

13. Diseases of Cotton

Wilt - *Fusarium oxysporum* f.sp. *vasinfectum*

Symptoms

The disease affects the crop at all stages. The earliest symptoms appear on the seedlings in the cotyledons which turn yellow and then brown. The base of petiole shows brown ring, followed by wilting and drying of the seedlings. In young and grown up plants, the first symptom is yellowing of edges of leaves and area around the veins i.e. discoloration starts from the margin and spreads towards the midrib. The leaves loose their turgidity, gradually turn brown, droop and finally drop off.

Symptoms start from the older leaves at the base, followed by younger ones towards the top, finally involving the branches and the whole plant. The defoliation or wilting may be complete leaving the stem alone standing in the field. Sometimes partial wilting occurs; where in only one portion of the plant is affected, the other remaining free. The taproot is usually stunted with less abundant laterals.

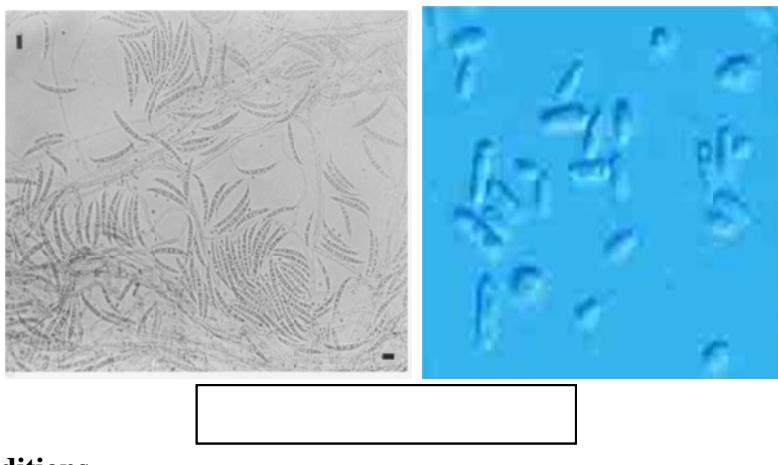


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Browning or blackening of vascular tissues is the other important symptom, black streaks or stripes may be seen extending upwards to the branches and downwards to lateral roots. In severe cases, discolouration may extend throughout the plant starting from roots extending to stem, leaves and even bolls. In transverse section, discoloured ring is seen in the woody tissues of stem. The plants affected later in the season are stunted with fewer bolls which are very small and open before they mature.

Pathogen

Macroconidia are 1 to 5 septate, hyaline, thin walled, falcate with tapering ends. The microconidia are hyaline, thin walled, spherical or elliptical, single or two celled. Chlamydospores are dark coloured and thick walled. The fungus also produces a vivotoxin, Fusaric acid which is partially responsible for wilting of the plants.



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 (*Mylolocerus pustulatus*).

Disease cycle

The fungus can survive in soil as saprophyte for many years and chlamydospores act as resting spores. The pathogen is both externally and internally seed-borne. The primary infection is mainly from dormant hyphae and chlamydospores in the soil. The secondary spread is through conidia and chlamydospores which are disseminated by wind and irrigation water.

Management

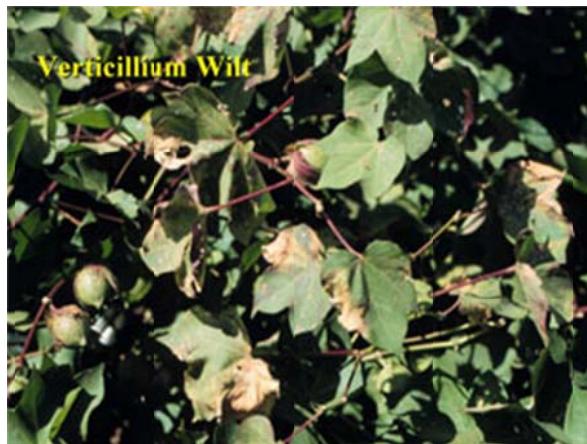
- Treat the acid delinted seeds with Carboxin or Carbendazim at 2 g/kg.
- Remove and burn the infected plant debris in the soil after deep summer ploughing during June-July.
- Apply increased doses of potash with a balanced dose of nitrogenous and phosphatic fertilizers.
- Apply heavy doses of farm yard manure or other organic manures. 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.

Verticillium wilt - *Verticillium dahliae*

Symptoms

The symptoms are seen when the crop is in squares and bolls. Plants infected at early stages are severely stunted. The first symptoms can be seen as bronzing of veins. It is followed by interveinal chlorosis and yellowing of leaves. Finally the leaves begin to dry, giving a scorched appearance. At this stage, the characteristic diagnostic feature is the drying of the leaf margins and areas between veins, which gives a “Tiger stripe” or “Tiger claw” appearance.

