Management of diseases of important Agriculture Crops of Tamil Nadu

P. Renukadevi, S. Nakkeeran and D. Alice

Center for Plant Protection Studies, Department of Plant Pathology,
Tamil Nadu Agricultural University, Coimbatore-641 003,
Tamil Nadu, India

Introduction:

Productivity of food crops grown for human consumption is at risk due to the incidence of pathogens, insect pests and weeds. Crop losses due to these harmful organisms can be substantial and may be prevented, or reduced, by crop protection measures. Crop management requires a multidisciplinary approach because pathogens (fungi, bacteria, viruses. nematodes) not only interact with each other, but with other biotic and abiotic factors to create heavy yield loss. The best way to ensure success of a disease-management program is to adapt it to the diseases expected and to use integrated disease-control measures. The implementation of integrated disease management involves usage of resistant or tolerant varieties, crop rotations, fungicides, nematicides, pesticides for vector control and suggested agronomic practices. The success of any one or all of these measures may depend on how carefully we scout our crops. This chapter gives information on symptoms and management of major diseases of important agricultural crops of Tamil Nadu.

1.DISEASES OF RICE

1. Blast

Causal organism : *Magnoporthe grisea*

Symptoms: The fungus infects leaf, leaf sheath, culm, node and neck of the panicle. On leaves, the spots are typically spindle shaped (Eye shaped) with dark brown margin and grey center **(Leaf blast).** Spots are sometimes encircled by yellow halo. Several spots coalesce resulting in bigger lesions, leading to drying of foliage.

Node infection(Node blast) :On nodes, necrotic black lesions are observed which cause weakening and breaking of nodes.

Neck infection (Neck blast) :The neck region of affected panicle becomes black, brittle, necrotic and breaks. Grains become chaffy or partially filled.

Favourable Conditions : Intermittent drizzles, cloudy weather, more of rainy days, longer duration of dew high relative humidity (93-99 per cent);Low night temperature (between 15-20˚C or less than 26˚C);Aavailability of collateral hosts and excess dose of nitrogen.

2.Brown leaf spot ((Sesame leaf spot)

Causal organism : *Helminthsporium oryzae (Drechslera oryzae)*

Symptoms: Symptoms of the disease appear on leaves, leaf sheath, glumes and grains.

On leaves, the spots are rectangular or oval resembling a sesame seed. They are uniformly brown or reddish brown with discrete margin; Spots have a halo. On the surface of **glumes and grains**, brown lesions are observed leading to grain discolouration.

Favourable Conditions : Temperature of 25-30˚C with relative humidity above 80 per cent are highly favourable; Excess of nitrogen aggravates the disease severity.

3. Sheath rot

Causal organism : *Sarocladium oryzae*

Stage of infection: Boot leaf stage

Symptoms: Upper most leaf sheath enclosing the ear head exhibits dark brown or black, circular to irregular patches. The panicle does not emerge fully from the flag leaf. The glumes are discoloured. White powdery growth of mycelium is seen inside the leaf sheath and also on the panicle. Grains get discoloured. Young panicles may not emerge from infected sheaths.

Favourable Conditions : Closer planting ;High doses of nitrogen; High humidity and temperature around 25-30˚C; Injuries made by leaf folder, brown plant hopper and mites increase infection

4. Sheath blight

Causal organism : *Rhizoctonia solani*

Stage of infection: Tillering stage

Symptoms: Lesions are formed on the leaf sheath near water level. The lesions become oval or ellipsoid and greyish green. As the disease progresses lesions enlarge and their centers turn greyish white with brown margin. Under favourable conditions lesions are formed on upper leaf sheath and on leaf blades resulting in leaf blight. Infection may extend to culm leading to rot. Inside the culm and on the leaf sheath, large number of small spherical, brown sclerotia are formed.

Favourable Conditions : High relative humidity (96-97 per cent), high temperature (30-32˚C);Closer planting;Heavy doses of nitrogenous fertilizers

5. Stem rot

Causal organism : *Sclerotium oryzae*

Symptoms: The fungus affects leaf sheath during later stages of crop growth near water level. Dark brown to black lesions are formed on the outer leaf sheath. The affected tissues rot and abundant small, spherical, black sclerotia are seen in the rotting tissue and visible to naked eye as dots. The culm collapses and plants lodge. If the diseased tiller is opened, profuse mycelial growth and large number of sclerotia can be seen.

Favourable Conditions : Infestation of leaf hoppers and stem borer ; High doses of nitrogenous fertilizers.

6. False smut (Lakshmi Disease)

Causal organism : *Ustilaginoidea virens*

Symptoms: Few grains in the earhead exhibit the symptoms. Affected grains get converted into green velvety mass that are much bigger than the normal grains. Spore balls are visible between glumes, and the glumes are not affected. Rainfall and cloudy weather during flowering and maturity favours the disease development.The fungus produces chlamydospores which later develop to sclerotia. Severe outbreak of this disease is recorded in recent years.

7. Oodubathi disease

Causal organism : *Ephelis oryzae*

Symptoms: The panicle emerges as a slender, dirty grey, cylindrical, spike since the spikelets are cemented by the fungal mycelium. No grains are formed on affected earhead.

8. Grain discolouration

Causal organism : *Helminthosporium, Curvularia , Alternaria Fusarium*

Symptoms: The grains are discoloured red, yellow, orange, pink or black, depending upon the organism involved and the degree of infection. The infection may be external or internal leading to discolouration of glumes, kernels or both. Dark brown or black spots appear on grains. Under humid conditions, the fungal growth may be prominently seen on grains .

9. Bacterial leaf blight

Causal organism : *Xanthomonas oryzae pv oryzae*

Symptoms: Blighting of seedling occurs in nursery.In main field, "Kresek' phase i.e. death of seedling is usually observed one or two weeks after transplanting. Symptoms are chiefly confined to leaves. Initial infection is seen as water-soaked lesion at the tip of leaf. Infection proceeds along the leaf margin in an irregular wavy manner. The affected portion turns straw coloured and the central leaf blade remains green for some time. Finally the entire leaf gets blighted. Bacterial ooze can be seen on the infected leaf surface, which dries up forming encrustation. Bacterial ooze can be observed from the cut end of the infected leaf when immersed in clear water.

