow resistant green gram varieties like LGG 407 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.
- Give one foliar spray of systemic insecticide (Dimethoate @ 750 ml/ha) on 30 days after sowing.

9. Leaf crinkle

C.O: **Leaf crinkle virus**

Diagnostic Symptoms

- The enlargement of 4th or 5th leaf is seen four or five weeks after sowing.
- Later crinkling and curling of the tips of leaflets are seen. The petioles as well as internodes are shortened.
- The infected plant gives a stunted and bushy appearance. Flowering is delayed by 8-10 days, inflorescence, if formed, is malformed and turns with small size flower buds and fails to open.
- The age of the plant is prolonged with dark green leaves till harvest.
- Pod setting is curtailed which decreases the yield drastically.

Disease cycle

PSI: The virus is seed-borne and primary infection occurs through infected seeds.

SSI: White fly, *Bemisia tabaci*, helps in the secondary spread. The virus is also transmissible through aphids and *Epilachna* beetles.

Management

- Use increased seed rate (25 kg/ha).
- Hot water treatment of the seed at 55°C for 30 minutes.
- Rogue out the diseased plants at weekly interval upto 45 days after sowing.
- Cultivate seed crop during rabi season.
- Remove weed hosts periodically.
- Spray Monocrotophos or Methyl demeton on 30 and 40 days after sowing at 500 ml/ha.

10. Cuscuta

Diagnostic Symptoms

- In field, it is noticed as small masses of branched thread- like, leafless stems which twine around the stem or leaves of host (Complete stem parasite)
- Leaves of parasite are represented by minute functionless scales
- When stem comes in contact with the host, haustoria penetrate the host cortex reaching fibro-vascular bundles
- Infected plants appears sick as the parasitic vine increases in size
- Plants die under severe infection

Survival and spread

- Perpetuates through seed which fall onto the ground
- Dispersed through birds and grazing animals

Management

- Crop seed should be free from dodder seeds
- Do not allow grazing animals to move in dodder infested field
- Badly infested crop should be burnt before the parasite produces flowers and seeds
- Five year crop rotation with non-host crop
- Spot treatment with Glyphosate, Pentachloro phenol or 2,4-D
- Spray herbicide, pursuit (200ml/acre), in problematic areas when the crop is at 20 days followed by urea spray (1%) within 5-7 days after herbicide treatment.

STUDY OF SYMPTOMS, CAUSE, ETIOLOGY, HOST-PARASITIC
RELATIONSHIP AND SPECIFIC CONTROL MEASURES OF DISEASES OF
BENGALGRAM, COWPEA AND SOYABEAN

BENGAL GRAM DISEASES

1. Wilt

C.O: *Fusarium oxysporum* f.sp. *ciceri*

Diagnostic Symptoms

- 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.

Disease cycle

PSI: The fungus may be seed-borne and survives in infected plant debris in soil. The primary infection is through chlamydospores in soil. The weed hosts like *Cyperus rotundus*, *Tribulus terrestris* and *Convolvulus arvensis* also serve as a source of inoculum.

SSI: through irrigation water, cultural operations and implements.

Management

- Treat the seeds with Carbendazim or Thiram at 2 g/kg or treat the seeds with *Trichoderma viride* at 4 g/kg or *Pseudomonas 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.

2. Rust

C.O: *Uromyces ciceris-arietini*

Diagnostic Symptoms

- The infection appears as small oval, brown, powdery lesions on both the surface, especially on lower surface of leaf.

- The lesions, which are uredosori, cover the entire leaf surface.
- Sometimes a ring of small pustules can be seen around larger pustules which occur on both leaf surfaces. Late in the season dark teliosori appear on the leaves.
- The rust pustules may appear on petioles, stems and pods.

Disease cycle

PSI: survives as uredospores in the legume weed *Trigonella polycerata* during summer months and serve as primary source of infection.

SSI: The spread is through wind-borne uredospores.

Management

- Destroy weed host.
- Dust Sulphur at 20 kg/h or spray [Mancozeb@0.25%](#)

3. Ascochyta blight

C.O: *Ascochyta rabiei*

(Perfect stage: *Mycosphaerella pinodes*)

Diagnostic 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 may appear on the stem and pods.
- The 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.

Disease cycle

PSI: from seed-borne pycnidia and plant debris in the soil.

SSI: through air-borne conidia. Rain splash also helps in the spread of the disease.

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%](#).

4. Stem and Root rot or dry root rot

C.O: **Rhizoctonia bataticola**

(Pycnidial stage: *Macrophomina phaseolina*)

(Sexual stage: *Thanatephorus cucumeris*)

Diagnostic Symptoms

- The first symptom of the disease is yellowing of the leaves.
- The affected leaves, petioles and leaflets droop within a day or two.
- The leaves and stems of the affected plants turn straw coloured and plants wilt within a week.
- The lower portion of the tap root usually remains in the soil when plants are uprooted.
- The tap root is dark showing signs of rotting and is devoid of most of the lateral and finer roots.
- Dark minute sclerotial bodies can be seen on the roots exposed or inside the wood.

