



Diseases of Cotton

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Theni

Seedling diseases

Soil borne diseases

Root rot- *Rhizoctonia bataticola*

Wilts – *Fusarium, Verticillium*

Foliar diseases

Fungal

Bacterial

Viral & Phytoplasma

Seedling Diseases

Seed decay and seedling root rot

Pythium spp.

Rhizoctonia solani

Post emergence seedling blight and sore-shin

Rhizoctonia solani

Rhizoctonia bataticola

Phoma exigua

Soil borne diseases

Root rot - *Rhizoctonia bataticola* – Seedling infection



1 - defeat of the shoot.

2 - damage to the stem at the root neck;

3 - longitudinal section of the affected lower part of the stem and root.

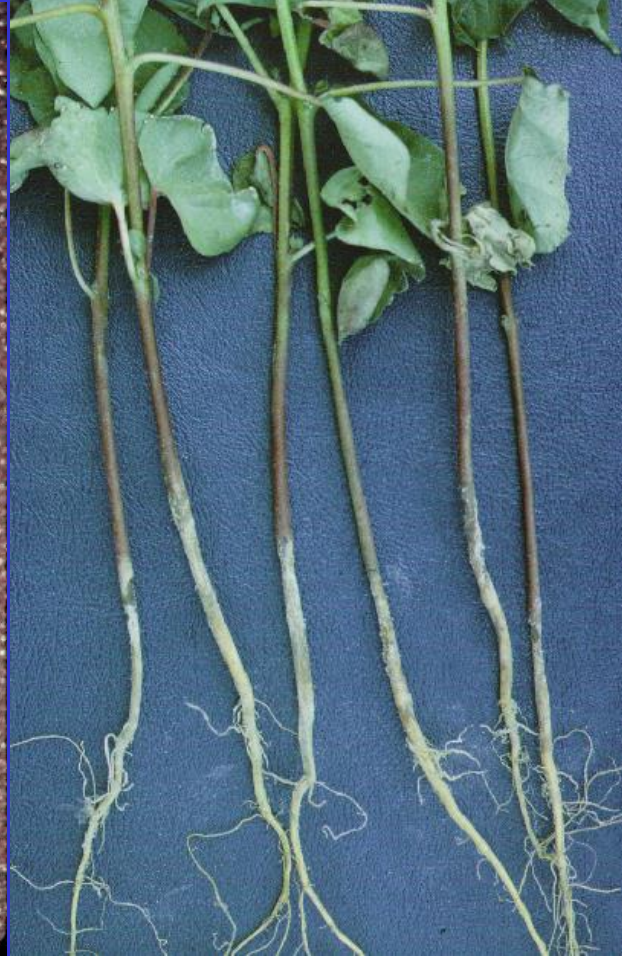
4 - the affected leaf on the underside;

5 - the affected leaf from the upper side.

- **In the affected plants, the apex droop, the cotyledons and leaves wrinkle and curl, and the petioles droop down.**
- **Such plants wilt and are easily pulled from the soil.**
- **At the root collar, small yellowish, and then expanding and deepening dark brown spots are formed on the upper part of the main root.**



Shriveled root



Post emergence Seedling blight
Rhizoctonia solani









Root Rot



**Thammampatti –
RCH 708**

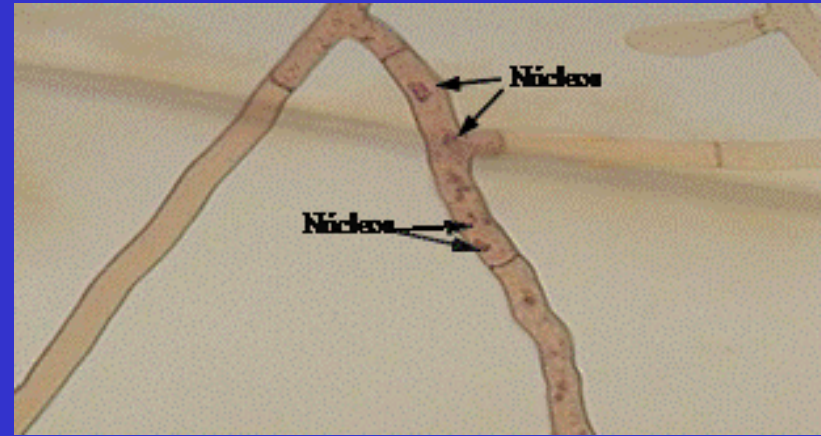
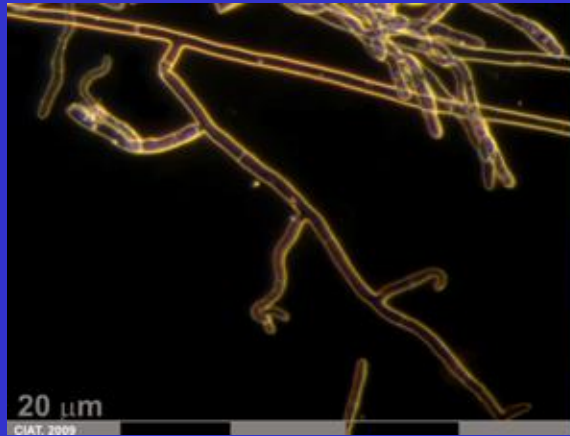


**Ariyalur – Bunny BG
II**

Rhizoctonia solani – Mortality of seedlings



Rhizoctonia solani



Management

- Luthra and vasudeva 1940 –recommended for checking the disease intensity *Phaseolus aconitifolius* and sorghum are commonly grown in mixed cropping
- Bio control- *P. fluorescens* is generally found in the rhizosphere of cotton seedling
- Seed treatment with this bacterium increase seedling survival
- Treat the seeds with *Trichoderma viride* @ 4g/kg or *Pseudomonas fluorescens* @ 10g/kg of seed.
- Adjust the sowing time- escape – high soil temperature
- Intercropping with sorghum/ moth bean
- Pyraclostrobin

Fusarium wilt – *Fusarium oxysporum* f. sp. *vasinfectum*



- In India-Nagpur in 1908
- Loss 60%
- Synder & Handsen (1940) – is the pathogen responsible for vascular wilt.
- The disease may appear at any stage of crop development.
- Depending on inoculum density, temperature

Black cotton soil/ heavy clay
pH – 7.6 – 8.0

Symptoms

- The symptoms first appear on the cotyledons, vein starts darkening, followed by chlorosis
- In very early stage of plant growth ,vein clearing on cotyledonary & first leaves also visible
- (Suryanaryana & Kalyansundram,1952)
- wilting and usually discoloration of the vascular tissue
- In transverse section ,discolored ring is seen in the woody tissues of stem
- Mahadevan *et al*,1967 has demonstrated the production of pectinolytic enzymes by pathogen

Fusarium Wilt Symptoms On Leaves of Plant



Beginning of zonal chlorosis

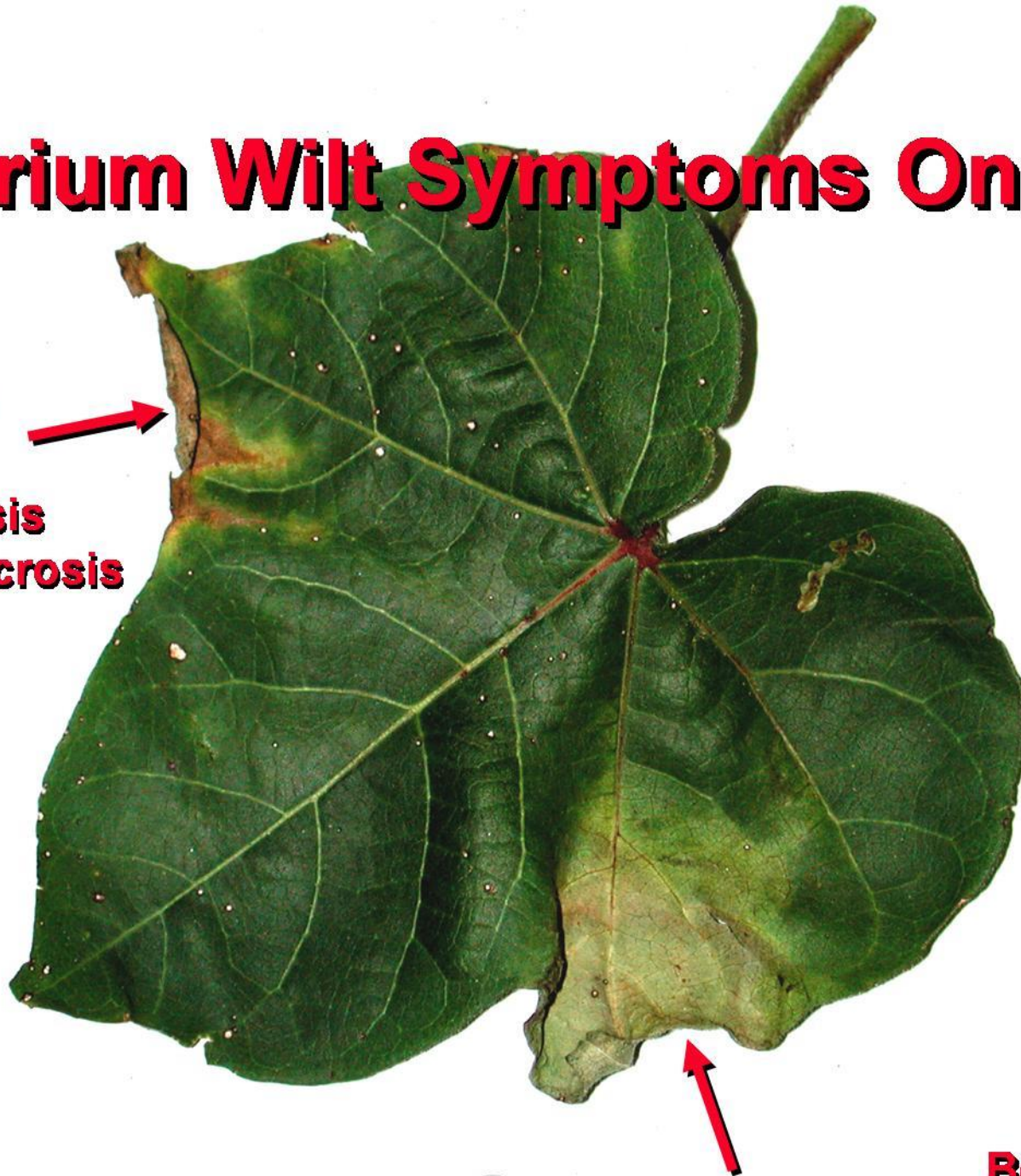


Leaves with recently lost turgor

Boman-TCE

Fusarium Wilt Symptoms On Leaf

**typical
zonal
chlorosis
and necrosis**



Boman-TCE

Fusarium Wilt

typical
zonal
chlorosis/necrosis



All different stages of **Fusarium wilt** on 47 day old cotton





**Fusarium
wilt**





Fig. 2. Wilt of foliage of cotton plants of various ages affected by Fusarium wilt. Older plants as well as seedlings may succumb to the disease.



Fig. 3. Fusarium wilt-induced interveinal chlorosis and necrosis of cotton foliage.



Early signs of Fusarium wilt in 47-day old cotton, where just one or two leaves are wilting. The plants will die rapidly.