Favorable Conditions : Clipping of tip of the seedling at the time of transplanting; Heavy rain, heavy dew, flooding, deep irrigation water ;Severe wind and temperature of 25-30 C; Application of excessive nitrogen, especially late top dressing

VIRAL AND PHYTOPLASMAL DISEASES

10. Rice Tungro Disease (RTD)

Causal organism : ***Rice tungro virus***

Symptoms: Infection occurs in nursery and main field. The chief symptoms are stunted growth of plant, reduced tillering, discolouration of leaves in various shades of yellow to orange. The discolouration starts from the tip and proceeds downwards. Older leaves exhibit rusty spots or dots of different sizes. The earheads are small and grains are ill-filled. The virus is transmitted by green leaf hoppers

11. Rice Yellow Dwarf Disease

Causal organism : Candidatus Phytoplasma

Symptoms: Plants become pale green, chlorotic and stunted. Large number of thin and pale tillers with yellowish green leaves are seen. There is excessive tillering . Affected plant looks like a clump of grass. Infected plants remain sterile. The disease in transmitted by Green leaf hoppers Disease management

Prophylactic measures as seed treatments

Dry seed treatment

Thiram or captan or carboxin or carbendazim at 2 g/kg of seeds.

Treat the seeds at least 24 hours prior to soaking for sprouting.

The treated seeds can be stored for 30 days without any loss in viability.

Wet seed treatment

Carbendazim or Tricyclozole at 2 g/lit of water for 1 kg of seed.

Soak the seeds in the solution for 2 h Drain the solution, sprout the seeds and sow in the nursery bed. This wet seed treatment gives protection to the seedlings up to 40 days from seedling disease such as blast and this method is better than dry seed treatment **or** Treat the seeds with talc based formulation of *P. fluorescens* (Pf1) @ 10g/kg of seed and soak in 1lit of water overnight. Decant the excess water and allow to sprout the seeds for 24 h and then sow.

Seedling dip with *Pseudomonas fluorescens*

Stagnate water to a depth of 2.5cm over an area of $25m^2$ in the main field. Sprinkle 2.5 kg of the talc based formulation of *Pseudomonas fluorescens* (Pf1) and mix with stagnated water. The seedlings pulled out from the nursery are to be soaked for 30 min. in the stagnated water and then transplanted. Biocontrol agents are compatible with biofertilizers

Biofertilizers and biocontrol agents can be mixed together for seed soaking

Fungicides and biocontrol agents are incompatible

i.) Nursery Diseases

1.Blast:Spray any one of the following: (for 20 cents): Carbendazim 50WP @ 1g/l or Tricyclozole 75 WP @ 1g/l or Metominostrobin 20 SC @ 1ml/l or

Azoxystrobin 25 SC @ 1 ml/l

2.Brown spot

Spray **(for 20 cents)** Metominostrobin @ 1ml /lit of water

3.Rice Tungro Disease (RTD)

To control Vector- hoppers

Apply Carbofuran 3G @ 3.5kg at 10 DAS or

Spray 2 rounds (10 and 20 DAS) with any one of the following insecticides for 20 cents area

Thiamethoxam 25 WDG 8g or Imidacloprid 17.8 SL 8ml

ii.) Main Field

Blast

Cultural method

 Remove collateral weed hosts from bunds and channels

 Use only disease free seedlings

 Avoid excess nitrogen

 Apply N in three split doses (50% basal, 25% in tillering phase and 25% N in panicle initiation stage)

Use resistant variety CO 47.

Chemical

Spray after observing initial infection of the disease,

 Carbendazim 50WP @ 500g/ha (or)

 Tricyclozole 75 WP @ 500g/ha (or)

 Metominostrobin 20 SC @ 500ml/ha (or)

 Azoxystrobin 25 SC @ 500 ml/ha

Biological control

 Seed Treatment with TNAU Pf 1liquid formulation @ 10 ml/kg of seeds

 Seedling root dipping with TNAU Pf 1liquid formulation (500 ml for

one hectare seedlings)

 Soil application with TNAU Pf 1liquid formulation (500ml/ha)

Foliar spray with TNAU Pf 1liquid formulation @ 5ml/lit

2.Brown spot

Spray Metominostrobin @ 500ml/ha

3.Sheath rot

Cultural

Apply Gypsum @ 500 kg/ha at two equal splits once basally and another at active tillering stage.

Botanicals

Neem oil 3%

Ipomoea leaf powder extract (25 kg/ha)

Prosopis leaf powder extract (25 kg/ha). First spray at boot leaf stage and second 15 days later

Chemical

Spray any one of the following:

Carbendazim @ 500g/ha

Metominostrobin @ 500 ml/ha

Hexaconazole 75% WG @ 100 mg/ lit 1st spray at the time of disease appearance and 2nd spray 15 days later

Biological control

 Seed Treatment with TNAU Pf 1liquid formulation @ 10 ml/kg of seeds

 Seedling root dipping with TNAU Pf 1liquid formulation (500 ml for one hectare seedlings)

Soil application with TNAU Pf 1liquid formulation (500ml/ha)

Foliar spray with TNAU Pf 1liquid formulation @ 5ml/lit

4.Sheath blight

Cultural

Apply Neem cake at 150 kg/ha

Botanical

Foliar spray with Neem oil at 3% (15 lit /ha) starting from disease appearance

Chemicial

Carbendazim 50 WP @ 500g/ha

Azoxystrobin @ 500ml/ha

Hexaconazole 75% WG @ 100mg/ lit 1st spray at the time of disease appearance and 2nd spray 15 days later

Biological control

 Seed Treatment with TNAU Pf 1liquid formulation @ 10 ml/kg of seeds

 Seedling root dipping with TNAU Pf 1liquid formulation (500 ml for one hectare seedlings)

Soil application with TNAU Pf 1liquid formulation (500ml/ha)

Foliar spray with TNAU Pf 1liquid formulation @ 5ml/lit

5.False smut

Two sprayings of Propiconazole 25 EC @ 500ml/ha **(or)** Copper hydroxide 77 WP @ 1.25 kg/ha at boot leaf and 50% flowering

6.Rice grain discoloration

Chemical Spray : Carbendazim + Thiram + Mancozeb (1:1:1) 0.2% at 50% flowering stage.

7.Bacterial blight

Two sprays of Copper hydroxide 77 WP@1.25 kg/ha 30 DAP & 45 DAP

Botanical / others

Spray fresh cowdung extract 20% twice (starting from initial appearance of the disease and another at fortnightly interval)

Neem oil 60 EC 3% (or) NSKE 5% is recommended for the control of sheath rot, sheath blight, grain discolouration and bacterial blight

For viral and Phytoplasma diseases

Cultural method

Plough the stubbles as soon as the crop is harvested to prevent the survival of yellow dwarf pathogen during off-season.

Physical methods

Light traps are to be set up to attract and control the leaf hopper vectors as well as to monitor the population.

In the early morning, the population of leafhopper alighting near the light trap should be killed by spraying/dusting the insecticides. This should be practiced every day.

Spray Two rounds of any one of the following insecticides

Thiamethoxam 25 WDG 100g/ha Imidacloprid 17.8 SL 100ml/ha at 15 and 30 days after transplanting. The vegetation on the bunds should also be sprayed with the insecticides.

