

EXERCISE NO.: 16
DISEASES OF COTTON

1. Angular Leaf Spot or Black Arm of Cotton

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

Symptoms:

Small water-soaked spots appear on the under surface of cotyledons, which may dry and wither. Such spots also appear on the leaves. They become angular bound by veinlets and turn brown to black in colour. Several small spots may coalesce. The infected petiole may collapse. Elongated, sunken and dark brown to black lesions appear on stem, petioles and branches. The young stems may be girdled and killed in the black arm phase. Sunken black lesions may be seen on the bolls. Young boll may fall-off. The attacked stem becomes weak. Bacterial slime is exuded on the brown lesions. Discoloration of lint may take place.

Etiology:

The bacterium is rod-shaped. It occurs singly or in pairs, capsulated, non-spore former, motile by one polar flagellum. Stain reaction is gram negative. The bacterium is aerobic.

Perpetuation:

The pathogen can remain as slimy mass inside the seed or on the fuzz. The disease may be carried over through infected leaves, bolls and twigs on the soil surface. The secondary infection is through water, wind.

Control measures:

1. Field sanitation

2. Seed Treatment:

a) Externally seed borne infection can be eradicated by delinting the seed with. Conc. H₂SO₄ for 5 minutes, wash with lime solution to neutralize the effect and finally washing with running water to remove the residue and drying seeds.

b) Internally seed borne infection can be eradicated by soaking seeds overnight in 100 ppm streptomycin sulphate or agrimycin.

3) Deshi cotton (*Gossypium arborum*) is tolerant comparatively.

4) Secondary spread of the disease can be controlled by spraying the crop with streptomycin sulphate 100 ppm + Copper oxychloride (0.25%) at an interval of 15 days.

2) Vascular Wilt of Cotton

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

Symptoms:

Wilt is restricted to black cotton soils with pH 7.8-8.00. It is rare in light to loam soils. The disease appears at all the stages of plant growth. In seedling stage, there is yellowing of cotyledons, browning of petioles, followed by death and falling of affected leaves. In young and adult plants, there is loss of turgidity, drooping of leaves and tender shoots, yellowing, browning and finally death of the plants.

An outstanding symptom is the browning and blackening of the woody tissue. When a stem or branch is cut cross-wise, the discolouration is usually found in a ring just beneath the bark. Sometimes the discolouration is observed through the woody tissue. In advanced cases, discolouration may extend throughout the plant from root through stem, branches, leaf, petioles, and peduncles and Wilting mostly occurs gradually, but after a rain followed by dry period, plant may wilt suddenly.

Etiology:

Mycelium is septate, hyaline and intravascular. The fungus is facultative parasite and produces three types of spores, Micro-conidia, which are one or bicelled, oblong, hyaline and borne on short conidiophores, Macro-conidia are 3 to 6 celled, chlamydospores, which are hyaline, spherical and thick walled.

Perpetuation:

Primary infection takes place through through soil borne inoculum.

Management:

- 1) Field sanitation, crop rotation and mix cropping are useful for reducing the incidence.
- 2) Use of resistant varieties. *G. arboreum* and *G. herbaceum* are susceptible whereas *G. hirsutum* and *G. barbadense* are immune.
- 3) American varieties are resistant to wilt in India.

3) Grey Mildew or Dahiya of Cotton

Causal organism: Imperfect stage : *Ramularia areola*

Perfect stage: *Mycosphaerella areola*.

Symptoms:

The fungus usually attacks the older leaves causing irregular to angular, pale, translucent spots. They are usually restricted by the veinlets and appear mostly on the lower surface of the leaf, though occasionally on the upper surface. A few to over a hundred spots may be found on a single leaf. In severe infections the leaves turn yellowish brown and fall off prematurely.

Etiology:

A frosty or whitish grey mildew growth consists of conidia and conidiophores and mycelium of the fungus. The mycelium is endophytic, septate. The conidiophores are short, septate, branched at the base. The conidia are borne singly or in short chains at the tip of the conidiophores and are colourless, irregularly oblong, with pointed, rounded, or flattened end, unicellular to three septate.

Management:

1. Destruction of infected plant debris.
2. Dust the crop with 300 mesh sulphur @ 20 kg/ha or spray crop with 0.05% propiconazole.

4) Anthracnose of Cotton

Causal organism: Imperfect stage: *Colletotrichum gossypii* Southw.

Colletotrichum capsici (Syd.) Butt & Bisby

Perfect stage: *Glomerella gossypii* (Southw) Edgerton

Symptoms:

In seedling stage, small, reddish circular spots appear on the cotyledons and primary leaves. When the lesions are on the collar region, the stem may be girdled, causing seedlings to wilt and die. In mature plants, the fungus attacks the stem, causing it to split and shred the bark. The symptoms are prominent on bolls as water-soaked, circular, slightly sunken reddish-brown spots which turn black in colour. As a result of boll infection, they open prematurely. The lint becomes stained, hard and compact.