Fusarium Wilt Symptoms in Mainstem



Discoloration of mainstem by fungal growth



Fusarium wilt - *G. arboreum*

Stand Loss from Fusarium



Boman-TCE

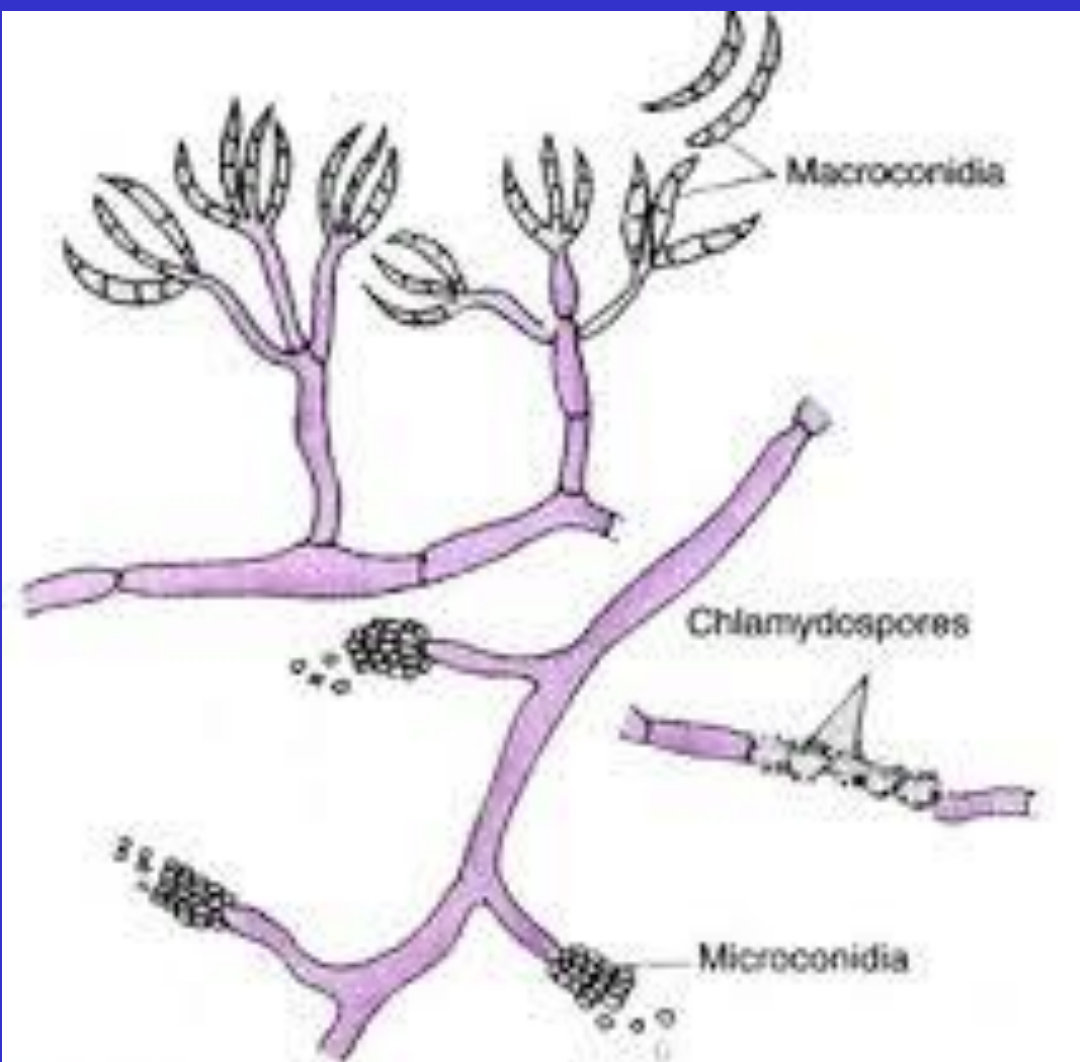
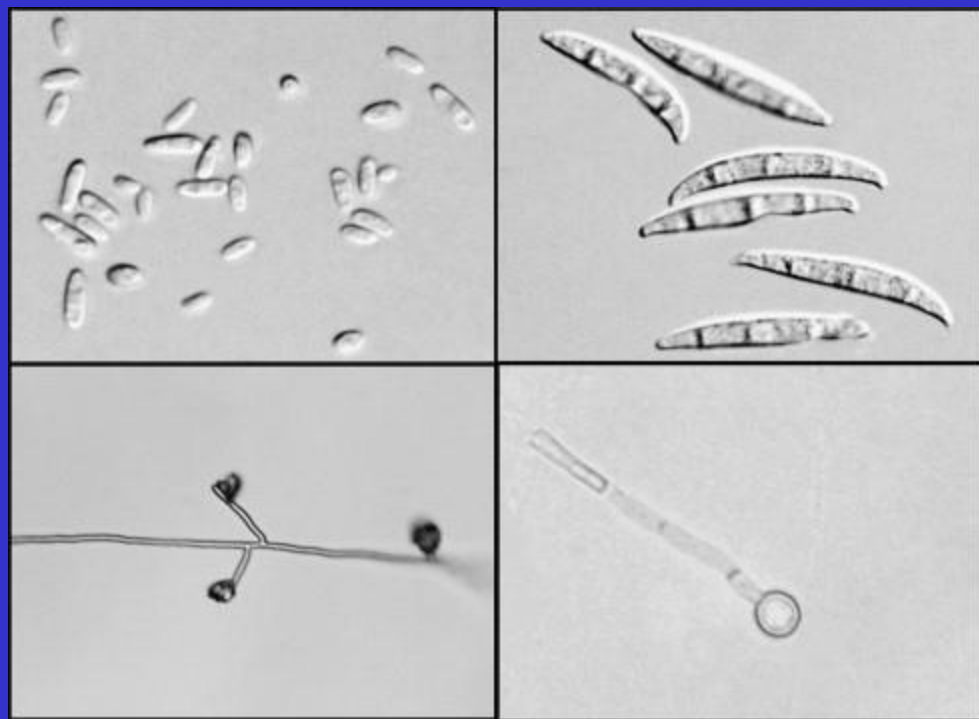
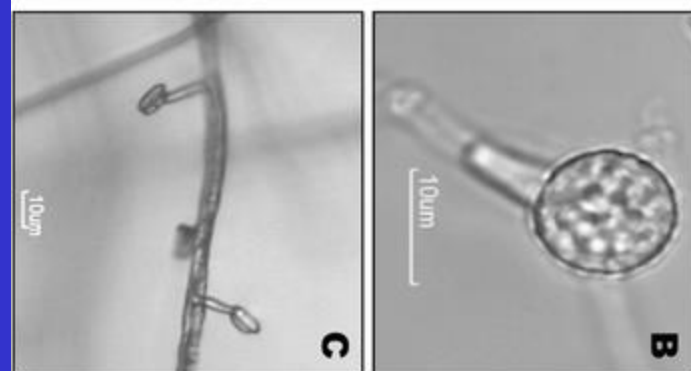
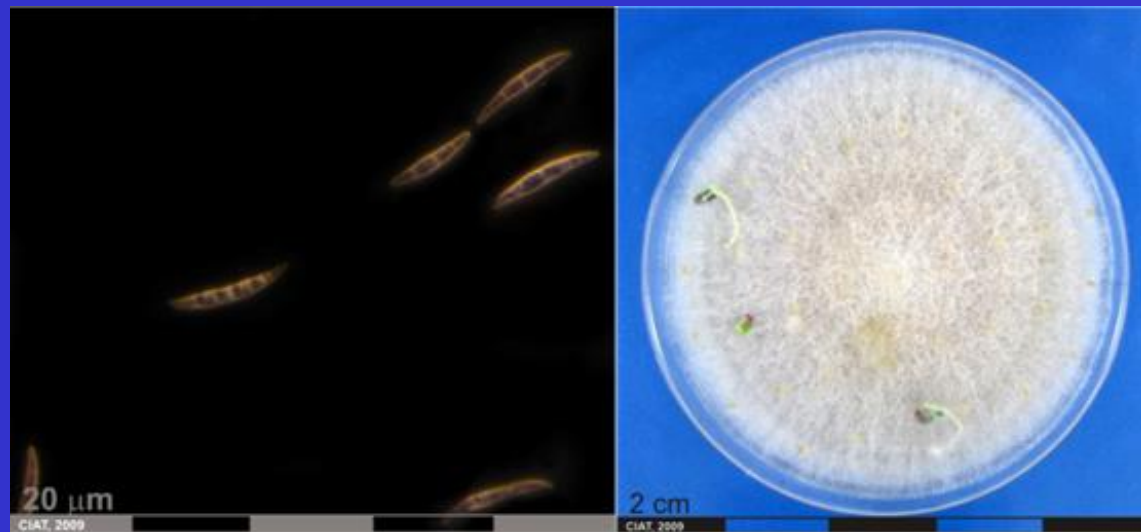
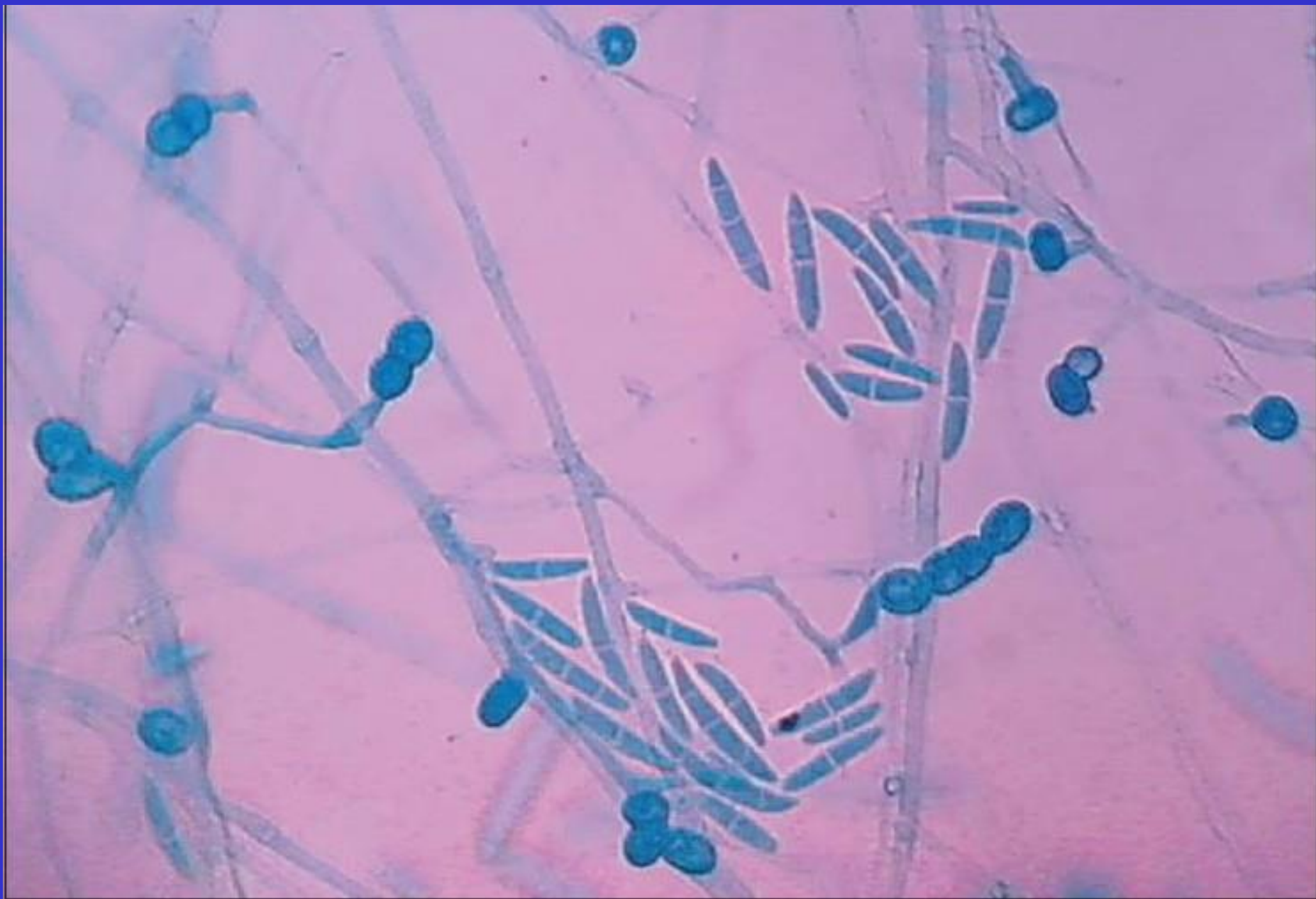
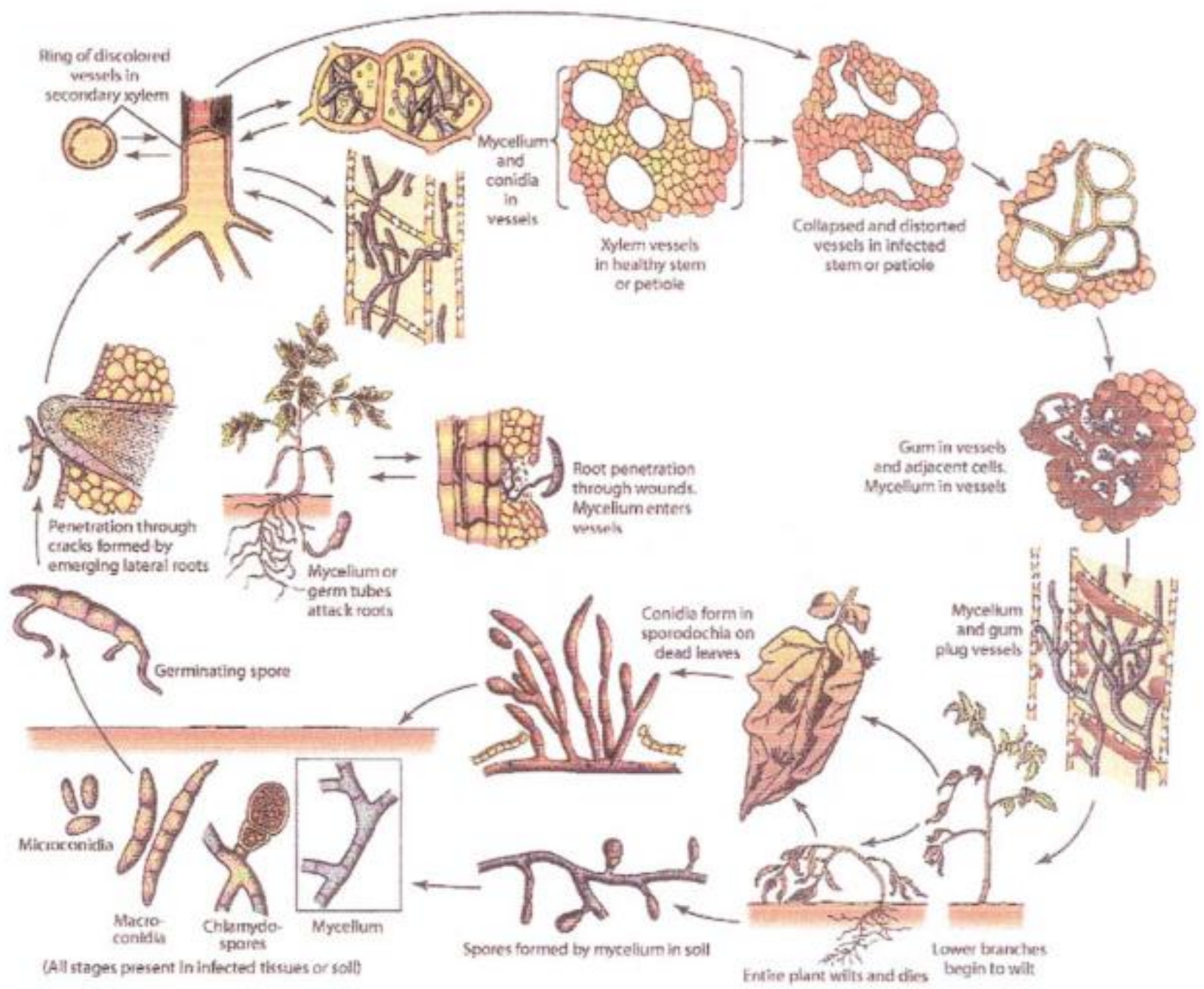


Fig. 16.7. *Fusarium*. Macroconidia and clustered microconidia. Portion of a hypha bearing chlamydoconidia is also shown.