2. DISEASES OF PEARL MILLET

1. Downy mildew or Green ear

Causal organism : *Sclerospora graminicola*

Symptoms: Two stages (i) Downy mildew stage (ii) Green ear stage

Downy mildew stage: Affected leaf exhibits white downy growth in patches on its lower surface. These patches expand and cover the entire lamina which turns yellow in due course. The downy growth consists of sporangiophores and sporangia.

Green ear stage : The earheads are converted into green leafy structures either partially or fully. The oospores serve as primary source of inoculum.

Favourable Conditions : Very high humidity (90%);Presence of water on the leaves; Low temperature of 15-25˚C favor the formation of sporangiophore and sporangia.

2. Rust

Causal organism: *Puccinia penniseti*

Symptoms: Infection is seen in the form of brownish yellow pustules on both the leaf surfaces. These represent the uredia of the fungus. Teliosori are black and seen on leaf and leaf sheath. Brinjal is the alternate host.

Favourable Conditions : Closer spacing ;Presence of abundant brinjal plants and other species of *Solanum* viz., *S.torvum, S. xanthocarpum* and *S. pubescents.*

3. Smut

Causal organism : *Tolyposporium penicillariae*

Symptoms: The disease becomes apparent at the time of grain set. A few grains, sporadically distributed on the earhead are replaced by green to black sori, which are much bigger than normal grains. The sorus wall is tough, surrounding the powdery mass of smut spores which are in balls.

Favourable Conditions : High relative humidity; Successive cropping with pearlmillet

4. Ergot / Sugary disease

Causal organism: *Claviceps fusiformis*

Symptoms: Small droplets of pinkish sticky fluid oozes out of the spikelets. The affected spikelets turn black and several such dark sticky patches are seen on the earhead. Grain formation is inhibited. The honey dew contains large number of hyaline single celled conidia. Later infected ovaries get converted into sclerotia.

A. Management of pearl millet diseases

1.Seed treatment

Removal of ergot / sclerotia to prevent primary infection

Dissolve 1 kg of common salt in 10 litres of water. Drop the seeds into the salt solution. Remove the ergot and sclerotia affected seeds which will float. Wash seeds in fresh water 2 or 3 times to remove the salt on the seeds. Dry the seeds in shade. Treat the seeds with Thiram @ 2g /kg of seed. Treat the seeds with Metalaxyl 6g/kg for the control of downy mildew in endemic areas

2. Downy Mildew: *Sclerospora graminicola*

- Grow downy mildew resistant varieties CO7, WCC 75, CO(Cu)9, TNAU-Cumbu Hybrid-CO9
- Transplanting reduces disease incidence. At the time of planting infected seedlings should be removed.
- In the direct sown crop, infested plants should be removed up to 45 days of sowing as and when the symptoms are noticed.

 Spray any one of the fungicides
 Metalaxyl + Mancozeb @500 g or Mancozeb 1000g/ha

3.Rust: *Puccinia penniseti*

Sowing during December - May result in less incidence.

Adopt control measures when there is rust incidence in the early stages as spread of infection to top leaves results in poor grain filling.

Spray any one of the following fungicides when the initial symptoms of the diseases are noticed.

 Wettable sulphur 2500g / ha
 Mancozeb 1000g/ha
 Repeat application 10 days after if necessary.

4.Sugary or Ergot disease: *Claviceps fusiformis*

Spray any one of the fungicides like Carbendazim 500g or Mancozeb 1000g /ha when 5 - 10% flowers have opened and again at 50% flowering stage.

B.Integrated management strategies for major pest and diseases of pearl millet

Seed treatment with Metalaxyl @ 6g/kg of seeds + Seed treatment with Imidacloprid @ 5g/kg of seeds + Removal of downy mildew infected plants up to 45 days of sowing + Spraying of Mancozeb @ 1000g/ha + Spraying of NSKE 5% @ 50% flowering against downy mildew, rust and shoot fly.

3. DISEASES OF FINGER MILLET

1. Blast

Causal organism: *Pyricularia grisea*

Symptoms: Infection occurs from sowing to crop maturity. On leaves, the spots are spindle shaped with brown margin and necrotic grey center. Conidiophores and conidia are formed in the center of the spots. Stem infection causes blackening of the region on either side of node leading to weakening, shrinking and breaking of plant. Ear head infection results in black discolouration either at neck region or at any portion of rachis. This causes either chaffiness or partial filling of grains.

2. Seedling blight / leaf spot:

Causal organism : *Helminthosporium nodulosum*

Symptoms: The fungus attacks all plant parts. Leaves show small oval elongated brown spots. The spots merge together to form bigger lesions and turn dark brown. Spots are also noticed on culm, leaf sheath, neck and panicle.

3. Mosaic / Mottle streak

Causal organism : *Finger millet mosaic virus / Finger millet mottle streak virus*

Symptoms: Affected leaves exhibit chlorotic streaks. Plants become stunted and pale. Earheads are small and grains are ill-filled. Vector: Jassid

A.Nursery

Seed treatment: Thiram 4 g or Captan 4 g or Carbendazim 2 g/kg or *Pseudomonas fluorescens* @10g/kg of seed.

Main field

1.Blast:

- Spray any one of the fungicides Edifenphos 500 ml or Carbendazim 500 g or Iprobenphos(IBP) @ 500 ml/ha. First spray immediately after noticing the symptoms. Second and third sprays at flowering stage at 15 days interval to control neck and finger infection.
- Foliar spray with Aureofungin sol 100 ppm at 50% earhead emergence followed by a second spray with Mancozeb 1000g/ha or *Pseudomonas fluorescens* @ 0.2% 10 days later

2.Virus diseases:Mosaic and Mottle streak

- Rogue out the affected plants.
- Spray any one of the insecticides like Monocrotophos 36 WSC 700 ml/ha or Methyl dematon 25EC 500 ml/ha on noticing symptoms and repeat twice if necessary at 20 days intervals for control of insect vectors

4. DISEASES OF MAIZE

1. Downy mildew / Crazy top

Causal organism: *Peranosclerospora sorghi*

Symptoms: Chlorotic streaks appear on the leaf and white fungus growth is seen on both the surfaces of leaf. Affected plants become stunted and exhibit bushy appearance due to shortening of internodes. Sometimes leafy growths in the tassel and proliferation of axillary buds on the stalk of the tassel are noticed.

Favourable Conditions : Low temperature (21-33˚C);High relative humidity (90 per cent) and drizzling;Young plants are highly susceptible.