Etiology:

The mycelium is septate. The fungus produces acervuli in which the setae are present. Conidia are hyaline, single-celled, sickle shape

Perpetuation:

Primary infection takes place through infected seeds and plant-debris, secondary infection by means of conidia disseminated by wind.

Management:

1. Seed treatment with Thiram 3 g OR Carbendazim 1 g + Thiram 3 g /kg of seed.
2. Spray the crop once or twice with copper oxychloride (0.25%) or Zineb (0.25%) after boll formation.

5) Root Rot

Causal organism - Sterile stage: *Rhizoctonia bataticola* (Taub.) Butt

Imperfect stage: *Macrophomina phaseolina* (Tassi) Goid.

Symptoms:

The symptoms may appear in seedling stage, where brownish spots on the cotyledons are seen. At collar region there is browning, which may extend downward. The fibrous roots undergo decaying. The bark of the roots shows rotting and shredding. Affected plants can be pulled out with ease. The disease appears in patches in the field.

Etiology:

The hyphae are thick, septate and produce black and irregular sclerotial bodies. Crop residue with sclerotia acts as primary source of infection.

Management:

1. Seed treatment with Thiram or Captan @ 3 g + 1 g Carbendazim/ kg seed.
2. Soil mulching after rains.
3. Mixed cropping with legumes and Sorghum.
4. Soil disinfection with 0.1% Carbendazim helps in controlling the disease

6) Boll Rot

It is a complex disease caused by several fungal pathogens viz., *Fusarium moniliforme*, *Colletotrichum capsici*, *Aspergillus flavus*, *A. niger*, *Rhizopus nigricans*, *Nematospora nagpuri* and *Botryodiplodia* sp.

Symptoms:

Initially, the disease appears as small brown or black dots which later enlarge to cover the entire bolls. Infection spreads to inner tissues and rotting of seeds and lint occur. The bolls never burst open and fall off prematurely. In some cases, the rotting may be external, causing rotting of the pericarp leaving the internal tissues free. On the affected bolls, a large number of fruiting Bodies of fungi are observed depending upon the nature of the fungi involved.

Predisposition:

Heavy rainfall during the square and boll formation stage, punctures caused by the insects, especially red cotton bug *Dysdercus cingulatus*, close spacing and excessive nitrogen application.

Etiology:

Many kinds of fungi are involved. The fungi survive in the infected bolls in the soil. The insects mainly help in the spread of the disease. The fungi make their entry only through the insect punctures. The secondary spread of the disease is also through air-borne conidia.

Management:

Adopt optimum spacing. Apply the recommended doses of fertilizers. Spray Copper oxychloride 0.2% or Carbendazim 0.1% or Mancozeb 0.2 % from 45th day at 15 days interval. Two or three sprays are necessary.

7) Leaf spot or blight

Causal organism: *Alternaria macrospora* Zimm.

Symptoms:

The disease may occur in all stages but more severe when plants are 45-60 days old. Small, pale to brown, irregular or round spots, measuring 0.5 to 6 mm diameter, may appear on the leaves. Each spot has a central lesion surrounded by concentric rings. Several spots coalesce together to form blighted areas. The affected leaves become brittle and fall off. Sometimes stem lesions are also seen. In severe cases, the spots may appear on bracts and boll

Etiology:

The fungus produces dark brown, short, 1-8 septate, irregularly bend conidiophores with a single conidium at the apex. The conidia are muriform, light to dark brown in colour with 3-9 transverse septa and four longitudinal septa, with a prominent beak. The pathogen survives in the dead leaves as dormant mycelium. The pathogen primarily spreads through irrigation water. The secondary spread is mainly by air-borne conidia.

Predisposition: High humidity, intermittent rains and moderate temperature of 25-28°C.

Management:

1. Remove and destroy the infected plant residues.
2. Spray 0.2% Mancozeb or Copper oxychloride at the initiation of the disease. Four to five sprays may be given at 15 days interval.

8) Reddening or *Lalya* Disease Of Cotton

American and Egyptian cotton are susceptible to this disease. Severe attack results in low yield and poor quality of crop. Butler (1908) reported for the first time the of this disease in India.

Red leaf is caused due to soil being puddled or ill drained or bad soil condition. High humidity and cloudy days accompanied by low temperature have been reported to increase the incidence of disease. It is also reported due to soil deficient in magnesium.