The affected leaves fall off leaving the branches barren. Infected stem and roots, when split open, show a pinkish discolouration of the woody tissue which may taper off into longitudinal streaks in the upper parts and branches. The infected leaf also shows brown spots at the end of the petioles. The affected plants may bear a few smaller bolls with immature lint.



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Pathogen

The fungus produces hyaline, septate mycelium and two types of spores. The conidia are single celled, hyaline, spherical to oval, borne singly on verticillate conidiophores. The micro sclerotia are globose to oblong, measuring 48-120 X 26-45um.

Favourable Conditions

- Low temperature of 15-20°C,
- Low lying and ill-drained soils,
- Heavy soils with alkaline reaction
- Heavy doses of nitrogenous fertilizers.

Disease Cycle

The fungus also infects the other hosts like brinjal, chilli, tobacco and bhendi. The fungus can survive in the infected plant debris and in soils as micro sclerotia upto 14 years. The seeds also carry the micro sclerotia and conidia in the fuzz. The primary spread is through the

micro sclerotia or conidia in the soil. The secondary spread is through the contact of diseased roots to healthy ones and through dissemination of infected plant parts through irrigation water and other implements.

Management

- Treat the delinted seeds with [Carboxin](#) or [Carbendazim](#) at 2 g/kg.
- Remove and destroy the infected plant debris after deep ploughing in summer months (June-July).
- Apply heavy doses of farmy and manure or compost at 100t/ha.
- 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.

Root rot - [*Rhizoctonia solani*](#)

Symptoms

The pathogen causes three types of symptoms viz., seedling disease, sore-shin and root rot. Germinating seedlings and seedlings of one to two weeks old are attacked by the fungus at the hypocotyl and cause black lesions, girdling of stem and death of the seedling, causing large gaps in the field. In sore-shin stage (4 to 6 weeks old plants), dark reddish-brown cankers are formed on the stems near the soil surface, later turning dark black and plant breaks at the collar region leading to drying of the leaves and subsequently the entire plant.





Typical root rot symptom appears normally at the time of maturity of the plants. The most prominent symptom is sudden and complete wilting of plants in patches. Initially, all the 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 even extends above ground level. In badly affected plants the woody portions may become black and brittle. A large number of dark brown sclerotia are seen on the wood or on the shredded bark.

Pathogen

The fungal hyphae are septate and fairly thick and produce black, irregular sclerotia which measure 100 m in diameter.

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.

Disease cycle

The disease is mainly soil-borne and the pathogen can survive in the soil as [sclerotia](#) for several years. The spread is through sclerotia which are disseminated by irrigation water, implements, and other cultural operations.

Management

- Treat the seeds with [Trichoderma viride](#) @ 4g/kg of seed.
- Spot drench with 0.1% Carbendazim.

- Apply farm yard manure at 10t/ha or neem cake at 150 Kg/ha.
- Adjust the sowing time, early sowing (First Week of April) or late sowing (Last week of June) so that crop escapes the high soil temperature conditions.
- Adopt intercropping with sorghum or moth bean (*Phaseolus aconitifolius*) to lower the soil temperature.

Anthracnose - *Colletotrichum capsici*

Symptoms

The pathogen infects the seedlings and produces small reddish circular spots on the cotyledons and primary leaves. The lesions develop on the collar region, stem may be girdled, causing seedling to wilt and die. In mature plants, the fungus attacks the stem, leading to stem splitting and shredding of bark. The most common symptom is boll spotting. Small water soaked, circular, reddish brown depressed spots appear on the bolls. The lint is stained to yellow or brown, becomes a solid brittle mass of fibre. The infected bolls cease to grow and burst and dry up prematurely.



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Pathogen

The pathogen forms large number of acervuli on the infected parts. The conidiophores are slightly curved, short, and club shaped. The conidia are hyaline and falcate, borne single on the conidiophores. Numerous black coloured and thick walled setae are also produced in acervulus.

Favourable Conditions

- Prolonged rainfall at the time of boll formation
- Close planting.

Disease Cycle

The pathogen survives as dormant mycelium in the seed or as conidia on the Surface of seeds for about a year. The pathogen also perpetuates on the rotten bolls and other plant debris in the soil. The secondary spread is by air-borne conidia. The pathogen also survives in the weed hosts viz., *Aristolachia bractiata* and *Hibiscus diversifolius*.