2.Rust

Causal organism: *Puccinia sorghi*

Symptoms: On both the surfaces of the leaf, brown pustules are seen. These represent the uredosori of the fungus. The alternate host is *Oxalis corniunlata*. Cool temperature and high relative humidity favours the disease

3. Leaf Blight

Causal organism: *Exserohilum turcicum* & *Helminthosporium maydis*

Turcicum Leaf Blight Symptoms: The fungus affects the crop at young stage. Early symptoms are oval, water-soaked spots on leaves. Mature symptoms are characteristic cigar shaped lesions that are 3 to 15cm long. Lesions are elliptical and tan in color, developing distinct dark areas as they mature that are associated with fungal sporulation. Lesions typically first appear on lower leaves, spreading to upper leaves and the ear sheaths as the crop matures. Under severe infection, lesions may coalesce, blighting the entire leaf.

Maydis Leaf Blight Symptoms:: Small yellowish round or oval spots appear on the leaves. These spots enlarge become elliptical and the center becomes straw coloured with a reddish brown margin. Conidia and conidiophores are formed in the center.

Favourable Conditions : Optimum temperature for the germination of conidia is 8 to 27˚C provided with freewater on the leaf;Infection takes place early in the wet season.

4.Charcoal rot

Causal organism: ***Macrophomina phaseolina***

Symptoms: The pathogen affects the plant mostly after flowering and the disease is named as Post Flowering Stalk Rot **(PFSR)**. The stalk of the

infected plants can be recognized by greyish streak. The pith becomes shredded and greyish black minute sclerotia develop on the vascular bundles. Shredding of the interior of the stalk often causes stalks to break in the region of the crown. The crown region of the infected plant becomes dark in colour. Shredding of root bark and disintegration of root system are the common features. High temperature and low soil moisture (drought) favours the disease

5.Bacterial Stalk rot

Causal organism: ***Erwinia dissolvens*****Symptoms:**The basal internodes develop soft rot and give a water soaked appearance. A mild sweet fermenting odour accompanies such rotting. Leaves some time show signs of wilting and affected plants topple down in few days. Ears and shank may also show rot. They fail to develop further and the ears hang down simply from the plant

B.Disease Management

1.Seed treatment: Carbendazim @ 2 g/kg or Thiram @ 4g/kg or Metalaxyl @ 3g/kg of seed

2. Downy mildew or Crazy top

Use resistant TNAU maize hybrid CO-6 Rogue out affected plants.

Spray Metalaxyl+ Mancozeb @ 1000g, Mancozeb 1000g/ha at 20 days after Sowing

3.Leaf blights

Spray Mancozeb or Zineb @2 -4 g/litre at 10 days interval after first appearance of the disease

4.Post Flowering Stalk rot

Follow crop rotation

Avoid water stress at flowering time reduced disease incidence

Avoid nutrient stress. Apply potash @ 80 kg/ha in endemic areas

Soil application of *P. fluorescens* (or) *T. viride* @ 2.5 kg / ha + 50 kg of well decomposed FYM or sand at 30 days after sowing

5.DISEASES OF PULSES

I. DISEASES OF REDGRAM

1. Wilt

Causal organism : *Fusarium oxysporum f.sp.udum*

Symptoms: The infected plants show gradual wilting and drying. Yellowing and premature drying of leaves and stems are noticed. The basal portion of stem and root region becomes black. When the bark of infected root is peeled, black streaks are seen and vascular tissues show discolouration. Xylem vessel is occupied by the growth of the hyphae which prevent the uptake of nutrients and water resulting in the death of plant.

Favourable conditions : Soil temperature of 17-25˚C; Continuous cultivation of redgram in the same field.

2. Powdery mildew

Causal organism: *Leveillula taurica*

Symptoms: On the lower surface of leaf, white powdery growth is seen in patches. Corresponding areas on the upper surface become yellow. This leads to premature shedding of leaves. Dry humid weather following rainfall favours the disease.

3. Leaf spot

Causal organism: *Cercospora indica*

Symptoms: Leaves show light brown small spots. Shot holes are formed in due course. Lesions develop on petioles and stem.

4. Sterility mosaic

Causal organism : *Pigeonpea sterility mosaic virus*

Symptoms: The affected plants are stunted and the internodes are shortened. Axillary buds are stimulated to grow and the branches are crowded at the top. The plant gives a bushy appearance. Leaves become small and crinkled exhibiting mottling symptom.The Eriophid mite *Aceria cajani* transmits the disease**.**

Disease Management:

1.Seed treatment

Talc formulation of *Trichoderma viride* @ 4g or *P. fluorescens* @ 10 g/kg seed (or) Carbendazim 2 g/kg or Thiram @ 4 g/kg.

2.Wilt

P. fluorescens (or) *T. viride* – 2.5 kg / ha + 50 kg of well decomposed FYM or sand at 30 days after sowing

3.Root rot : ***Spot drenching with Carbendazim @ 1 gm/ lit***

4.**Sterility Mosaic :** Rogue out the infected plants in the early stages of ***growth.***

Spray Fenazaquin @ 1 ml/lit on 45 and 60 DAS as prophylactic spray.

II. DISEASES OF BENGALGRAM

1. Blight

Causal organism : ***Ascochyta rabiei***

Symptoms: Infected leaflets exhibit round or elongated lesions bearing depressed brown spots surrounded by a brown margin. Spots also appear on a stems and pods. The spots on the stem and pod have pycnidia arranged in concentric circles as black dots. The fungus is carried through seeds.

Favourable conditions : High rainfall during flowering;Temperature of 20-25˚C;Relative humidity of 60%.

2. Rust

Causal organism : ***Uromyces ciceris-arietini***

Symptoms: Small oval, brown powdery lesions appear on the lower surface of the leaf. Later the lesions can be seen on both the surfaces. Uredosori cover the entire leaf area and late in the season dark teliosori appear on the leaves. The fungus survives as uredospores in the legume weed *Trigonella polycerata*

3. Wilt

Causal organism : ***Fusarium oxysporum*** **f.sp.** ***Ciceris***

Symptoms: Infection may occur at seedling or flowering stage. Affected plant exhibits drooping of leaves in the upper part and quickly the entire plant exhibits the symptom. Dark brown or black discolouration is noticed below and above the collar region. Vascular browning is conspicuously seen as black streaks on the stem and root below the bark. High soil temperature (above 25˚C) and high soil moisture favours the disease.

Disease Management

1.Seed treatment: Talc formulation of *T. viride* @ 4g or *P. fluorescens* @ 10 g/kg seed (or) Carbendazim @ 2 g/kg or Thiram @ 4 g/kg of seed

2. Blight

Exposure of seed at 40-50˚C reduced the survival of *A. rabiei* by about 40-70 per cent. Spray with Carbendazim at 500 g/ha or Chlorothalonil 1kg/ha. Follow crop rotation with cereals.

Rust

Destory weed host.

Spray Carbendazim 500 g/ha or Propiconazole 1L/ha

4.Wilt:

Soil application with P. *fluorescens* @ 2.5 kg/ha + 50 kg of well decomposed FYM or sand.