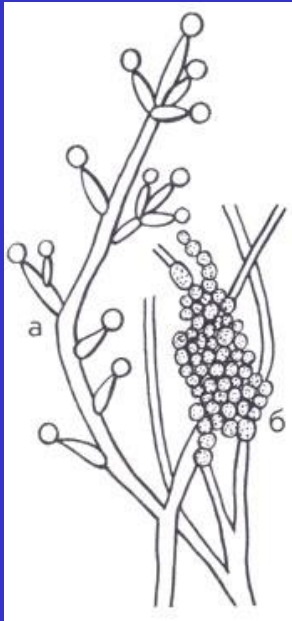
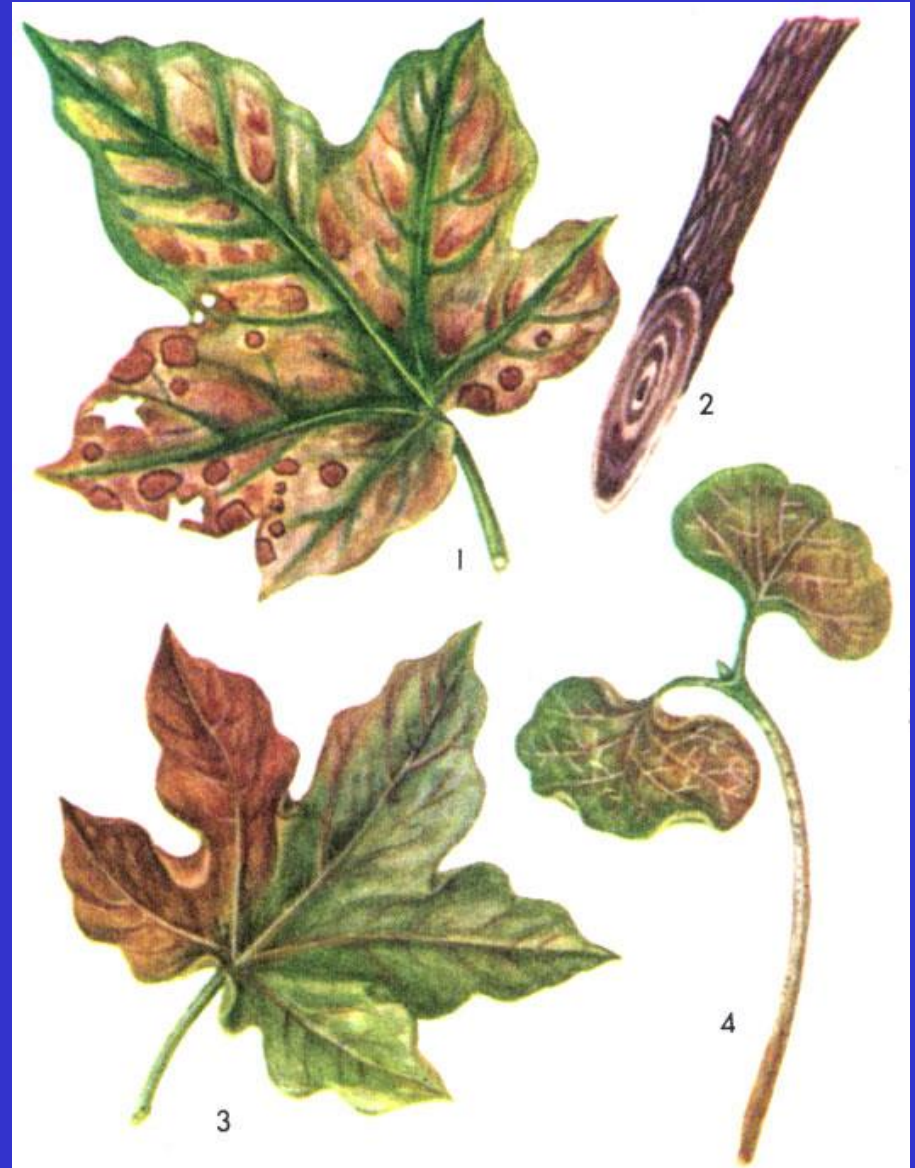




Management

- **Fields should be deeply ploughed and left for solarization.**
- **Resistent variety-JLA-101,AKH-590, Verun, Bijoy, BDS Varalakshmi, Vijay, Pratap**
(Neal *et al.*, 1954)
- **Seed treatment with Carbendazim @ 2 g/kg seeds should be given, Prothioconazole / Imidazole**
- **Kalyanasundram (1954) has ascribed the resistence of cotton to wilt in zinc amended soil, greater reserves of CHO, ascorbic acid and reducing sugars in cotton plants**

Verticillium wilt



Symptoms

- Disease attacks – crop is in square and bolls
- Bronzing of veins – interveinal chlorosis- yellowing
- Tiger claw appearance
- Infected plants ripen prematurely, boll development is stopped
- Vascular discoloration in stems- sudden and almost total defoliation (Pegg & Brady 2002).
- The disease is distributed generally and apparently it is associated with alkaline soils (Drummond *et al.*, 1949)

Microsclerotia dark brown to black, abundant, thick-walled,, consisting of swollen almost globular cells (Smith 1965)



Verticillium wilt (*Verticillium dahliae* Kleb.):

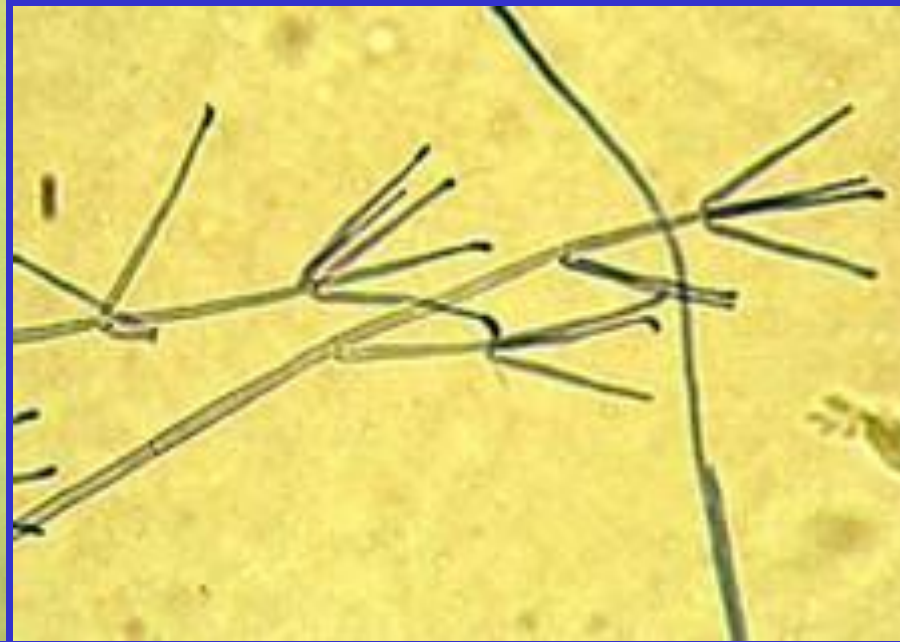
- 1 - The affected leaf from the upper side;
- 2 - The affected leaf on the underside;
- 3 - Cut of the affected stem.
- 4 - The affected plant during the germination period;
- 5 - Affected leaf;
- 6 - Cut of the affected stem.

Reported in India 1968
from Coimbatore

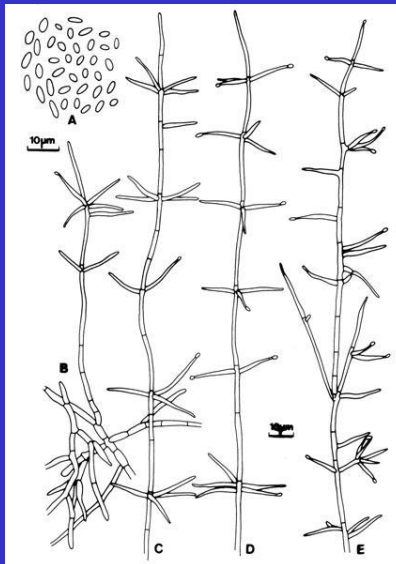
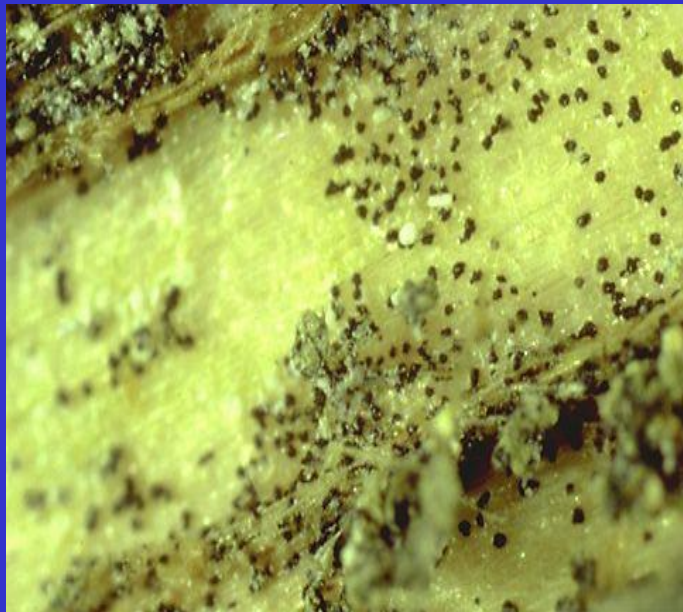




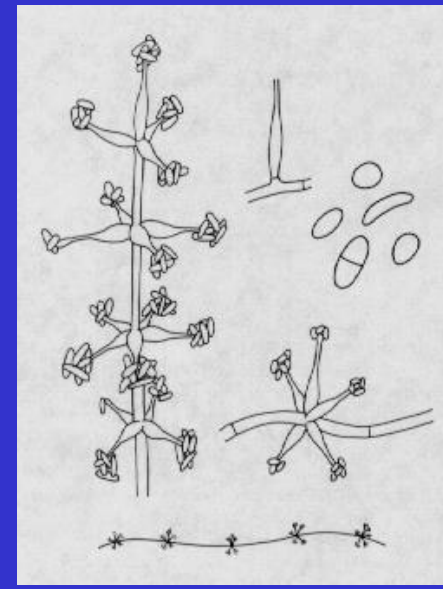
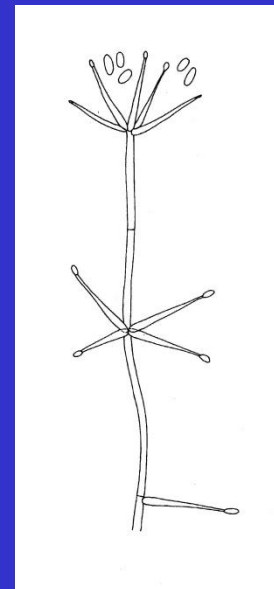
Verticillium albo atrum