Symptoms:

Leaves of the affected cotton plants turn yellow or red during all the stages of growth. The discolouration starts at the margins and extend inwards-. The red colour may also develop as patches in interveinal portion of the leaves in severe cases; the whole-Leaf is involved. The affected leaves roll down wards, begin to dry and ultimately shed. The affected plant exhibits early fruiting and excessive shedding of the bolls.

Management:

- 1) Application of F.Y.M. or compost or nitrogenous manures which may help to improve the physical condition of soil ultimately minimizing the incidence.
- 2) Spray 2% diammonium phosphate or 1% urea. Avoid hot winds by providing wind breaks like shevari.
- 3) The chlorophyll in the leaf cell decomposes and probably results in the formation of anthocyanin pigment as soon as temperature falls below 34°C.

9) 2-4-D Injury in Cotton

2-4-D is a broad spectrum selective post emergence herbicide used for control of herbaceous annual dicot weeds. But crops like cotton, tomato, tobacco are extremely sensitive to 2-4-D which can cause harmful damage to crops (cotton).

Symptoms:

1) Leaves are greatly modified. They become narrow and deeply lobed. Scorching, rolling and puckering of leaves which hamper normal photosynthesis in plants. As a result of 2,4-D injury there can be elongation of leaves giving string like slender-appearance.

2) Disruption of phloem tissues and dislocation of normal translocation of food material so plants looks like wilted.

3) Alteration of nucleic acid (protein metabolism) Growth ceases

4) Blocking of gaseous exchange between leaf and atmosphere so ultimately plant die. Malformation is also observed in crop.

6) If 2, 4-D concentration is high then the symptoms are seen within 2 days.

If it is low then the symptoms are seen within 8-10 days.

Management: Urea (2%) spray may show little recovery if the damage is in early stage.

EXERCISE NO.17
DISEASES OF RED GRAM (TUR)

1) Wilt of Tur

Causal organism: *Fusarium oxysporum* f.sp. *Udum* (Butler) Snyder and Hansen

Symptoms:

The main symptom of the disease is wilting of seedlings and adult plants as if they have suffered from water shortage even though there may be plenty of moisture in the field. Wilting is characterized by gradual, sometimes sudden, yellowing, drooping and drying of leaves followed by drying of the entire plant or sometimes of its branches. Examination of roots of infected plants show discoloration of vascular tissues when split open longitudinally and dark streaks under the bark of roots. Sometimes dark brown bands may be seen on the main stem.

Etiology: Mycelium septate, intravascular. Pathogen produce micro and macro-conidia and chlamydospores. Macro conidia are fusoid.

Perpetuation: Perpetuation in soil as chlamydospores

Management:

- a) Grow resistant varieties BND- 1 and BND-2.BSMR-736 and BSMR-853 are also resistant to wilt.
- b) Removal and burning of affected plants ALONG with roots.
- c) Deep ploughing during summer.
- d) Long crop rotation.

2. Sterility Mosaic

Symptoms:

The disease attack can be seen in all stages of crop growth. Leaves show typical mosaic mottling symptoms. Yellow patches intermingle with green colour of leaf. The green portions exhibit puckering symptom. In severe cases, leaves become smaller and cluster near tip because of shortened internodes and stimulation of auxiliary buds. The plants are generally stunted and do not produce pod. Plants infected at early stages (up to 45 days) of

crop growth show near complete sterility and yield loss up to 95 per cent. As plants become older (after 45 days), their susceptibility to the disease decreases and such plants show partial sterility. If pods develop, the seeds may be small, shrivelled and immature. Because the infected plants show sterility and the leaves show the 'mosaic symptom.

Perpetuation and transmission:

The disease is transmitted by an Eriophid mite *Aceria cajani*. The self-sown red gram plants and perennial types of red gram serve as sources of infection.

Management:

- i) Rogue out infected plants up to 40 days after sowing.
- ii) Spray Monocrotophos at 500 ml/ha soon after appearance of the disease and if necessary, repeat after 15 days.
- iii) Grow resistant genotypes/cultivars like ICP6997035, VR3, Purple 1, DAL 1, DA32, ICP 6997, Bahar, 13, BSMR 235, ICP 7198, PR 5149, ICP 8861, BSMR-736, BSMR-853 and BDN-7 and Bhavanisagar 1.

EXERCISE NO.18
DISEASES OF BENGAL GRAM OR CHICK PEA

1) Wilt of Gram

Causal organism: *Fusarium oxysporum* f. sp. *Eked* (Radw.) Snyder and Hans.