III. DISEASES OF BLACKGRAM AND GREENGRAM

1. Root rot

Causal organism : *Rhizoctonia bataticola*

Symptoms: Affected plant exhibits drooping and drying of leaves and branches. The basal portion of stem turns brown and the bark of the roots become shredded. Large number of spherical to irregular black sclerotia can be seen in shredded tissues.

Favourable conditions : Day temperature of 30˚C; Prolonged dry season followed by irrigation.

2. Powdery mildew

Causal organism : *Erysiphe polygoni*

Symptoms: On the upper surface of leaf, white powdery growth of the fungus is seen. More often, the entire surface is covered. The colour of

the growth later turns grey and the leaves become brown. The disease becomes severe during flowering and maturity stages. The white growth consists of the external mycelium, conidiophores and conidia.

Favourable Conditions : Warm humid weather. The disease is severe generally during late kharif and rabi seasons.

3. Leaf spot

Causal organism : *Cercospora canescens*

Symptoms: Small circular to irregular reddish spots are observed on the surface of leaves. The center later turns grey and defoliation occurs in severe cases. Large number of conidiophores and conidia are formed in the center. Lesions can also be seen on petioles and stem.

Favourable Conditions : Humid weather and dense plant population

4. Rust

Causal organism : *Uromyces phaseoli typical*

Symptoms: On the lower surface of leaf reddish brown pustules are seen in abundance, representing the uredosori of the fungus. Affected leaves turn yellow. The uredospores are brown, echinulate and single celled. Teliospores are elliptical and papillate. The fungus is an autoecious, macrocyclic rust.

Favourable Conditions : Cloudy humid weather, temperature of 21-26˚ C .Nights with heavy dews.

5. Yellow mosaic

Causal organism : ***Mungbean yellow mosaic virus*** **(MYMV)**

Symptoms: The initial infection is observed as small irregular, yellow patches on leaves. These patches enlarge in size and cover the entire

lamina. The whole leaf later completely turns yellow. Pods become yellow, small and distorted.

Favourable condition: Transmitted by whitefly, *Bemisia tabaci* under favourable conditions. Disease spreads by feeding of plants by viruliferous whiteflies. Summer sown crops are highly susceptible. Weed hosts viz., *Croton sparsiflorus, Acalypha indica*, *Eclipta alba* and other legume hosts serve as reservoir for inoculum.

6. Disease : Leaf crinkle

Causal organism : *Urdbean leaf crinkle virus* (ULCV)

Symptoms: Initial symptoms appear on young leaves. Affected leaves are puckered and curled. The plants get stunted and appear bushy. Petioles and internodes are shortened. The inflorescence is deformed. Flowers seldom open.

Favourable condition:

Presence of weed hosts like *Aristolochia bracteata* and *Digera arvensis.* Kharif season crop and continuous cropping of other legumes serve as source of inoculum. The virus is seed-borne and primary infection occurs through infected seeds. Perhaps white fly, *Bemisia tabaci* helps in the secondary spread. The virus is also sap transmissible.

Disease management:

1.Seed treatment

a.Talc formulation of *T. viride* @ 4g or *P. fluorescens* @ 10 g/kg seed (or) Carbendazim 2 g/kg or Thiram @ 4 g/kg

b.**Root rot-stem fly complex**

Seed treatment with *Beauveria bassiana* + *Pseudomonas fluorescens* @ 5 g each/kg of seed

2.Powdery Mildew

- Spray NSKE 5% or Neem oil 3% twice at 10 days interval from initial disease appearance.
- Spray Eucalyptus leaf extract 10% at initiation of the disease and 10 days later.

Spray Carbendazim 500 g or wettable sulphur 1500g/ha or Propiconazole 500 ml/ha at initiation of the disease and 10 days later

3.Rust

Spray Mancozeb 1000g or wettable sulphur 1500g /ha at initiation of the disease and 10 days later.

4.Leaf spot

Spray Carbendazim 500 g/ha or Mancozeb 1000g /ha at initiation of the disease and 10 days later.

5.Yellow mosaic and Leaf Crinkle

Integrated Disease Management

- Growing resistant varieties such as VBN 4, VBN 6 and VBN 7
- Seed treatment with Dimethoate (or) Imidacloprid @ 5 ml /kg
- Installation of yellow sticky traps 12 nos/ha
- Rogue out the infected plants up to 45 days
- Foliar spray of notchi leaf extract 10% at 30 DAS or neem formulation 3 ml/lit Spray methyl demeton 25 EC 500 ml/ha or dimethoate 30 EC 500 ml/ha or thiamethoxam 75 WS 1g /3 lit and repeat after 15 days, if necessary.

Root rot

- Seed treatment with *Trichoderma viride* 4 g/kg or *Pseudomonas fluorescens*
- 10 g/kg
- Basal application of zinc sulphate 25 kg/ha
- Basal application of neem cake @ 150 kg/ha
- Soil application *P. fluorescens* or *T. viride* – 2.5 kg / ha + 50 kg of well
- decomposed FYM or sand at 30 days after sowing.
- Spot drenching of Carbendazim @ 1 gm/ lit

6. D**ISEASES OF COTTON**

1. Fusarium wilt

Causal organism : *Fusarium oxysporum* f.sp. *vasinfectum*

Symptoms: In the affected plants, leaves loose their turgidity, turn yellow and fall off. Symptoms start from the base and proceed upward. . The plant starts wilting and finally dries . The tap root is stunted and lateral roots are limited. On the wood region of roots and stem black streaks are seen. The vascular bundles of affected plants are traversed by the growth of hyphal threads. The mycelium is septate and hyaline. The fungus produces micro and macroconidia and chlamydospores.

Favourable Conditions :

- Soil temperature of 20-30˚C
- Hot and dry periods followed by rains
- Heavy black soils with an alkaline reaction
- Increased doses of nitrogen and phosphatic fertilizers
- Wounds caused by nematode *(Meloidogyne incognita and* grubs of Ash weevil *(Myllocerus pustulatus).*

Disease : Verticillium wilt

Causal organism : *Verticillium dahliae*

Symptoms: The affected plants are severely stunted. Leaves exhibit bronzing of veins followed by interveinal chlorosis and yellowing of leaves. Leaves dry giving a scorched appearance. The characteristic feature is the drying of leaf margin and interveinal areas. Infected stem and roots show pinkish discolouration of the wood.

Favourable Conditions :

 Low temperature of 15-20˚C,

 Low lying and ill-drained soils,

 Heavy soils with alkaline reaction

Heavy doses of nitrogenous fertilizers.

3. Disease : Root rot

Causal organism : *Rhizoctonia solani*

Symptoms: Affected plant wilts suddenly and decay of root system observed. The bark of the root and the lower portion of the stem gets shredded. Large number of sclerotia are found on the affected tissue.