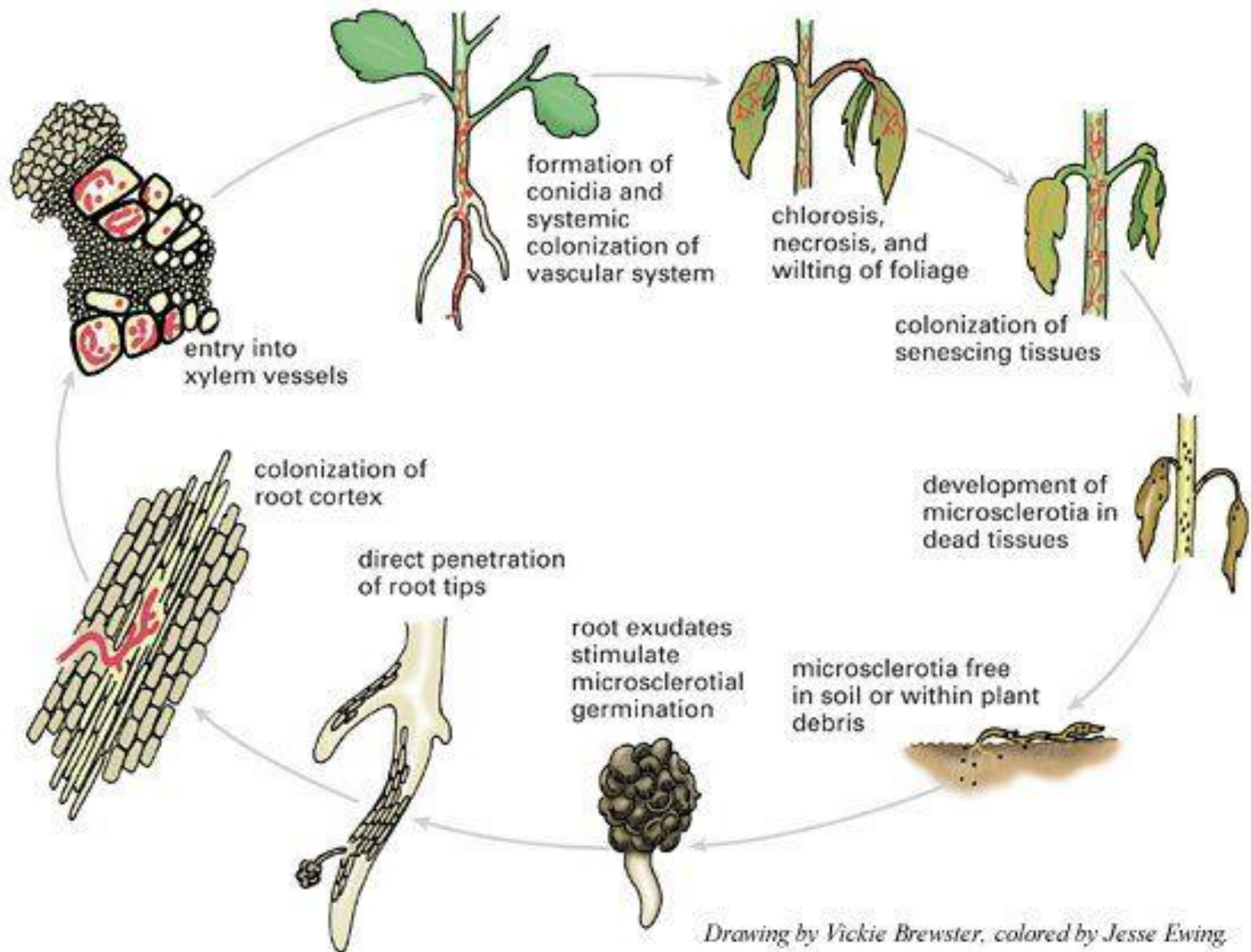


Verticillium dahliae

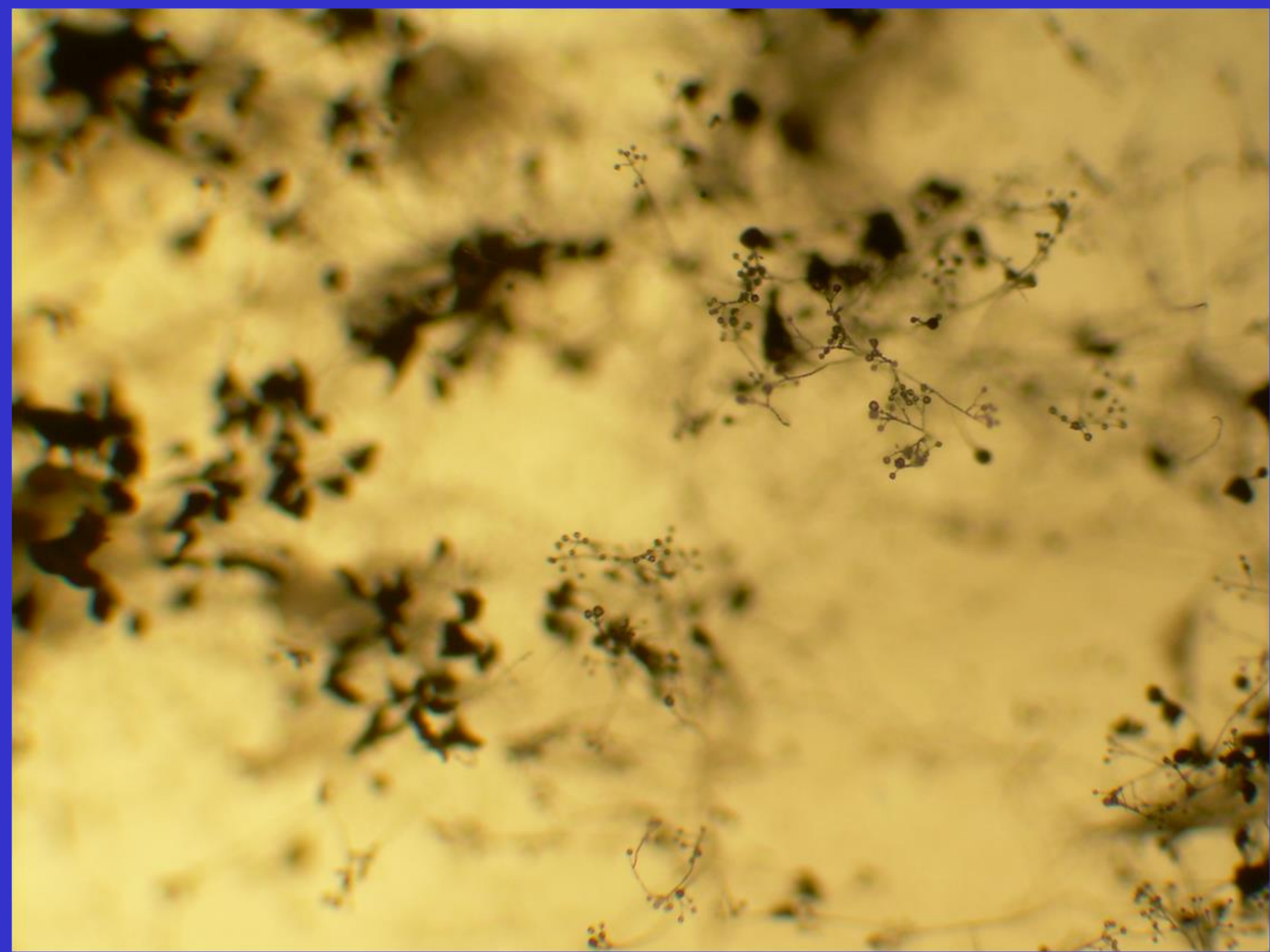


Verticillium lecanii





Drawing by Vickie Brewster, colored by Jesse Ewing





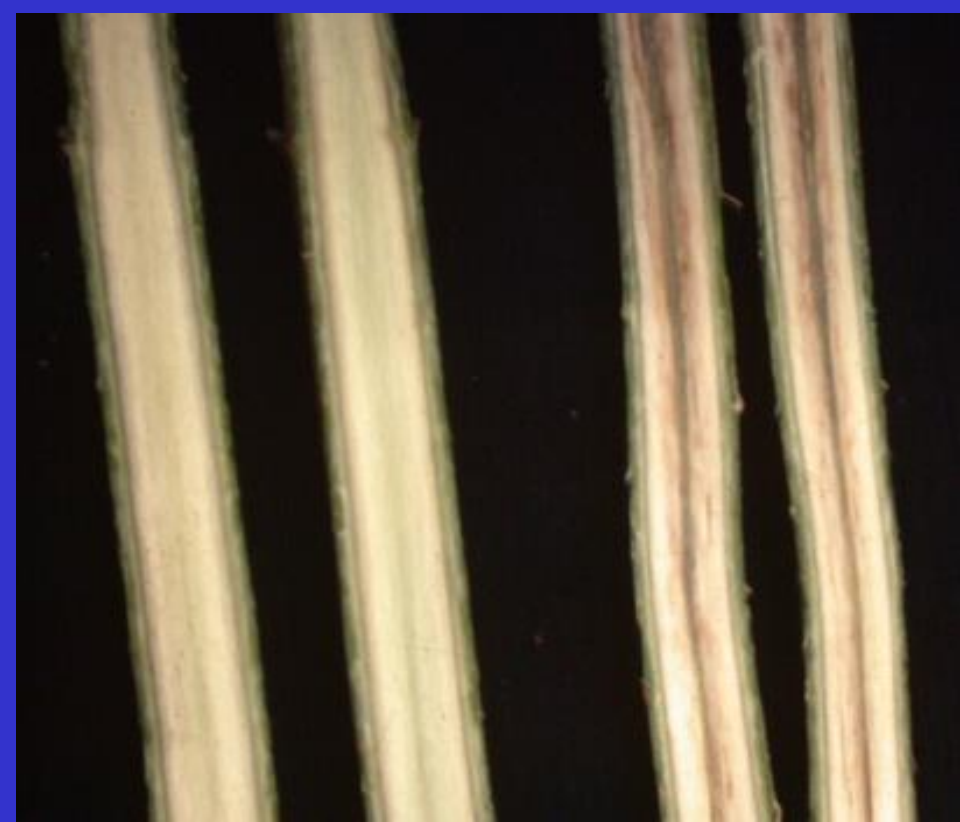
Verticillium wilt-
Verticillium dahliae



Vascular browning



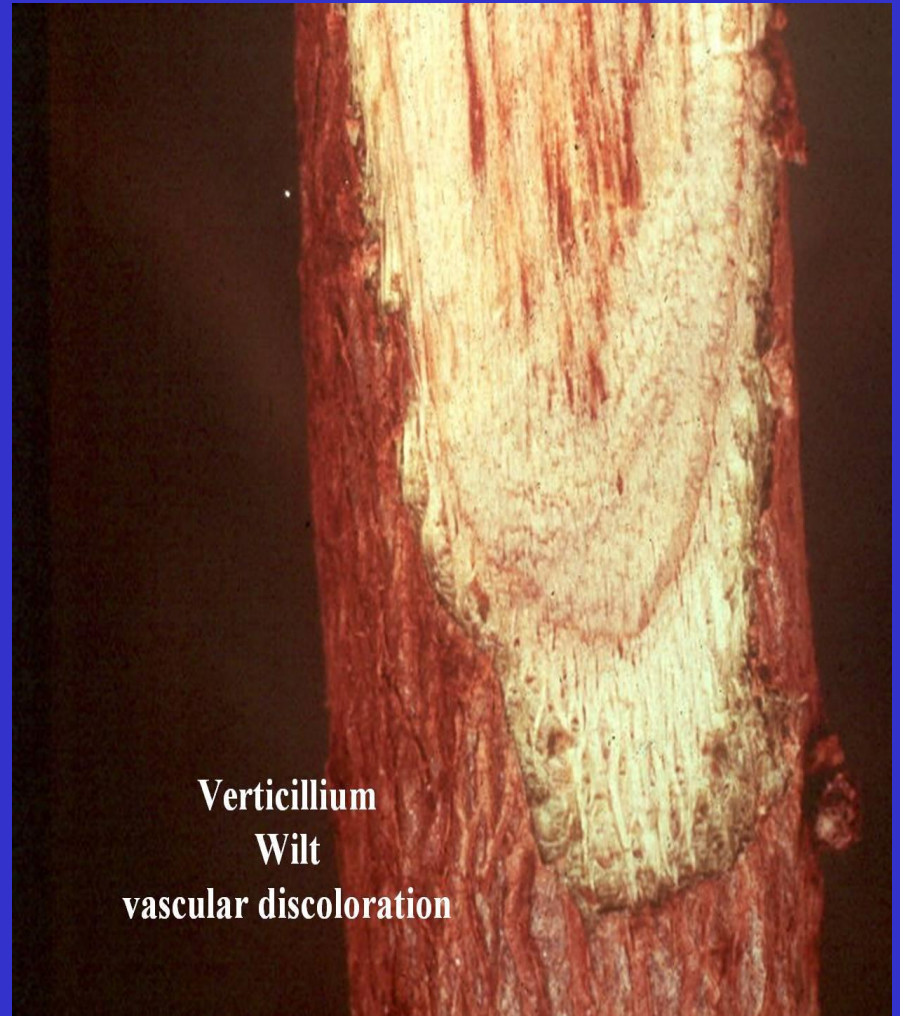
Verticillium dahliae
Tiger stripe symptom



longitudinal section



cross section

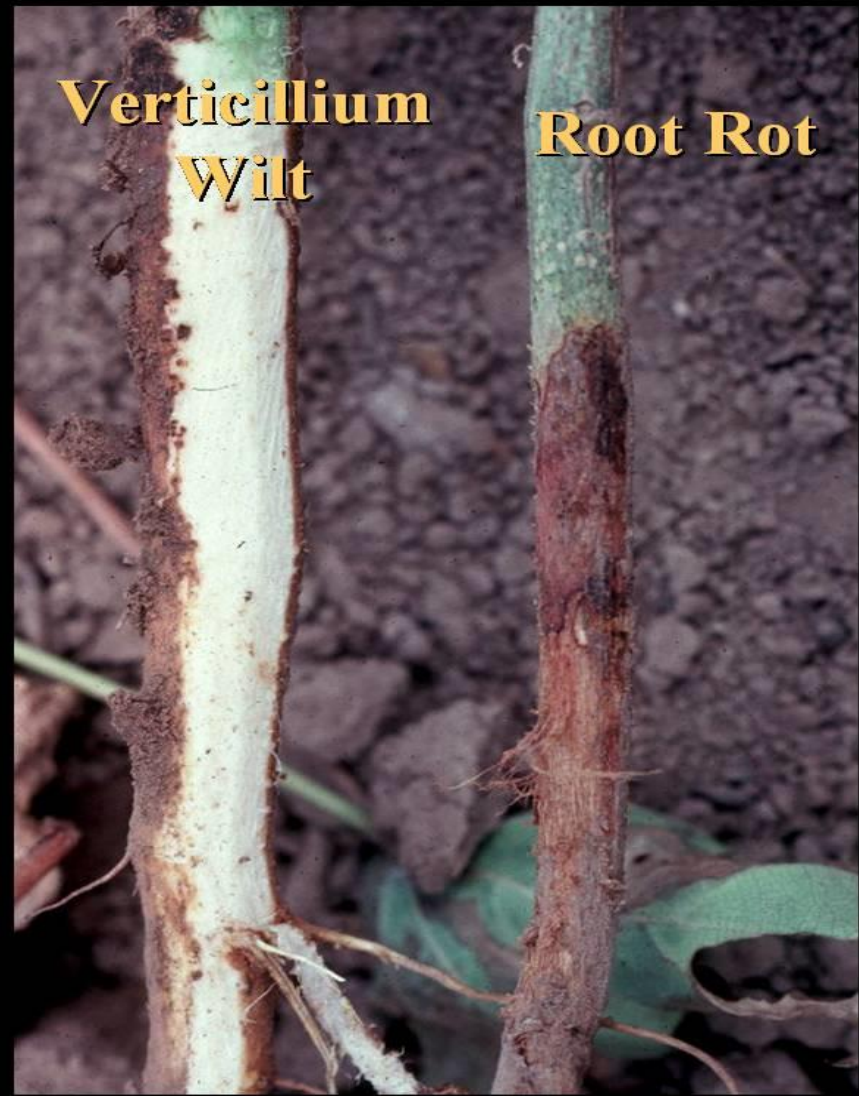
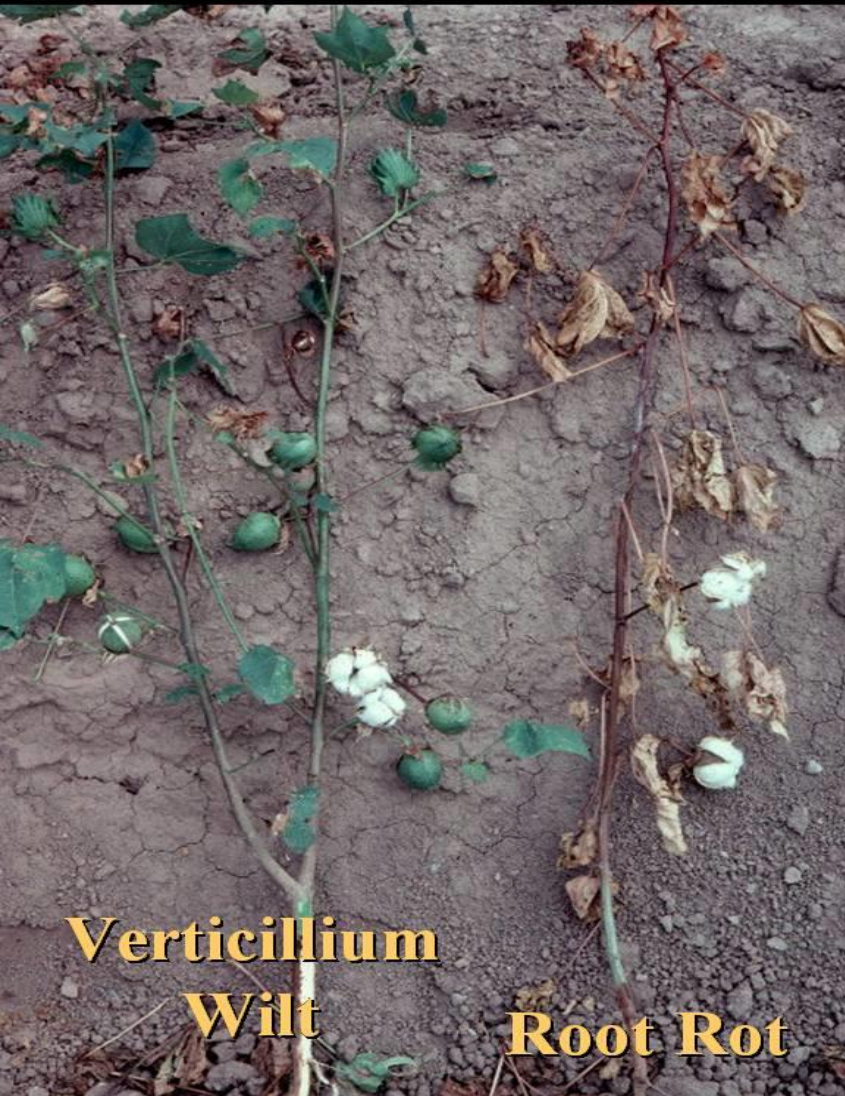