Symptoms:

The disease appears at all the stages of plant growth. Young seedlings (3-5 weeks old) collapse and lie flat on the ground. The seedlings retain almost normal green colour. Such collapsed seedlings, when uprooted usually show uneven shrinking of the stem above and below the collar region, and when split open vertically from collar region downward black discoloration of internal tissues is clearly visible. Adult plants show typical, wilting, *i.e.* drooping of the petioles and rachis. Drooping is visible initially in the upper part of the plant, but within a day or two it is seen on the entire plants. The lower leaves are chlorotic. Gradually all the leaves turn yellow and the light brown or straw coloured. Dried leaflets of infected plants are not shed at maturity. Affected plants, when uprooted and examined before complete drying, show external rotting, drying or discoloration of roots. When the stem is split by holding half the branches of the affected plants, in each hand and pulling downwards, internal discoloration can be seen. Discoloration of pith, and part of wood around the collar region and few inches above the collar region is seen. Sometimes partial wilting is observed.

Etiology: Septate intravascular mycelium. Produce micro, macro-conidia and chlamydospores.

Perpetuation: Perpetuation in soil in the form of thick walled resistant chlamydospores.

Management:

- 1) Use resistant varieties Vishwas (G1), Vikas (Phule G-5), released by MPKV, Rahuri
- 2) Destruction of affected plants. The gram is also affected by root rot caused by *R. solani*, (*Macrophomzina phaieblina*) and in Konkan area due to *Sclerotium rolfsii*.

2) Root Rot of Bengal Gram

Causal organism: Sterile stage: *Rhizoctonia bataticola* (Taub) Butler

Imperfect stage: *Macrophomina phaseolina* (Tassi) Goud

Sexual stage: *Thanatephorus cucumeris* (Frank) Donk

Symptoms:

The disease occurs severely in the seedling stage. A dark brown lesion develops on the stem near ground level. The infected seedling slowly turn yellow and petioles and leaflets show drooping, leads to complete drying of the plant. The stem near the collar region show rotting symptom. The black dead tissues contain pinkish mycelial growth and sclerotia.

Etiology:

The hyphae of the fungus are dark brown, filamentous and septate with constrictions in hyphal branches at the junction with main hypha. The sclerotia are brown and irregular in shape. The fungus has its sexual stage, *T. cucumeris*, which produces 2-4 basidiopores in terminal clusters on a celled hypha.

Predisposition: Heavy soils with poor drainage and warm humid weather.

Perpetuation: The pathogen survives in the soil in infected host debris as sclerotia for several years. The secondary spread is through farm implements, irrigation water and rain splash.

Management:

- I. Treat the seeds with Carbendazim or Thiram @ 2 gm/kg or
- II. Seed pelletizing with *Trichoderma viride* at 4 g/kg OR
Pseudomonas fluorescens 10g/kg of seed.
Apply farmyard manure @ 10 t/ha
- III. Grow resistant genotypes like ICC 32, ICC 42, ICC 12223, ICC 11322 and H82-2

3) Stem Rot: *Sclerotinia sclerotiarum*

The disease appears mostly on stem rot. On adult plants water soaked lesion on upper parts of stem are seen. The affected portion is covered with white cottony growth and brownish sclerotial bodies.

Collar rot: *Sclerotium rolfsii*

The water soaked black lesions develop near collar region in seedling up to 6 weeks, leading to yellowing and death. Older seedlings may dry without collapsing.

Management:

Disease is soil borne. The disease can be controlled by soil drenching of (O. 2%)PCNB.

4) Ascochyta Blight:

Causal organism: *Ascochyta rabiei* (Pass.) Labr.

Symptoms:

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

Etiology:

The fungus produces hyaline to brown and septate mycelium. Pycnidia are spherical to sub-globose with a prominent ostiole. Pycnidiospores (conidia) are formed from hyaline phialides from the inner cells of the pycnidium. They are hyaline, oval to oblong, straight or slightly curved and single celled, occasionally bicelled.

Predisposition:

High rainfall during flowering, temperature ranged between 20 to 25⁰ C and relative humidity of 60 per cent.

Perpetuation:

The fungus survives in the infected plant debris as pycnidia. The pathogen is also externally and internally seed-borne. The primary spread is from seed-borne pycnidia and plant debris in the soil. The secondary spread is mainly through air-borne pycnidiospores (conidia). Rain splash also helps in the spread of the disease.

Management:

- i) Remove and destroy the infected plant debris in the field.
- ii) Treat the seeds with Thiram 2g OR Carbendazim 2 g OR Thiram + Carbendazim at 2 g/kg seed.
- iii) Spray with 0.1 % Carbendazim for preventing secondary spread.

5) Stunt Disease

Causal virus: Chick pea stunt virus (CPSV)

Symptoms:

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

Transmission:

The virus is transmitted by *Aphis craccivora*.

Management:

- i) Rogue out the infected plants.
- ii) Vector control by spraying Monocrotophos at 500 nil/ha.