Favourable conditions:

 Dry weather following heavy rains,

 High soil temperature (35-39˚C),

 Cultivation of favourable hosts like vegetables,

 Oil seeds and legumes preceding cotton

Wounds caused by ash weevil grubs and nematodes.

4. Leaf blight

Causal organism : *Alternaria macrospora*

Symptoms: The leaves show brown, round to irregular necrotic spots.

The spots show concentric rings. The spots merge to form bigger patches and the infected leaf withers.

Favourable Conditions: High humidity; Intermittent rains; Moderate temperature of 25-28˚ C.

5. Myrothecium leaf spot

Causal organism : *Myrothecium roridum*

Symptoms: The spots are circular with grey centers and dark brown margin. The center of the spot dries and withers leaving a shot hole.

6. Areolate mildew

Causal organism : *Ramularia areola*

Symptoms: The spots are observed on lower surface of leaves. Lesions are irregular to angular, pale white bound by veinlets. They show frosty white growth consisting of conidiophores and conidia. Leaves became chlorotic and yellow.

Favourable Conditions

Wet humid conditions during winter cotton season; Intermittent rains during Nor th-East monsoon season;Low temperature (20-30˚C) during October-January; Close planting, excessive application of nitrogenous fertilizers;Very early sowing or very late sowing of cotton

7.Angular leaf spot / Black arm

Causal organism : *Xanthomonas axonopodis* pv. *malvacearum*

Symptoms:

Angular leaf spot

Symptoms are observed on the leaves, stem and branches and on bolls. On leaves, angular brown to black water soaked spots are seen and the

spots are restricted by veins.

Black vein

The infection spreads to the vein and the affected vein becomes black With bacterial ooze forming an encrustation on veins. This is vein blight stage (black vein).

Black arm

On the surface of stems and branches, elongate black lesions are observed. This causes breaking of the branches which hang on the affected plant. This is black arm stage.

Boll rot.

On the surface of bolls, round to irregular black water soaked, sunken lesions develop. This causes premature opening and shedding of bolls. The lint turns yellow because of bacterial ooze. The bacterium is a Gram negative rod with a single polar flagellum.

Favorable Conditions : Optimum soil temperature of 28˚C; High atmospheric temperature of 30-40˚C;Relative humidity of 85 per cent, early sowing, ;Delayed thinning;Poor tillage, late irrigation;Potassium deficiency in soil ;Rain followed by bright sunshine during the months of October and November are highly favorable.

Disease Management:

Soil drenching with Trifloxystrobin+Tebuconazole – 0.75g/litre .

2. Root rot

Cultural Method

Apply Neem cake @ 150 kg/ha to the soil and treat the seeds with talc based *T. viride* @ 4 g/kg to reduce the root rot incidence.

Biological control

Seed treatment with *T. viride* @ 10 g/kg followed by basal application of zinc sulphate @ 50 kg/ha

Seed treatment with *Bacillus* (BSC 5) @ 10g/kg followed by soil application @ 2.5 kg/ ha in 250kg of compost at the time of sowing. Seed treatment with *Pseudomonas* (PF1) @ 10g/kg and soil application @ 2.5 kg/ha in 250 kg of compost at the time of sowing.

Chemical

Spot drench Carbendazim @ 1 g/lit at the base of affected plants as well as surrounding healthy plants.

2.Wilts

Treat the acid delinted seeds with Carboxin or Carbendazim at 2 g/kg. Remove and burn the infected plant debris in the soil after deep summer ploughing during June-July. Apply increased doses of potash with a balanced dose of nitrogenous and phosphatic fertilizers. Apply heavy doses of farm yard manure or other organic manures @100t/ha. Follow mixed cropping with non-host plants. Grow disease resistant varieties of *G. hirsutum* and *G. barbadense* like Varalakshmi, Vijay Pratap, Jayadhar and Verum. Spot drench with Carbendazim 1g/litre.

Verticilium wilt: Follow crop rotation by growing paddy or lucerne or chrysanthemum for 2-3 years. Spot drench with 0.05g/l benomyl or carbendazim 500mg/l. Grow disease resistant varieties like Sujatha, Suvin and CBS 156 and tolerant variety like MCU 5 WT.

Alternaria leaf spot

Spray any one of the following: Copper Oxychloride 1250g or Mancozeb 1000g or Chlorothalonil

500g/ha or Difenaconazole- 0.05%. **or** Krexoxym methyl – 0.1% Tebuconazole – 1ml/

litre Trifloxystrobin+Tebuconazole – 0.6g/litre 60, 90 and 120 days after sowing.

Bacillus subtilis (BSC 5) – 0.04% on 60, 90 and 120 days after sowing.

Grey Mildew

Spray Carbendazim 250 g/ha or Mancozeb 1000g or Chlorothalonil 500g/ha or Difenaconazole- 0.05% or Krexoxym methyl – 0.1% or Tebuconazole – 1ml/litre 60, 90 and 120 days after sowing

Bacterial leaf blight

Avoid stacking of infected plants Spray Streptomycin sulphate + Tetracycline mixture 100g + Copper oxychloride 1250g/ha.

Repeat spraying at 10 days interval twice or thrice if drizzling continues

Boll rot Spray any one of the following:

Carbendazim 500g or Mancozeb 2000g or Copper oxychloride 2500g/ha along with an insecticide recommended for bollworm from 45th day at fortnightly interval.

7. DISEASES OF SUGARCANE

1. Red rot

Causal organism : *Colletotrichum falcatum*

Symptoms: Symptoms are observed on the leaves and canes. On the midrib, circular to oval spots with red margin and straw coloured center are observed. In the central region, acervuli could be seen black dots. The infected leaves break at the lesions. In the affected canes, the internal tissues become red with cross white patches. The stalks become hollow.

Favourable Conditions: Monoculturing of sugarcane;Successive ratoon cropping; Water logged conditions and injuries caused by insects; Monoculturing of sugarcane; Successive ratoon cropping.; Water logged conditions and injuries caused by insects.

2. Sett rot or Pineapple disease

Causal organism : - *Ceratocystis paradoxa*

Symptoms: The disease is observed as soon as the setts are planted. The central core of affected tissue turns black. Cavities are formed in the etts and the rotting tissues emit pineapple odour.

Favourable Conditions : Poorly drained fields; Heavy clay soils ;Temperature of 25-30^{o} C ; Prolonged rainfall after planting.

3. Whip smut

Causal organism : *Ustilago scitaminea*

Symptoms: The affected plants are stunted and the central shoot is converted into a long curved whip like sorus. The sours is covered by a silvery, membrane which soon ruptures exposing a dark mass ofteliospores.

4.Favourable Conditions : Monoculturing of sugarcane; Continuous ratooning and dry weather during tillering stage.