**Verticillium
Wilt
vascular discoloration**



Difference

Verticillium Wilt VS Root Rot



Management

- **Crop rotation with cereals**
- **Resistant varieties - MCU 5VT, Surabhi, Savitha (Hybrid)**
- **Tolerant varieties - Sujatha, CBS156**
- ***Trichoderma virens*-are effective biological control agents against *Verticillium* wilt**

(Zhang *et al.*, 1996)

- **Nitrogen and P in ratio 1:0.7 @150-250 N kg /he**
- **Treatment with systemic fungicide –vitavax-4%**
- **Spot drench with 0.05 per cent Benomyl or Carbendazim**

Alternaria Leaf Spot

Alternaria macrospora - Cotyledon infection



Leaf blight - *Alternaria macrospora*

- **Severe when plants are 45- 60 days old**
- **Small brown irregular round spots**
- **Each spot has central necrotic lesion surrounded by concentric ring.**
- **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.**

Leaf blight - *Alternaria macrospora*



Typical symptom on leaves





Alternaria leaf spot – Severe symptom



Close-up of Diseased Plant Terminal Region



Boman-TAEX

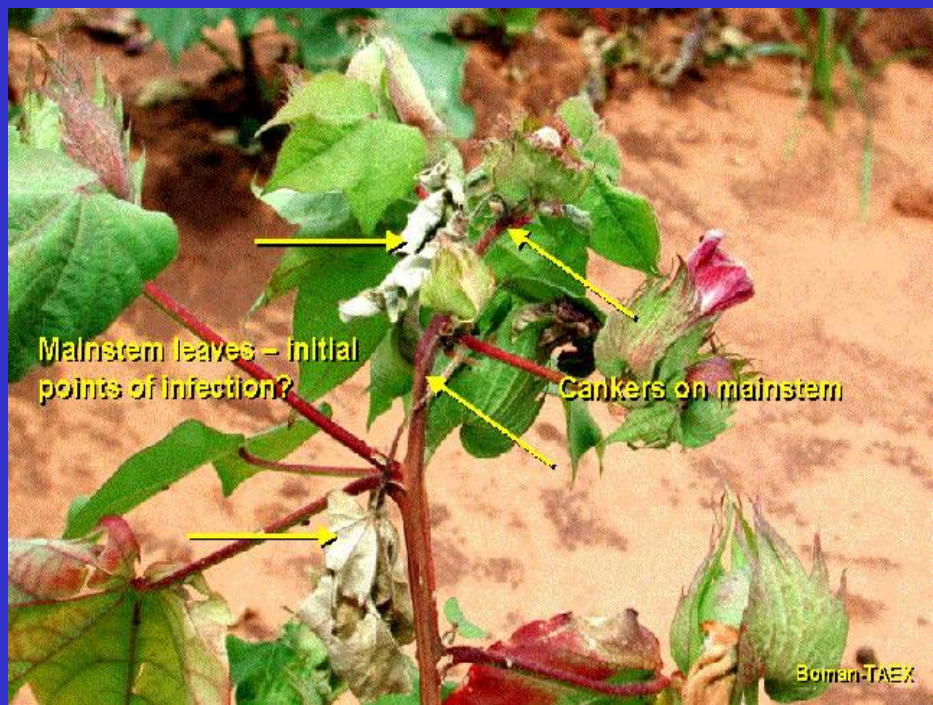
Close-up of Diseased Plant Showing Typical Terminal Curling



Cankers on mainstem

Boman-TAEX

Mainstem leaves – initial points of infection?



Cankers on mainstem

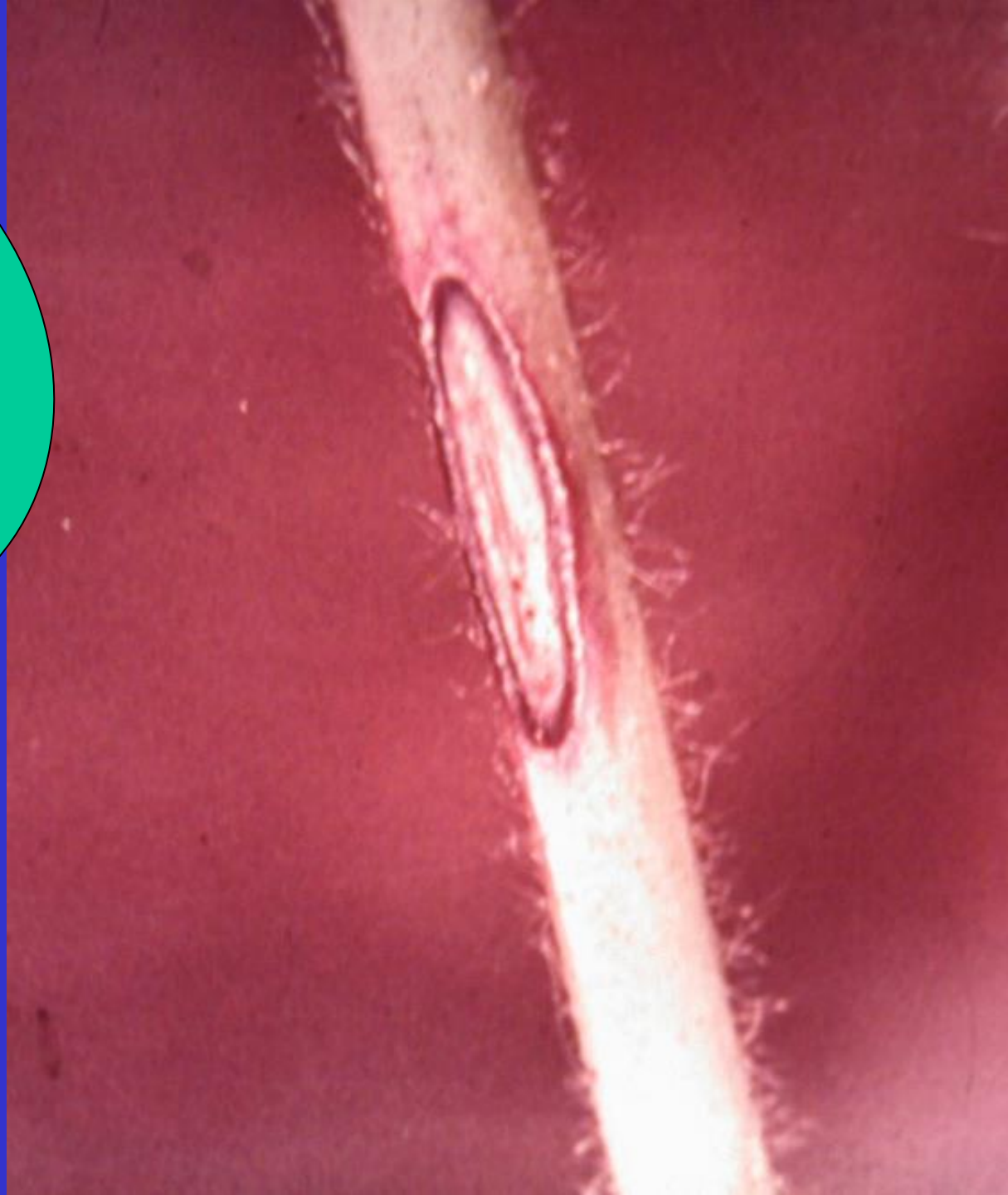
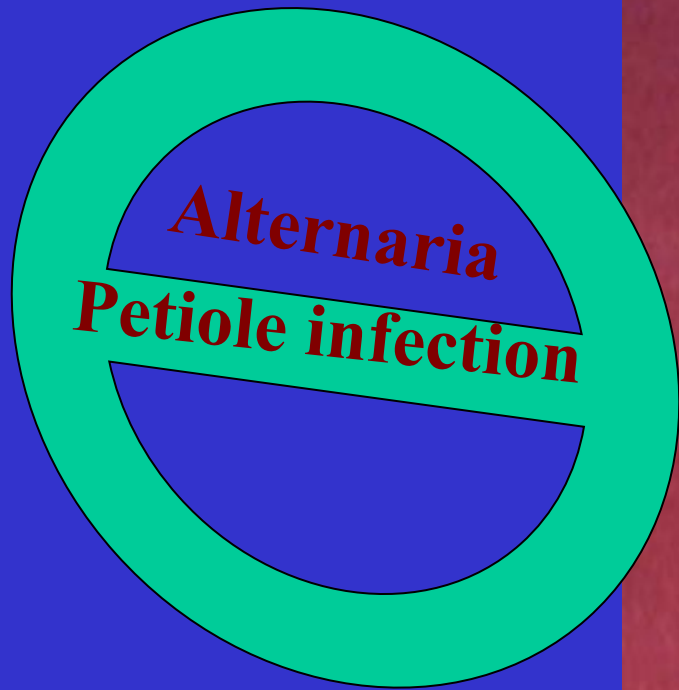
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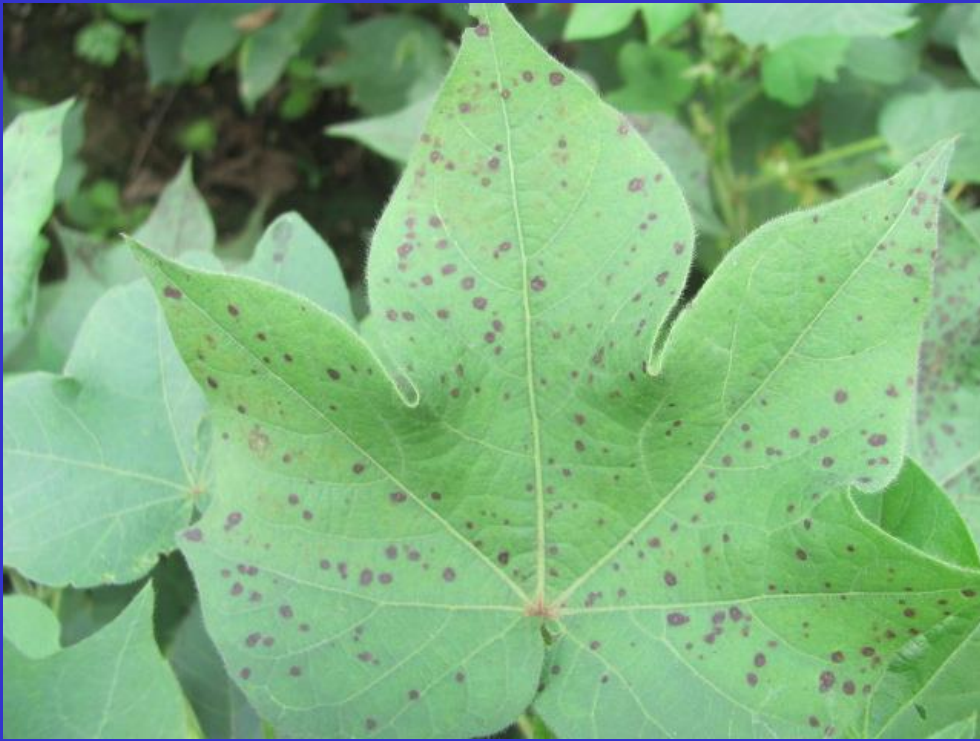


**Whole plant
drying due to
Alternaria blight**



Boll infection - *Alternaria*







Alternaria solani



Alternaria alternata

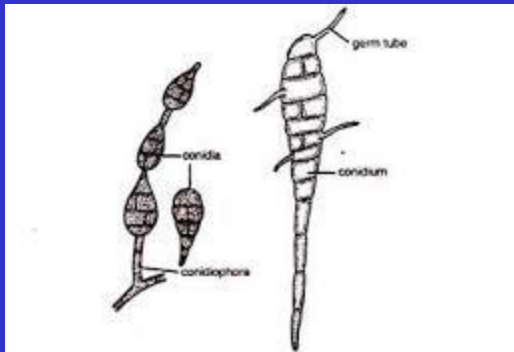


Fig. 3. *Alternaria*. (A-F) Conidia in acropetal chain and germinating conidium.



Management

- **Remove infected debris**
- **CCH4 (resistant line)**
- **Spray Mancozeb or Copper oxychloride at 2kg/ha at the intimation of the disease.**
- **Four to five sprays may be given at 15 days interval.**

Grey mildew- *Ramularia areola*

- The dorsal surface of the leaves show profuse sporulation (giving the lesions a white mildew-like appearance).
- light green to yellow green coloration on the ventral (upper) leaf surface - necrotic and dark brown - easily mistaken from the angular leaf spot phase of bacterial blight.
- 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.