Management

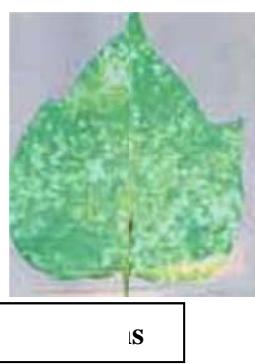
- Treat the delinted seeds with Carbendazim or Carboxin or Thiram or Captan at 2g/kg.
- Remove and burn the infected plant debris and bolls in the soil.
- Rogue out the weed hosts.
- Spray the crop at boll formation stage with Mancozeb 2kg or Copper oxychloride 2.5 kg or Carbendazim 500g/ha.

Grey or Areolate mildew - *Ramularia areola* (Sexual stage: *Mycosphaerella areola*)

Symptoms

The disease usually appears on the under surface of the bottom leaves when the crop is nearing maturity. Irregular to angular pale translucent lesions which measure 1-10 mm (usually 3-4 mm) develop on the lower surface, usually bound by vein lets. On the upper surface, the lesions appear as light green or yellow green specks.

A frosty or whitish grey powdery growth, consisting of conidiophores of the fungus, appears on the lower surface. When several spots coalesce, the entire leaf surface is covered by white to grey powdery growth. White or grey powdery growth may occur on the upper surface also. The infection spreads to upper leaves and entire plant may be affected. The affected leaves dry up from margin, cup inward; turn yellowish brown and fall off prematurely.



Pathogen

The pathogen produces endophytic, septate mycelium. Conidiophores are short, hyaline and branched at the base. Conidia are borne singly or in chains at the tips of conidiophores. The conidia are hyaline, irregularly oblong with pointed ends, sometimes rounded to flattened ends, unicellular or 1-3 septate. The perfect stage of the fungus produces perithecia containing many asci. The ascospores are hyaline and usually two celled.

Favourable Conditions

- Wet humid conditions during winter cotton season,
- Intermittent rains during North-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

Disease cycle

The pathogen survives during the summer in the infected crop residues. The perennial cotton plants and self-sown cotton plants also harbour the pathogen during summer months. The primary infection is through conidia from infected plant debris and secondary spread is through wind, rain splash, irrigation water and implements.

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.
- Adopt the correct spacing based on soil conditions and varieties.
- Spray the crop with Carbendazim at 500g/ha, repeat after a week.
- Grow the resistant varieties like Sujatha and Varalakshmi.

Boll rot - Fungal complex

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 and 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.



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Favourable Conditions

- Heavy rainfall during the square and boll formation stage,
- Wounds caused by the insects,
- Especially red cotton bug *Dysdercus cingulata*
- Close spacing and excessive nitrogen application.

Disease Cycle

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 wounds caused by the insects. 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 2.5kg along with an insecticide for bollworm from 45th day at 15 days interval.
- Two or three sprays are necessary.

Leaf blight - *Alternaria macrospora*

Symptoms

The disease may occur in all stages but more severe when plants are 45-60 days old. Small, plate to brown, irregular or round spots, measuring 0.5 to 6mm 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 bolls.



Symptoms

Pathogen

The fungus produces dark brown, short, 1-8 septate, irregularly bend conidiophores with a single conidium at the apex. The conidia are obclavate, light to dark brown in colour with 3-9 transverse septa and four longitudinal septa, with a prominent beak.



Favourable Conditions

- High humidity.

- Intermittent rains.
- Moderate temperature of 25-28° C.

Disease cycle

The pathogen survives in the dead leaves as dormant mycelium. The pathogen primarily spreads through irrigation water. The secondary spread is mainly by airborne conidia.

Management

- Remove and destroy the infected plant residues.
- Spray Mancozeb 2 kg or Copper oxychloride at 2kg/ha at the intimation of the disease. Four to five sprays may be given at 15 days interval.

Bacterial blight - *Xanthomonas axonopodis* pv. *malvacearum*

Symptoms

The bacterium attacks all stages from seed to harvest. Usually five common phases of symptoms are noticed.

i) Seedling blight:

Small, water-soaked, circular or irregular lesions develop on the cotyledons, later, the infection spreads to stem through petiole and cause withering and death of seedlings.

ii) Angular leaf spot:

Small, dark green, water soaked areas develop on lower surface of leaves, enlarge gradually and become angular when restricted by veins and veinlets and spots are visible on both the surface of leaves. As the lesions become older, they turn to reddish brown colour and infection spreads to veins and veinlets.

iii) Vein blight or vein necrosis or black vein:

The infection of veins cause blackening of the veins and veinlets, gives a typical 'blighting' appearance. On the lower surface of the leaf, bacterial oozes are formed as crusts or scales. The affected leaves become crinkled and twisted inward and show withering. The infection also spreads from veins to petiole and cause blighting leading to defoliation.

iv) Black arm:

On the stem and fruiting branches, dark brown to black lesions are formed, which may girdle the stem and branches to cause premature drooping off of the leaves, cracking of stem and

gummosis, resulting in breaking of the stem and hang typically as dry black twig to give a characteristic “black arm” symptom.

v) Square rot / Boll rot:

On the bolls, water soaked lesions appear and turn into dark black and sunken irregular spots. The infection slowly spreads to entire boll and shedding occurs. The infection on mature bolls lead to premature bursting. The bacterium spreads inside the boll and lint gets stained yellow because of bacterial ooze and loses its appearance and market value. The pathogen also infects the seed and causes reduction in size and viability of the seeds.