5. Disease : Mosaic

Causal organism : *Sugarcane mosaic potyvirus*

Symptoms: The disease appears prominently on young leaves. Linear chlorotic stripes alternating with dark green areas are seen on the leaves.

At \ later stages yellow stripes appear on leaf sheath and stalk. The virus is a rod. The virus gets transmitted by setts and the aphid, *Raphalosiphum maidis*.

6. Disease : Grassy shoot Disease(GSD)

Causal organism : Candidatus phytoplasma

Symptoms: Large number of lanky tillers are produced from the Affected sett. Leaves become narrow, pale green to white in colour. The internodes get shortened and plants appear bushy due to excessive tillering. The pathogen in transmitted by Aphids-*Melanaphis sacchari and Rhaphalosiphum maidis*

8. Disease : Phanerogamic parasite

Causal organism : *Striga spp.*

Symptoms: It is partial root parasite with chlorophyll bearing leaves. The parasite attaches to the host root by haustoria and suck the mineral nutrients and water. As a result the parasitised cane becomes stunted.

Management:

Red rot:

Selection of setts from healthy nursery programme growing of Recommended resistant and moderately resistant varieties *viz*., Co86249, CoSi95071, CoG 93076, CoC 22, CoSi 6 and CoG 5 Adopt sett treatment With Carbendazim before planting (Carbendazim 50 WP, @ 0.05% or Carbendazim 25 DS @ 0.1% along with 1.0% Urea for 5 minutes) the Irrigation interval in a red rot affected field must be lengthened. Once in 15 days during tillering, growth phases and once in 25 days during

Maturity phase which restricts the spread. Removal of the affected Clumps at an early stage and soil drenching with 0.1 % Carbandazim 50 WP or 0.25 % lime. The trash of red rot affected field after harvest may be uniformly spread And Burnt The red rot affected field must be rotated with rice for one season and Other crops for two seasons.

Smut:

Growing of resistant and moderately resistant varieties viz., Co 86249, CoG

- 93076, CoC 22, CoSi6 and CoG 5
- Sett treatment with fungicides *viz*., Triadimefon @ 0.1% or Carbendazim @ 0.1% for 10 minutes.
- Treating the seed setts with Aerated Steam Therapy (AST) at 50 ºC for 1 hour or in hot water at 50 ºC for 30 minutes or at 52 ºC for 18 minutes Removal of smut whips with gunny bags/polythene bag and burnt Discourage ratooning of the diseased crops having more than 10 per cent infection

Phanerogamic parasite

- Regular weeding and intercultural operation during early stages of parasite growth. Spray Fernoxone (sodium salt of 2, 4-D) at 450g /500 litre of water.

General management

Select healthy setts for planting. In the seed crop, select plants which do not show symptoms of red rot, smut, grassy shoot and ratoon stunting. Setts showing red colour at the cut end and hollows should be rejected and burnt.

Set fire to residues of previous crop to eliminate debris of fungal pathogens.

In fields which had shown high level of red rot disease, follow crop rotation with rice. The setts should be soaked in 0.1% Carbendazim or 0.05% Triademefon for 15 minutes. Treat setts with aerated steam at 50°C for one hour to control primary infection of grassy shoot disease.Clumps infected by grassy shoot, smut and ratoon stunting diseases should be

immediately uprooted and destroyed.Use resistant varieties for the following

diseases: Red rot CO 62198, CO 7704 (Resistant),

8. DISEASES OF OILSEEDS

I . DISEASES OF GROUNDNUT

1. Early leaf spot: *Cercopora arachidicola*

Late leaf spot: *Phaeoisariopsis personata*

Symptoms:

a.Early leaf spot: The sports are circular to irregular and reddish brown to dark brown in colour. Spots appear on the upper surface, encircled by a bright yellow halo. On the lower surface the lesions are light brown in colour.

b. Late leaf spot: Leaves show dark, small, circular spots scattered on the surface and appear in large numbers. The lower surface of the lesion turns to carbonaceous black. Petioles and stem also exhibit black elongated lesions. Spotted leaves shed prematurely

The mycelium is inter and intracellular. Conidiophores are short, olivaceous brown, 1-2 septate and geniculate, arising in clusters.

Favourable Conditions : Prolonged high relative humidity for 3 days Low temperature (20 C) with dew on leaf surface; Heavy doses of

nitrogen andphosporus fertilizers ; Deficiency of magesium in soil.

2. Rust :

Causal organism : *Puccinia arachidis*

Symptoms: The leaflets exhibit large number of small powdery pustules on the lower surface. Correspondingly the upper surface shows yellow discolouration which later turns brown. Pustules coalesce and severe infection causes drying and shedding of leaves. Pustules are also seen on petiole and stem. The pustules represent the uredosori.

Favourable Conditions

High relative humidity (above 85 per cent);Heavy rainfall.Low temperature (20-25˚C).

3. Collar rot / Seedling blight / Crown rot

Causal organism : ***Aspergillus niger*** *and* ***A. pulverulentum***

Symptoms: The fungus causes pre-emergence and post-emergence rot and crown rot symptoms.

Post-emergence rot: Young seedlings exhibit circular brown spots on cotyledons. Similar spots appear on the collar region. The affected portion becomes soft and rots. Profuse growth of the fungus is seen on the affected regions.

Crown rot: The adult plants develop large brown lesions on the stem. Leaves droop and plants wilt.

4. Root rot

Causal organism : *Macrophomina phaseolina*

Symptoms: The affected plants exhibit reddish brown discolouration on the stem near soil level. Leaves and branches droop and the whole plant wilts. White mycelial growth is observed on the lesions. The bark of the root becomes shredded and large number of sclerotia are formed in the shredded tissues and also on the wood.

Favourable Conditions : Prolonged rainy season at seedling stage and Low lying areas.

5.Disease : Ring mosaic / Bud necrosis / Bud blight

Causal organism : *Groundnut bud necrosis virus*

Symptoms: The disease is characterized by mottling and ring spotting of leaves, reduction in leaf size and stunting of plants. Leaves are malformed to varying sizes and they become narrow with necrotic lesions. Stem also exhibits streaks and necrosis of bud occurs in advanced stages. The virus is transmitted by the thrips, *Frankliniella schultzi* and *Thrips tabaci*

Disease management

1. Seed treatment: Treat the seeds with any one of the following Thiram @ 4g/kg of seed or Mancozeb @ 4g/kg of seed or Carboxin @ 2g/kg of seed or Carbendazim @ 2g/kg of seed or Talc formulation of *T. viride* @ 4g/kg of seed or *P. fluorescens* @10g/kg of seed.

2. Early leaf Spot and Late leaf Spot:

Spray any one of the following:

Carbendazim 500 g/ha or Mancozeb 1000 g/ha or Chlorothalonil 1000

g/ha . If necessary give the second round 15 days later.