Grey mildew

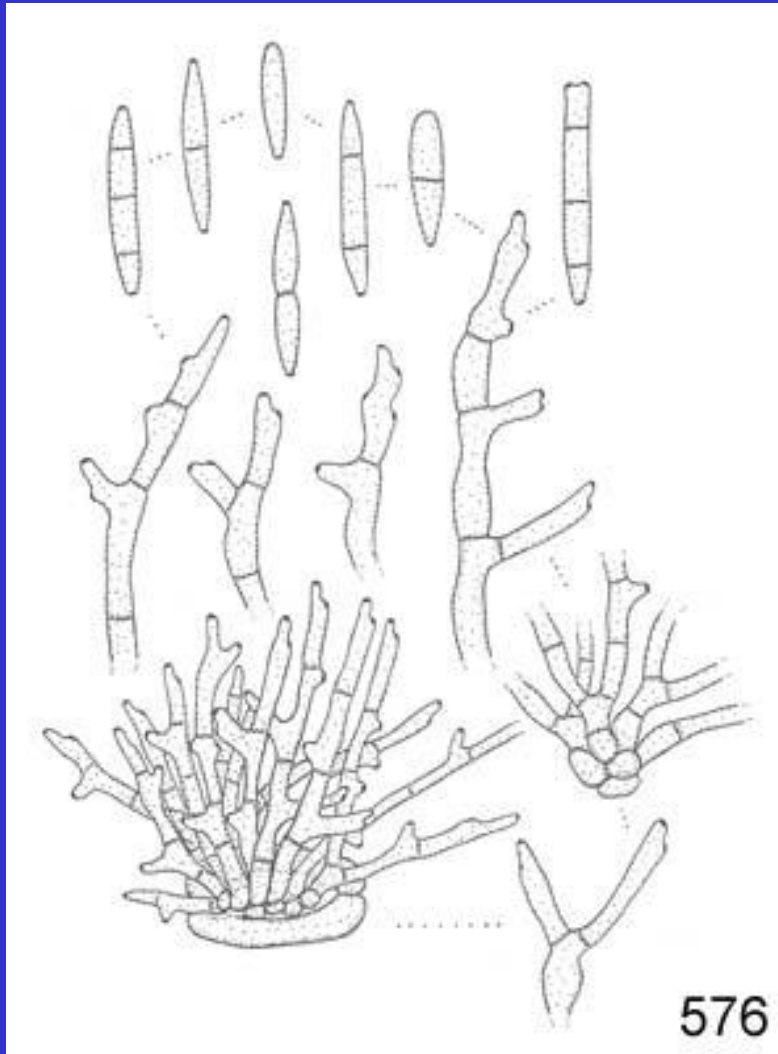
*Ramularia
areola*

Development of Grey mildew

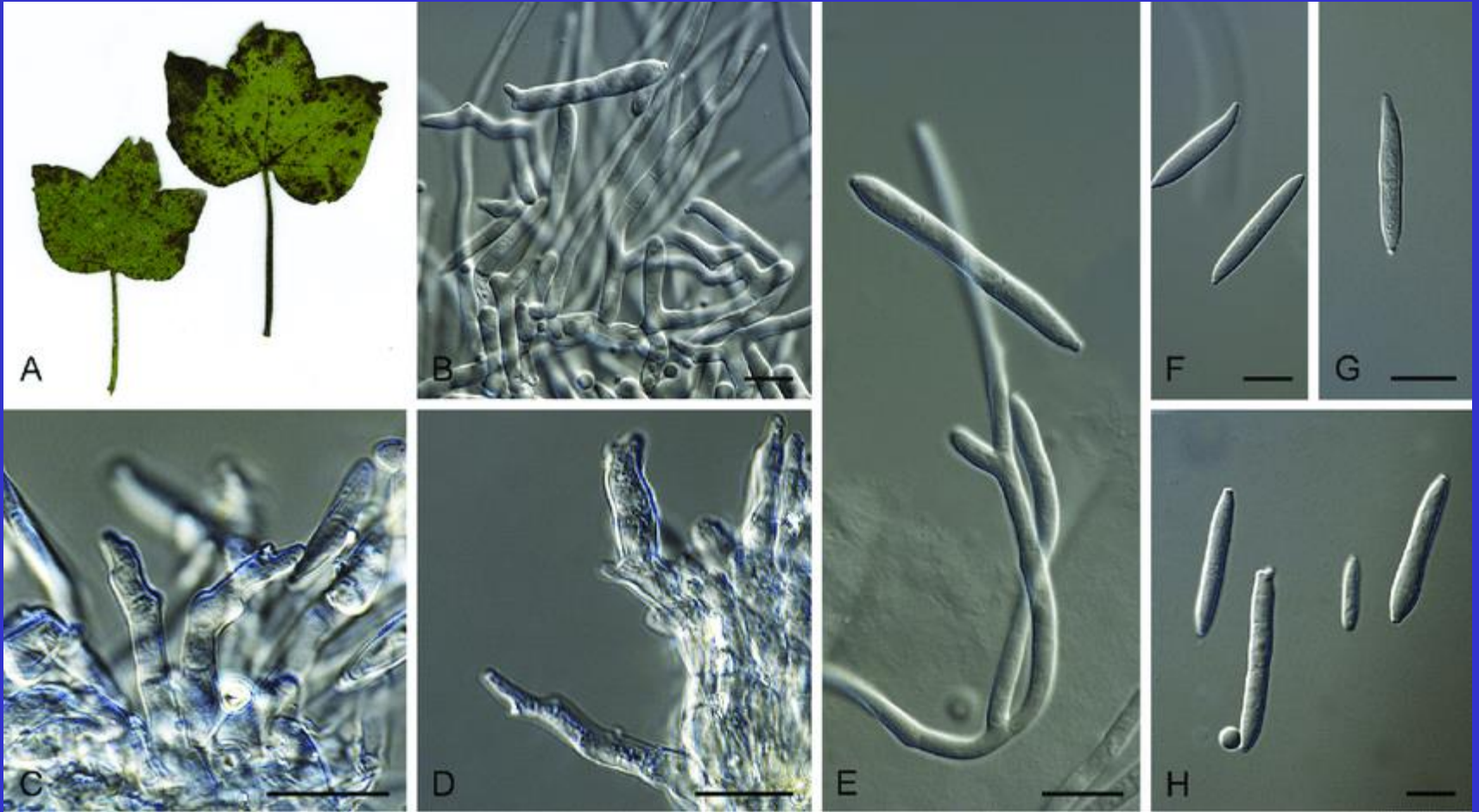




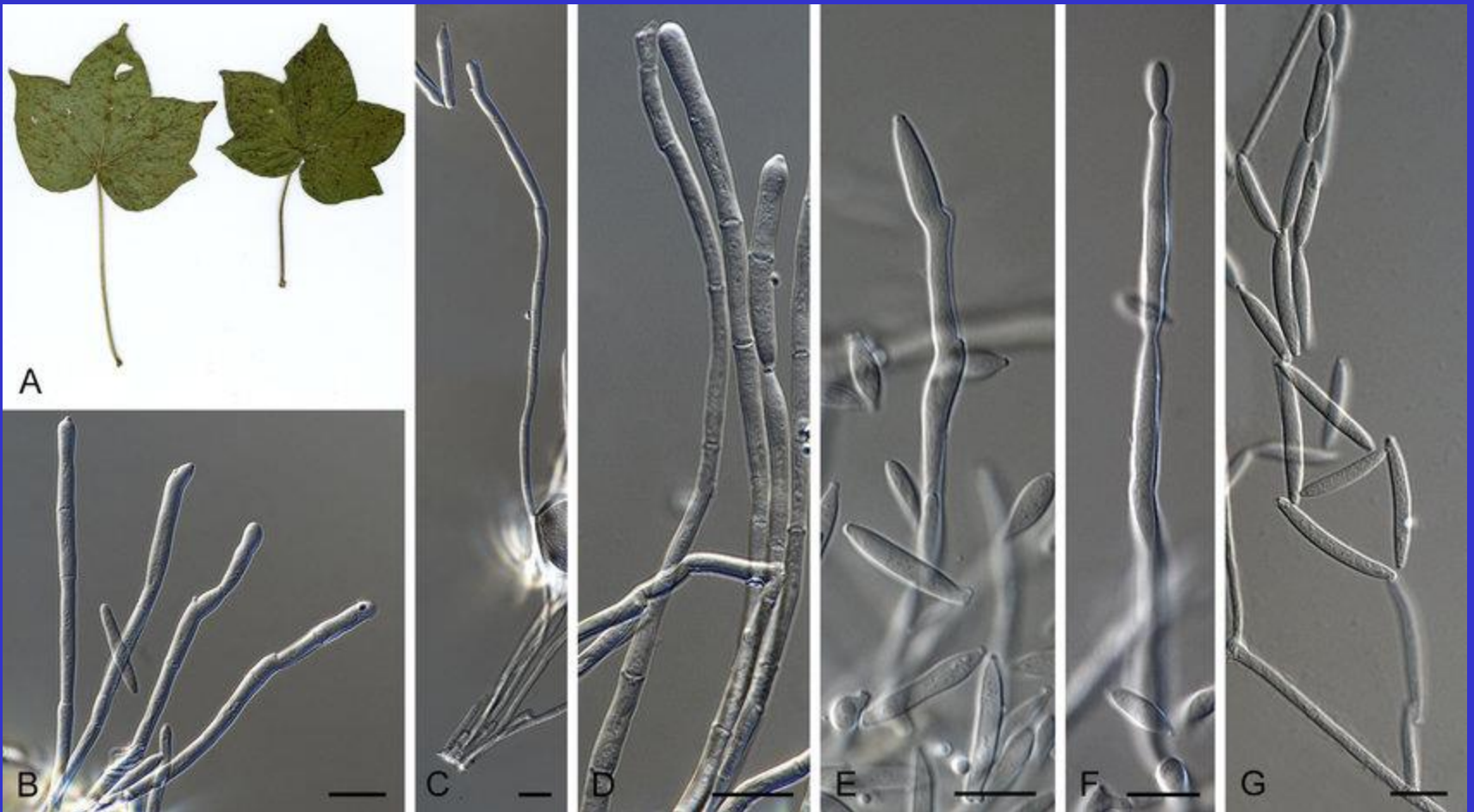
Severity of grey mildew



Ramulariopsis gossypii



Ramulariopsis pseudoglycines



Management

- **Crop debris should be removed**
- **Crop rotation with cereals**
- **Spray the crop with Carbendazim at 250-375g or Wettable sulphur at 1.25-2.0 kg/ha, repeat after a week.**
- **Grow the resistant varieties like Sujatha and Varalakshmi, GMR 5, GMR 9 (resistant lines).**

Name: Anthracnose

Caused by: *Glomerella gossypii*; *Colletotrichum gossypii*

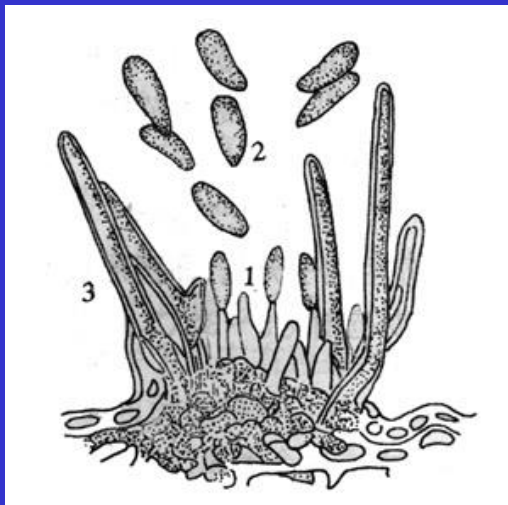
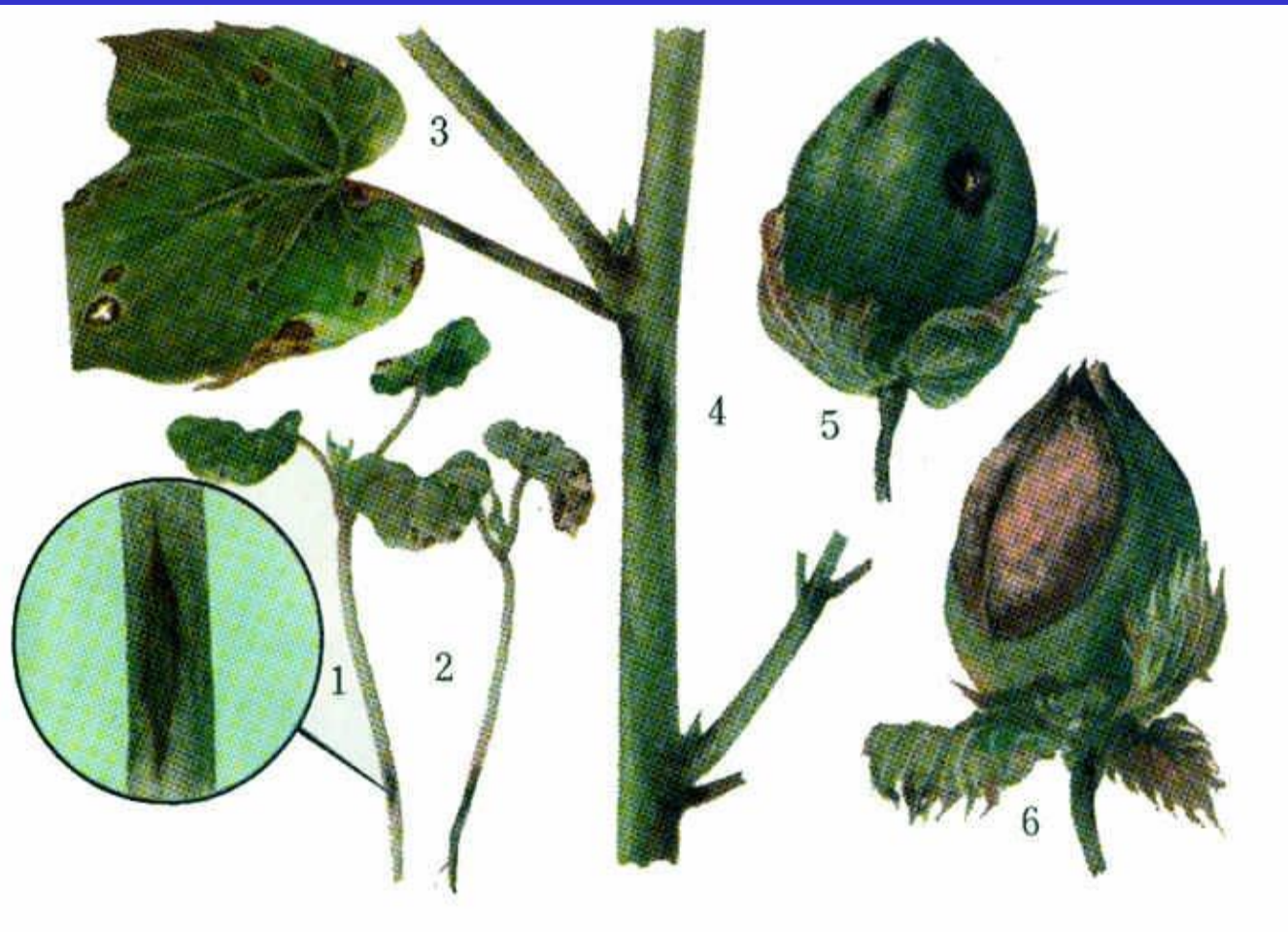