Disease cycle

PSI: The pathogen survives in the soil in infected host debris as sclerotia for several years.

SSI: The secondary spread is through farm implements, irrigation water and rain splash.

Management

- Treat the seeds with Carbendazim or Thiram at 2 g/kg or seed pelleting with *Trichoderma viride* at 4 g/kg or *Pseudomonas fluorescens* @ 10g/kg of seed.
- Apply farmyard manure at 10 t/ha.
- Grow tolerant genotypes like ICCV 10

COWPEA DISEASES

1. Cowpea mosaic

C.O: **Cowpea yellow mosaic virus (Syn: Cowpea mosaic virus, yellow strain)**

Diagnostic Symptoms

- Chlorotic spots with diffuse borders (diam. 1-3 mm) are produced in inoculated primary leaves.
- Trifoliate leaves develop a bright yellow or light green mosaic.
- The severity increases in younger leaves with moderate distortion and reduction in size. The affected leaves are leathery.
- The infected plants produce a few pods which are small and distorted.
- Chlorotic spots are also produced on pods. Plants do not show necrosis.

Disease cycle

Transmitted by various beetles with biting mouth parts. The virus is transmitted by chrysomelid beetles viz., *Ootheca mutabilis*, *Cerotoma variegata* and *C. ruficornis*.

Management

- Remove the infected plants as soon as symptoms appear.
- Grow resistant varieties
- Rogue out and destroy the weed hosts

SOYBEAN DISEASES

1. Rust

C.O: **Phakopsora pachyrhizi**

Diagnostic Symptoms

- Large number of light brown pustules appears on lower surface of the leaves in the initial stages, later turns to reddish brown to tan colour.
- Tan lesions consist of small uredia surrounded by slightly discolored necrotic areas on leaf surfaces.
- Uredial pustules become more numerous with advancing infection and often will coalesce forming larger pustules that break open releasing masses of uredospores.
- Lesions are generally restricted by veins giving angular appearance.
- The leaves gradually become yellow and premature defoliation occurs resulting in yield loss.

Disease cycle

PSI: The pathogen survives as teleutospores in crop debris.

SSI: Secondary spread is through wind borne uredospores.

Management

- Early maturing cultivars escape rust infection.
- Spray twice with Saprol (Triforine)@0.05%, Delan (Dithianon)@0.2% or [Mancozeb@0.1%](#) at weekly interval, beginning at the first appearance of the disease are effective in controlling the disease.
- Grow resistant varieties like PK 73-84, PK-310, IC 89495, IC 89498, etc.

2. Soybean mosaic

C.O: **Soybean mosaic virus**

Diagnostic Symptoms

- Infected plants can be recognized by their stunted growth, distorted and puckered leaves.
- The leaves are dwarfed, crinkled and narrow with their margins turned downwards.
- In severe cases, dark green blister like puckering along the veins takes place.

- Pod setting is drastically reduced. Infected plants produce distorted pods and fewer seeds.
- Seed discolouration can be seen under severe infection. The infected plants remain green even at the end of the growing season.

Disease cycle

The virus is seed borne and is transmitted by aphids.

Management

- Use virus free seed from healthy crop.
- Rogue out infected plants and burn them.
- Spray [monochrotophos@1.5ml/lit](#) or dimethoate@2ml/lit to control the vector

3. Bacterial pustule

C.O: *Xanthomonas axonopodis* pv. *glycines*

Diagnostic Symptoms

- Symptoms are evident as tiny, light green spots with elevated centers that later on turn into raised lightly coloured pustules, typically without exudates.
- Infection is more frequent on the lower ones. Spots may vary from minute specks to large, irregular, mottled brown areas.
- Severely affected portions of leaves are torn away by wind imparting a ragged appearance to plants, and results in premature defoliation.
- Raised red brown spots on pods may also develop. The disease reduces the yield as well as the oil content in seeds.

Disease cycle

The bacterium survives in crop residue and seed

Management

- Remove and burn infected plant debris.
- Crop rotation with grain crop is recommended
- Two sprays at 45 and 55 DAS with a mixture of [Blitox@0.2%](#) + Streptocycline@250ppm effectively control the disease.

EX No. 14

Date:

FIELD VISITS AT APPROPRIATE TIME DURING THE SEMESTER

EX No. 15

Date:

FIELD VISITS AT APPROPRIATE TIME DURING THE SEMESTER

EX No. 16

Date:

FIELD VISITS AT APPROPRIATE TIME DURING THE SEMESTER