Combined infection of rust and Leaf spot

Spray any one of the following: Spray 10% *Calotropis* leaf extract or Spray Carbendazim 250 g + Mancozeb 1000g/ha or Chlorothalonil 1000g/ha. If necessary give the second round 15 days later.

3.Rust: Spray any one of the following:

Mancozeb 1000g /ha or Chlorothalonil 1000g /ha or Wettable sulphur 2500g /ha or Tridemorph 500 ml/ha or If necessary, repeat the spray 15 days later.

4.Collar rot

 Crop rotation.

 Destruction of plant debris.

 Remove and destroy previous season's infested crop debris in the field

Seed treatment with *Trichoderma viride* / *T.harzianum* @ 4 g/kg of seeds and soil application of *Trichoderma viride* / *T.harzianum* at 2.5kg/ha, preferably with organic amendments such as castor cake or neem cake or mustard cake @ 500 kg/ ha.

5.Root rot:

Soil application of *P. fluorescens* @ 2.5g /ha mixed with 50 kg of well decomposed FYM / sand at 30 DAS.

Spot drench with Carbendazim 1 g / l

6.Groundnut Bud Necrosis:

Adopt a close spacing of 15 x 15 cm. Remove infected plants up to 6 weeks after sowing and spray Monocrotophos 36 WSC 500 ml/ha, 30

days after sowing either alone or in combination with antiviral principles. Antiviral principles from sorghum or coconut leaves.

AVP are extracted as follows: Sorghum or coconut leaves collected, dried, cut into small bits and powdered to one kg of leaf powder two litres of water is added and heated to 60°C for one hour. It is then filtered through muslin cloth and diluted to 10 litres and sprayed. To cover one ha 500 litre of fluid will be required. Two sprays at 10 and 20 days after sowing will be needed

II. DISEASES OF SUNFLOWER

1. Leaf blight

Causal organism : *Alternaria helianthi*

Symptoms: Spots are circular, brown with concentric rings, encircled by yellow halo. Spots coalesce to become bigger and irregular patches. Affected leaf exhibits drying. Spots are also noticed on sepals, petals and stem.

Favourable Conditions : Rainy weather;Cool winter climate;Late sown crops are highly susceptible.

2. Rust

Causal organism : *Puccinia helianthi*

Symptoms: On the lower surface of leaf, large number of reddish brown pustules are seen either scattered or in groups on leaves at the bottom of the plant. These pustules are powdery in nature and represent the uredosori. Uredospores are echinulate and round to elliptical with a stalk and the fungus is an autoecious rust.

Favorable Conditions : Day temperature of 25.5° to 30.5°C with Relative humidity of 86 to 92 per cent enhances intensity of rust attack.

3. Head rot

Causal organism : *Rhizopus* sp.

Symptoms: Affected heads show water soaked lesions on the lower surface, which turn brown. The head turns soft, pulpy and tissues putrefy. The seeds are converted into black mass. The head is not filled properly and it withers finally.

Favourable Conditions : Prolonged rainy weather at flowering ;Damages caused by insects and caterpillars.

Root rot or charcoal rot :

Causal organism : *Macrophomina phaseolina*

Symptoms: In affected plants, leaves droop and start drying. Bark at the lower portion of stem and root splits into threads and large number of sclerotia are observed on the affected tissue. Pycnidia also develop on the stem.

Sunflower necrosis disease -*Tobacco streak virus* (TSV)

Symptoms: Characterised by the sudden necrosis of part of lamina followed by twisting of leaves and systemic mosaic. Necrosis of lamina of the lamina, petiole, stem floral calyx and corolla. Vector: Thrips

Disease management

1.Seed treatment: Treat the seeds with any one of the following:

T. viride @ 4g/kg of seed,Thiram @ 4g/kg of seed,Carbendazim @ 2g/kg of seed

2. **Alternaria leaf spot and Rust:** Spray Mancozeb 1000g/ha

3.Charcoal rot:

Soil application of *P. fluorescens* or *T. viride* – 2.5 Kg / ha + 50 Kg of well decomposed FYM or sand at 30 days after sowing. Spot drenching with Carbendazim @ 1 gm/ litre.

4.Head rot :

Spray Mancozeb 1000g/ha in case of intermittent rainfall at the head stage, directing the spray to cover the capitulum.Repeat fungicidal application after 10 days if humid weather continues

5.Necrosis virus disease:

Raise sorghum as border crop (One month prior to sunflower sowing).

Imidacloprid seed treatment 2g/kg % Imidacloprid foliar spray at 30 & 45 DAS

III. DISEASES OF GINGELLY

1. Root rot (Charcoal rot)

Causal organism : *Macrophomina phaseolina*

Symptoms: Affected plant exhibits brown discolouration at the stem close to soil. Leaves become yellow, droop and plants die in patches. Bark shredding is noticed in stem and root. The fungus produces dark

brown sclerotia. It also forms pycnidia bearing hyaline, single celled, elliptical conidia. **Favourable Conditions :** Day temperature of 30˚C and above; Prolonged drought followed by copious irrigation.

2. Leaf blight

Causal organism : *Alternaria sesame*

Symptoms: Spots are round to irregular, necrotic with concentric rings in The center. Several spots coalesce leading to blight.

3. Powdery mildew

Causal organism : *Erysiphe cichoracearum*

Symptoms: Leaves show white powdery growth on the upper surface. Often the entire lamina is covered by fungal growth. Severe infection leads to malformation of leaves. The white growth consists of hyaline, septate mycelium, conidiophores and chains of conidia.

Favourable Conditions : Dry humid weather; Low relative humidity.

4. Phyllody

Causal organism : Candidatus Phytoplasma

Symptoms: The floral parts are altered into green leafy, phylloid s tructures. Plant exhibits clusters of leaves at the axil and also at the terminal portion which gives a bushy appearance to the plant. The phytoplasma is transmitted by the jassid vector, *Orosius albicinctus.*

DISEASE MANAGEMENT

1.Seed treatment: Treat the seeds with any one of the following *P. fluorescens* @ 10g/kg of seed, *T. viride* @ 4g/kg of seed, Thiram @ 4g/kg of seed, Carbendazim @ 2g/kg of seed

2.Powdery mildew: Apply any one of the following.Sulphur dust 25 kg/ha or Wettable sulphur 25 kg/ha

3.Alternaria blight: Spray Mancozeb 1000g/ha

4.Root rot: Soil application of *P. fluorescens* or *T. viride* – 2.5 Kg / ha + 50 Kg of well decomposed FYM or sand at 30 days after sowing. Spot drench Carbendazim – 1 gm/ litre

5.Phyllody : Remove and destroy infected plants.To control vector, spray Monocrotophos 36 or Dimethoate 30 EC 500 ml/ha combined with intercropping of Sesamum + Redgram (6 : 1)