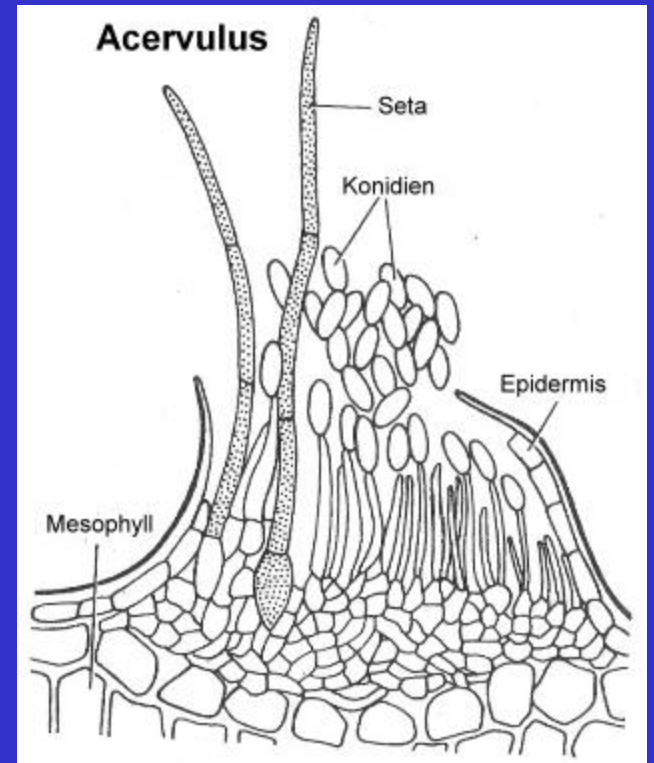
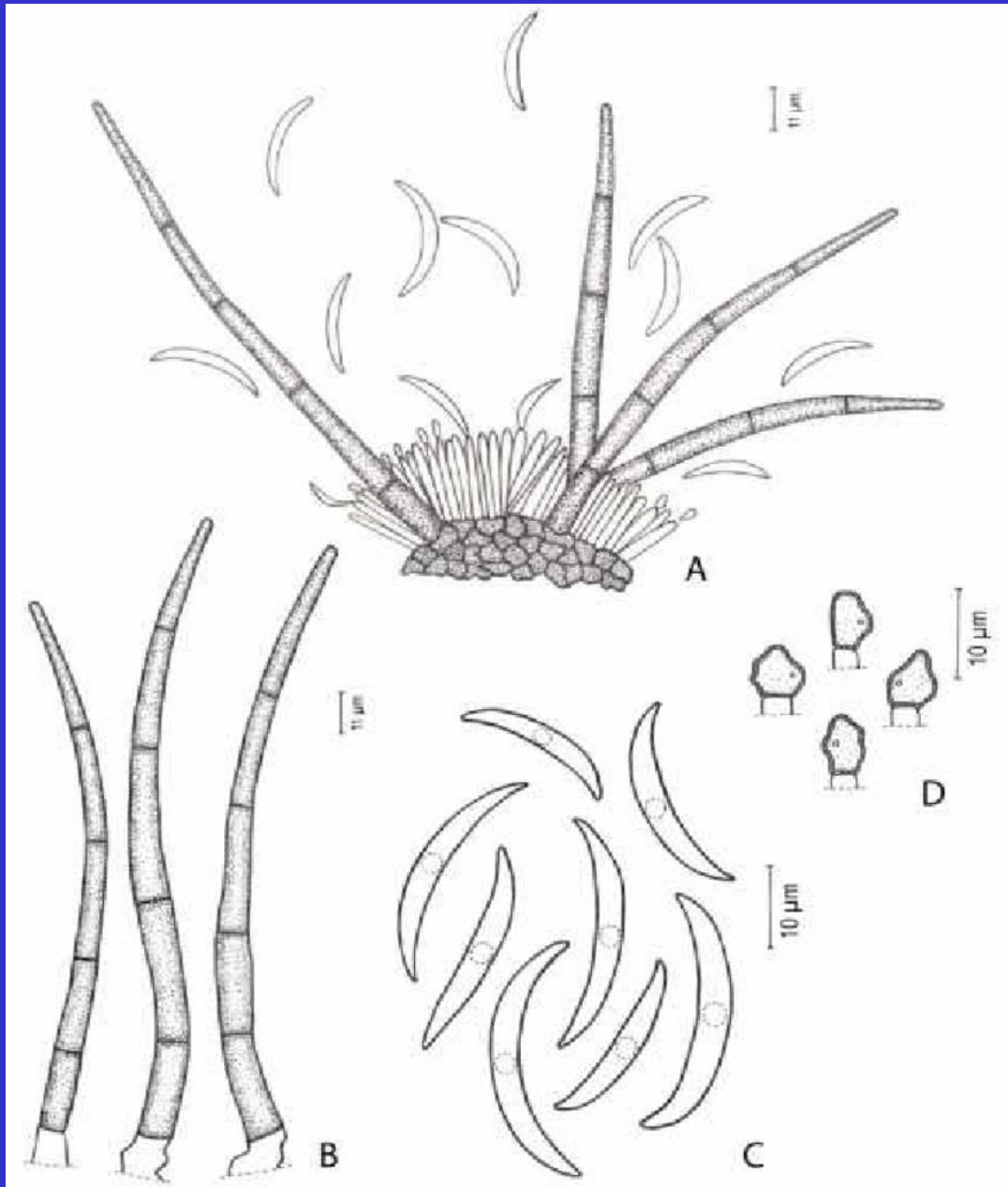
Anthracnose

(Glomerella gossypii)

- **The fungus infects the seedlings and produces small reddish circular spots on the cotyledons and primary leaves.**
- **Seedling – stem girdling – wilt**
- **Mature plants – stem splitting – bark shredding**
- **Boll spotting- water soaked, reddish brown depressed spots – burst and premature drying.**
- **Old cotton bolls and other plants parts in the fields are responsible for perpetuation of the fungus**
- ***Aristolochia bracteata* and *Hibiscus diversifolius* also affected by pathogen**









10 μ m



Management

- **Adopt optimum spacing**
- **Apply recommended dose of fertilizers**
- **Rotation of crops using winter legumes**
- **Spray mancozeb 2kg/ha from 45th day at 15 days interval.**
- **Spray Fenvalerate 75g a.i./ha + Copper oxychloride 2.5kg or Carbendazim 1kg or Mancozeb 2 kg/ha from 45th day at 15 days interval.**
- **Two or three sprays are necessary**

Name: Ascochyta Blight (Wet Weather Blight)

Caused by: *Ascochyta gossypii* (*Phoma exigua*)

Foliar Symptoms: Ascochyta blight forms lesions on cotyledons, leaves, stems, and bolls. Lesions on the cotyledons and leaves approach 2 mm





UGA1234096

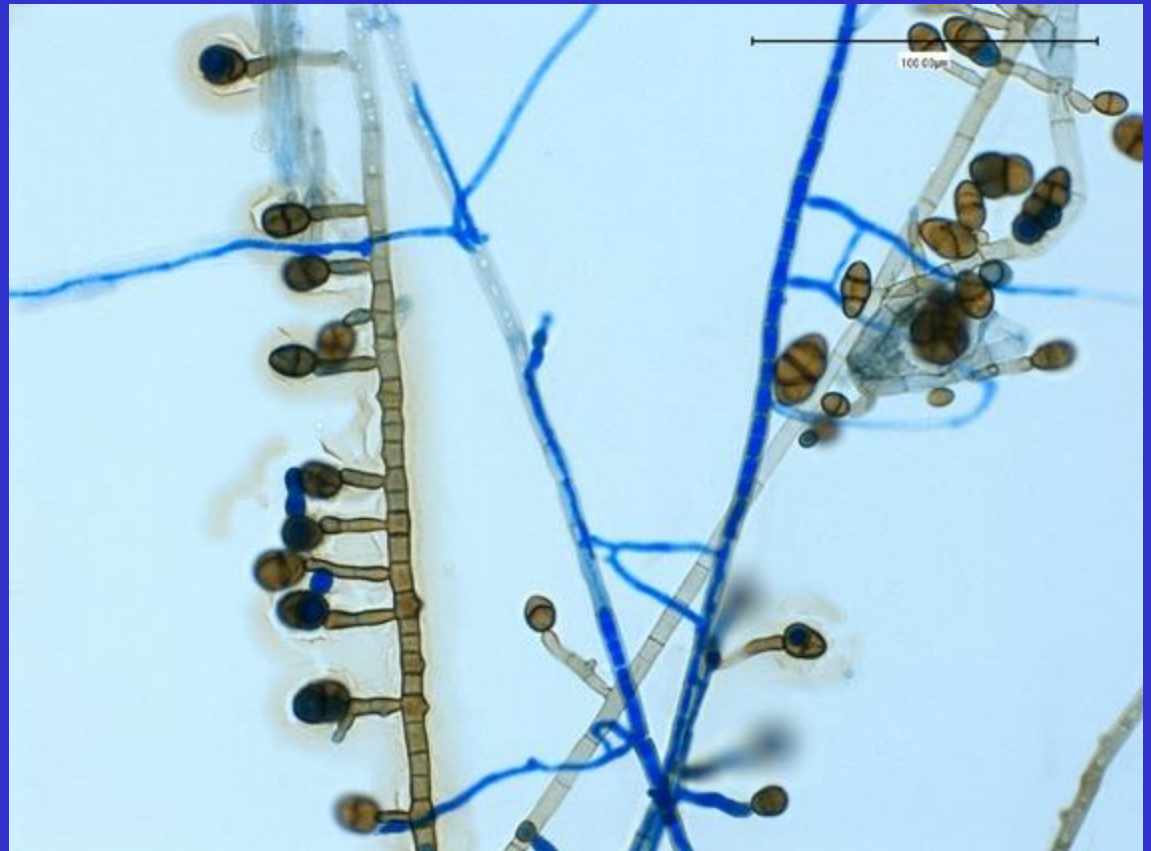
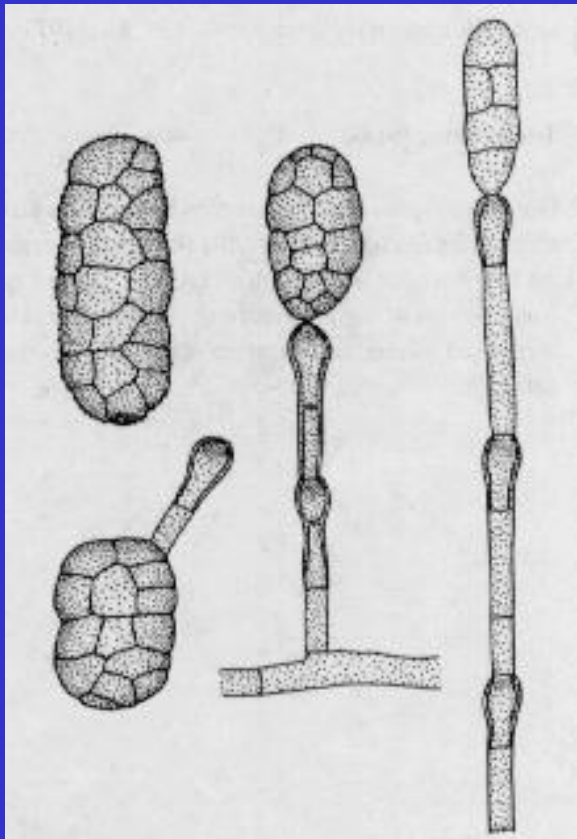


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Stemphylium Leaf Spot







RUST (*Phakopsora gossypii*)

- **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 leaves finally turn reddish brown & shed prematurely & the bolls are small & fail to open**