Angular leaf spot



Bacterial blight lesions on leaf and the blackleg symptom on the leaf petiole



Boll rot

Pathogen

The [bacterium](#) is a short rod with a single polar [flagellum](#). It is [Gram negative](#), non-spore forming and measures 1.0-1.2 X 0.7-0.9 μm .

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 and
- Potassium deficiency in soil.
- Rain followed by bright sunshine during the months of October and November are highly favorable.

Disease Cycle

The bacterium survives on infected, dried plant debris in soil for several years. The bacterium is also seed-borne and remains in the form of slimy mass on the fuzz of seed coat. The bacterium also attacks other hosts like *Thunbergia thespesioides*, *Eriodendron anfractuosum* and [Jatropha curcus](#). The primary infection starts mainly from the seed-borne bacterium. The secondary spread of the bacteria may be through wind, wind blown rain splash, irrigation water, insects and other implements.

Management

- Delint the cotton seeds with concentrated sulphuric acid at 100ml/kg of seed. Treat the delinted seeds with carboxin or oxycarboxin at 2 g/kg or soak the seeds in 1000 ppm [Streptomycin sulphate](#) overnight.
- Remove and destroy the infected plant debris. Rogue out the volunteer cotton plants and weed hosts.

- Follow crop rotation with non-host crops.
- Early thinning and early earthing up with potash.
- Grow resistant varieties like Sujatha, 1412 and CRH 71.
- Spray with Streptomycin sulphate +Ttetracycline mixture 100g along with Copper oxychloride at 1.25 Kg/ha.

Leaf Curl Disease- Cotton leaf curl virus

Symptoms

Downward and upward curling of leaves and thickening of veins and enation on underside of leaves are the characteristic symptoms of the disease. In severe infection all the leaves are curled and growth retarded. Boll bearing capacity is reduced



Pathogen

It is caused by [Cotton leaf curl virus](#) - a [begomovirus](#) of family geminiviridae. The virions are typical [geminate](#) particles, [ss circular DNA](#), [bipartite genome](#) with DNA-A and DNA-B components.

Disease Cycle

The primary source is the [viruliferous whitefly](#) vector [Bemisia tabaci](#). The alternate hosts and cultivated hosts serve as virus reservoirs throughout the year. Not transmitted by seed or contact.

Management

- Management of planting date to avoid peak vector population.
- Elimination of volunteer perennial cotton and alternate hosts including malvaceous hosts like wild okra
- Use of fungus [Paecilomyces farinosus](#) which parasitizes [B.tabaci](#). It brings down vector population.
- Foliar application of neem leaf extract and 1% neem oil resulted in 80% reduction of virus transmission.
- Vector management by application of granular [systemic insecticides](#).

Stenosis or Small leaf - [Phytoplsama](#)

Symptoms

The disease appears when the plants are two to three months old and affected plants are stunted. They put forth numerous extremely small leaves in cluster and the dormant buds are stimulated resulting in profuse vegetative growth. The leaves are disfigured and variously lobed. Flowers remain small with abortive ovary.

Large number of flower buds and young seeds. Root system is poorly developed and can be easily pulled out. Sometimes, the disease affects only the base of the plant, resulting in the formation of clump of short branches which bear small and deformed leaves. The mode of transmission of disease and the role of vector are unknown.

Management

- Rogue out the infected plants periodically.
- Cotton varieties developed from *Gossypium hirsutum* and *G. barbadense* are found to be resistant to the disease.

Minor diseases

Leaf spot - *Cercospora gossypina*

Round or irregular grayish spots with dark brown or blackish borders appear on older leaves.

Myrothecium leaf spot - *Myrothecium roridum*

Reddish spots of 0.5 mm- 1 cm diameter may appear near the margins of the leaves. The affected portions fall off leaving irregular shot holes in the leaves.

Rust - *Phakopsora desmum*

Yellowish brown raised pustules appear on the lower surface of leaves with rusty spores. Several pustules join to give rusty appearance to entire leaf. The sori may also develop on bolls.

Sooty mould - *Capnodium sp.*

Dark specks appear on the leaves and bolls, slowly spread and black powdery growth covers the entire leaf area and bolls.



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