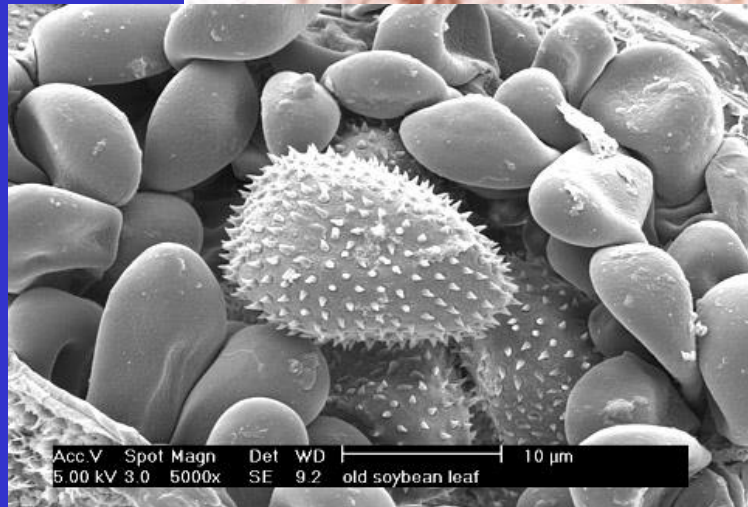
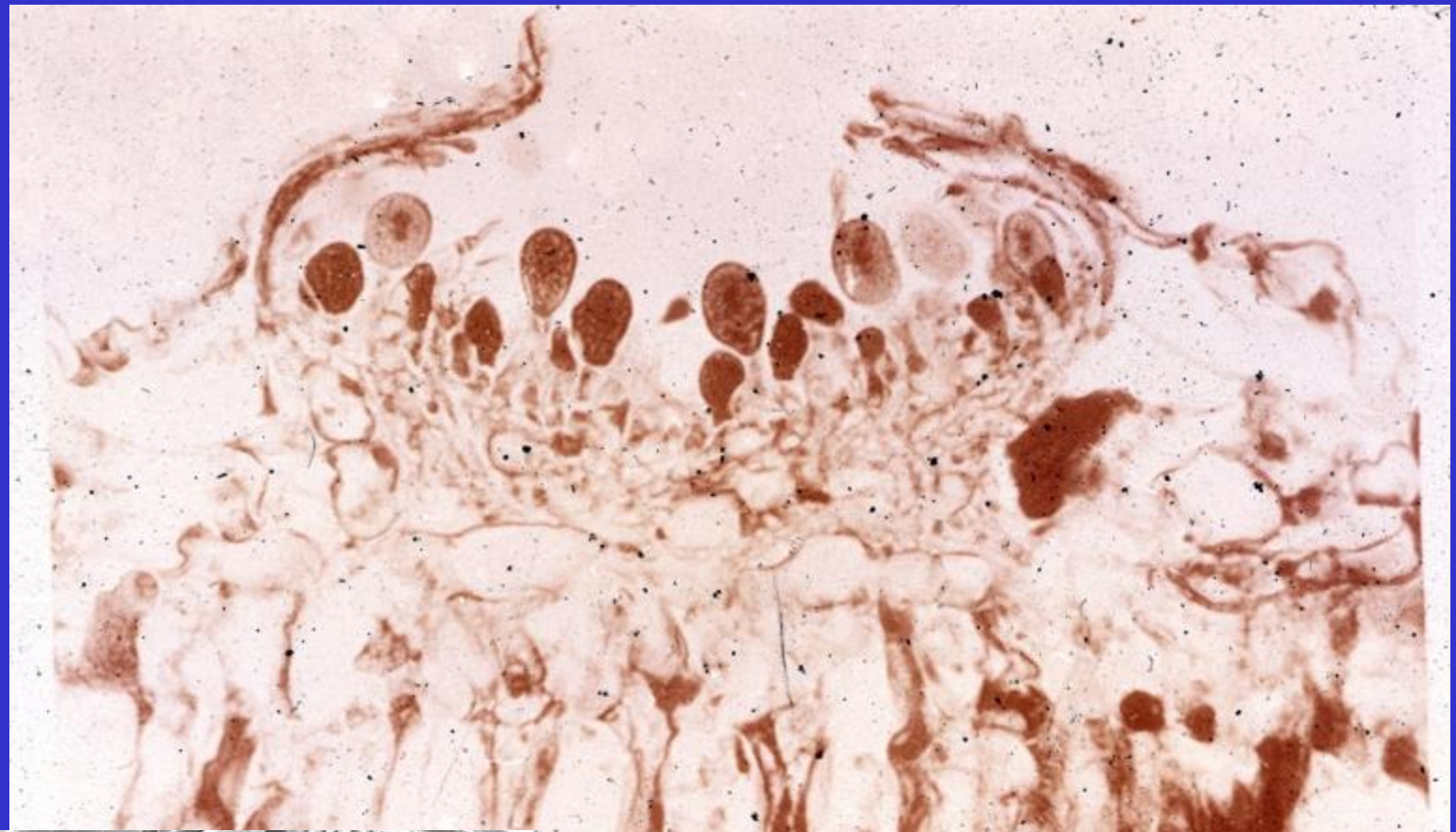
(Cooper, 1939)

- **The sori may also develop on bolls**
- **The potassium deficiency also favour the development of the wilt disease**









Management

- **Rogue out the infected plants periodically.**
- **Spray – Wettable sulphur / Tebuconazole**
- **Spray Mancozeb 2kg or Copper oxychloride 2.5 kg or Ziram 2.5 lit or Carbendazim 500g/ha**

Name: Target Spot

Caused by: *Corynespora cassiicola*

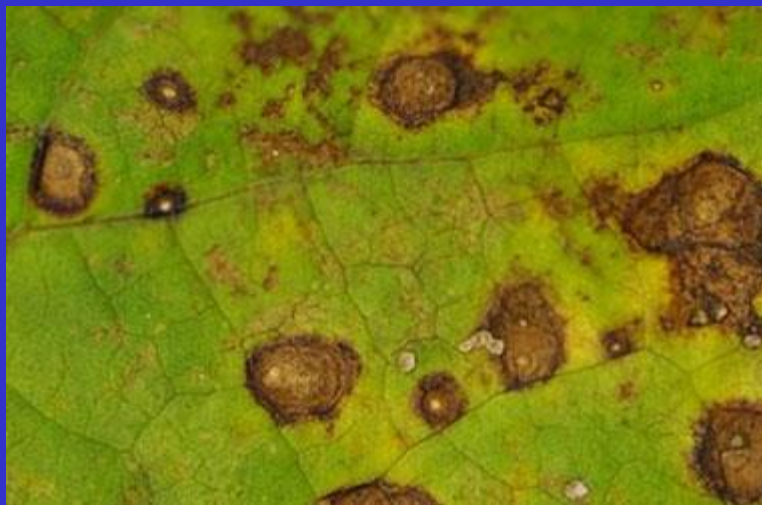
Foliar Symptoms: Characteristic symptoms of Target Spot include brown lesions, sometimes approaching 2 cm (~1 inch) in diameter, exhibiting a series of concentric rings.

Unlike *Stemphylium* and *Alternaria* Leaf Spot, the spots are typically not bordered by a dark band.

Leaf spots and premature defoliation are generally confined to the interior canopy (unlike that found in *Stemphylium* and *Alternaria* diseases.)



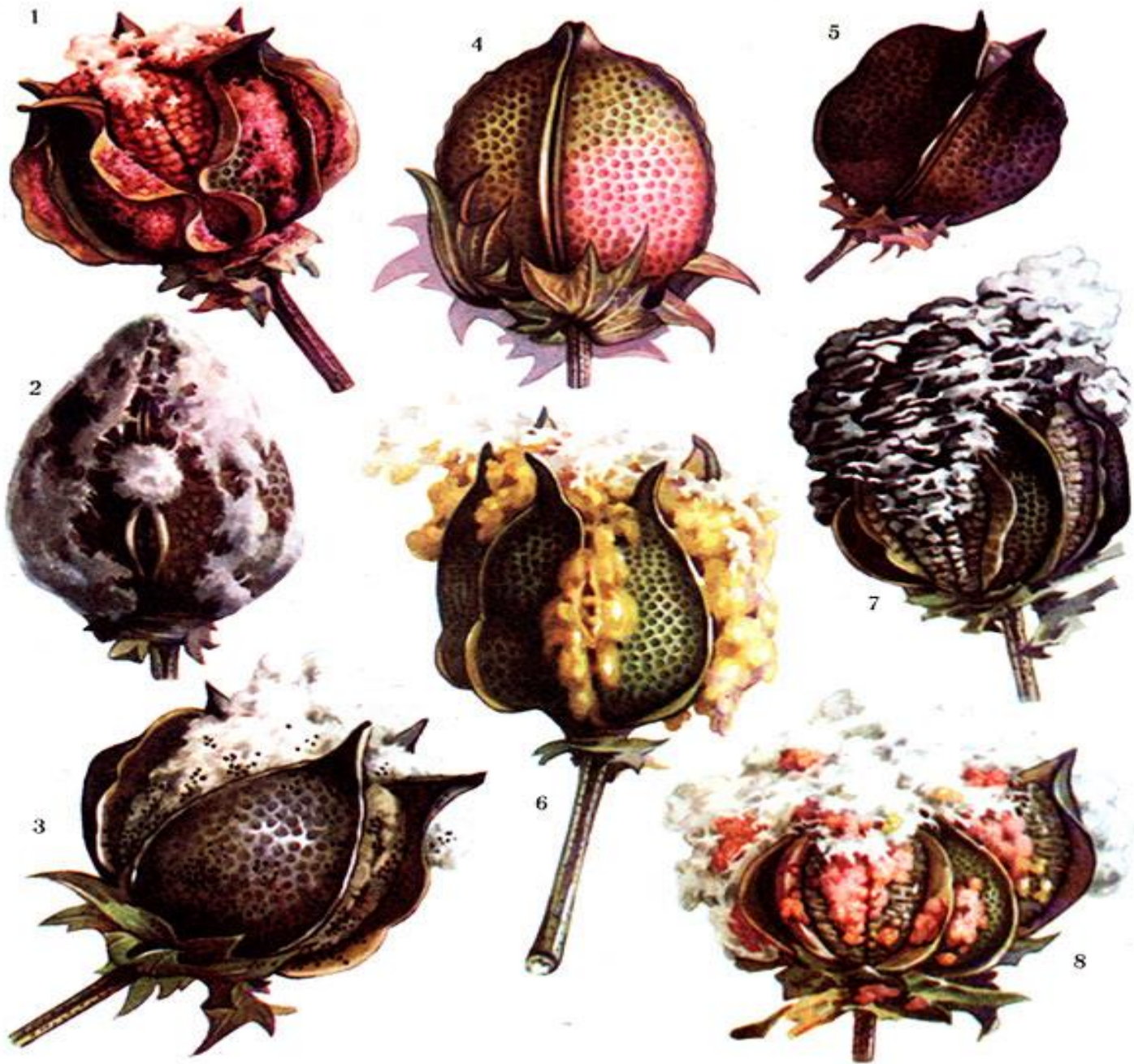
Cercospora Leaf Spot
Cercospora gossypii





Boll rot

*Fusarium
moniliforme,
Aspergillus flavus*



1. **Pink rot** (*Trichothecium roseum* Fr.);
2. **Grey rot** (*Botrytis cinerea* Fr.)
3. **Nigrosporosis** (*Nigrospora gossypii* Jacz.);
- 4, 5. **Aspergillus** (*Aspergillus niger* Tiegh.), Initial and final lesions;
6. **Adhesive bacteriosis** (pathogens - various kinds of bacteria and actinomycetes);
7. **Black sheath** (pathogens - mushrooms from the genera *Cladosporium* Link, *Macrosporium* Fries and *Alternaria* Nees);
8. **Fusarium** (pathogens - fungi of the genus *Fusarium* Link)

Bacterial Leaf Blight

Xanthomonas axonopodis pv. *malvacearum* - Seedling blight



Bacterial blight

(X. axonopodis pv. malvacearum)

- **Seedling blight : water-soaked, circular or irregular lesions develop on the cotyledons**
- **Angular leaf spot : water soaked areas develop on lower surface of leaves, enlarge gradually and become angular**
- **Vein blight or vein necrosis or black vein : 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.**

Bacterial blight

(X. axonopodis pv. malvacearum)

- **Black arm** : premature drooping off of the leaves, -- breaking of the stem and hang typically as dry black twig to give a characteristic “black arm” symptom
- **Square rot / Boll rot** : water soaked lesions appear and turn into dark black and sunken irregular spots-bolls lead to premature bursting.

Angular leaf spot-
Xanthomonas axonopodis pv.
malvacearum





Angular leaf spot

Xanthomonas axonopodis pv.
malvacearum



Bacterial Blight





Vein blight





Bacterial Blight



Bacterial Blight



Black arm and vein blight



Boll rot symptom of BLB



Boll rot symptom of BLB





**Bacterial Blight Symptoms
On Main Stem and Leaf**



Boman-Texas Cooperative Extension

Bacterial Blight Symptoms on Bottom Side of Leaf



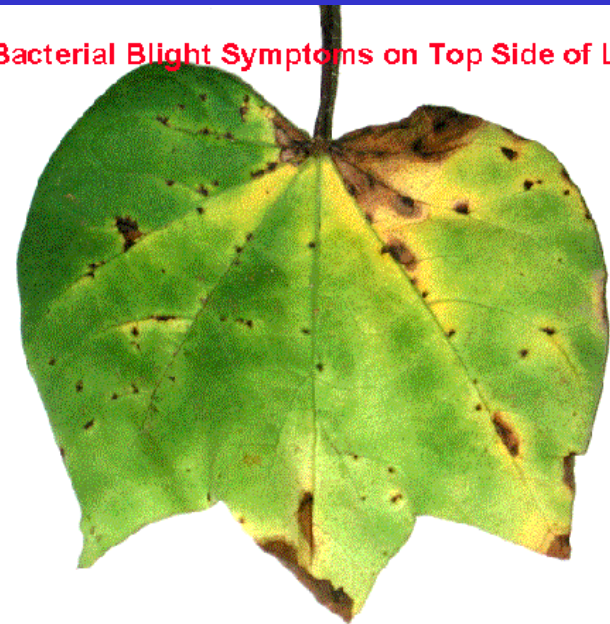
Boman-Texas Cooperative Extension

Bacterial Blight Symptoms



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Bacterial Blight Symptoms on Top Side of Leaf



Boman-Texas Cooperative Extension



Management

- Seeds treated with conc. HCL
- Remove the infected debris
- Rogue out weed hosts
- Verma *et al*, 1997. Hot water treatment of seed at 56°C for 10 min destroys the external as well as internal inoculums without affecting seed viability
- Mathur *et al* (1973) Had reported that seed treatment with Agrimycin (3g/40 kg seeds) & its spray are most promising in controlling the black arm of cotton
- Neem based formulations such as plantolyte & Agricare cure much more effectively than the best antibiotics such as Aminoglycosides, Streptomycin & Kanamycin
- Resistant varieties - MCU 10, L 604, L 389 (*Gossypium herbaceum*)

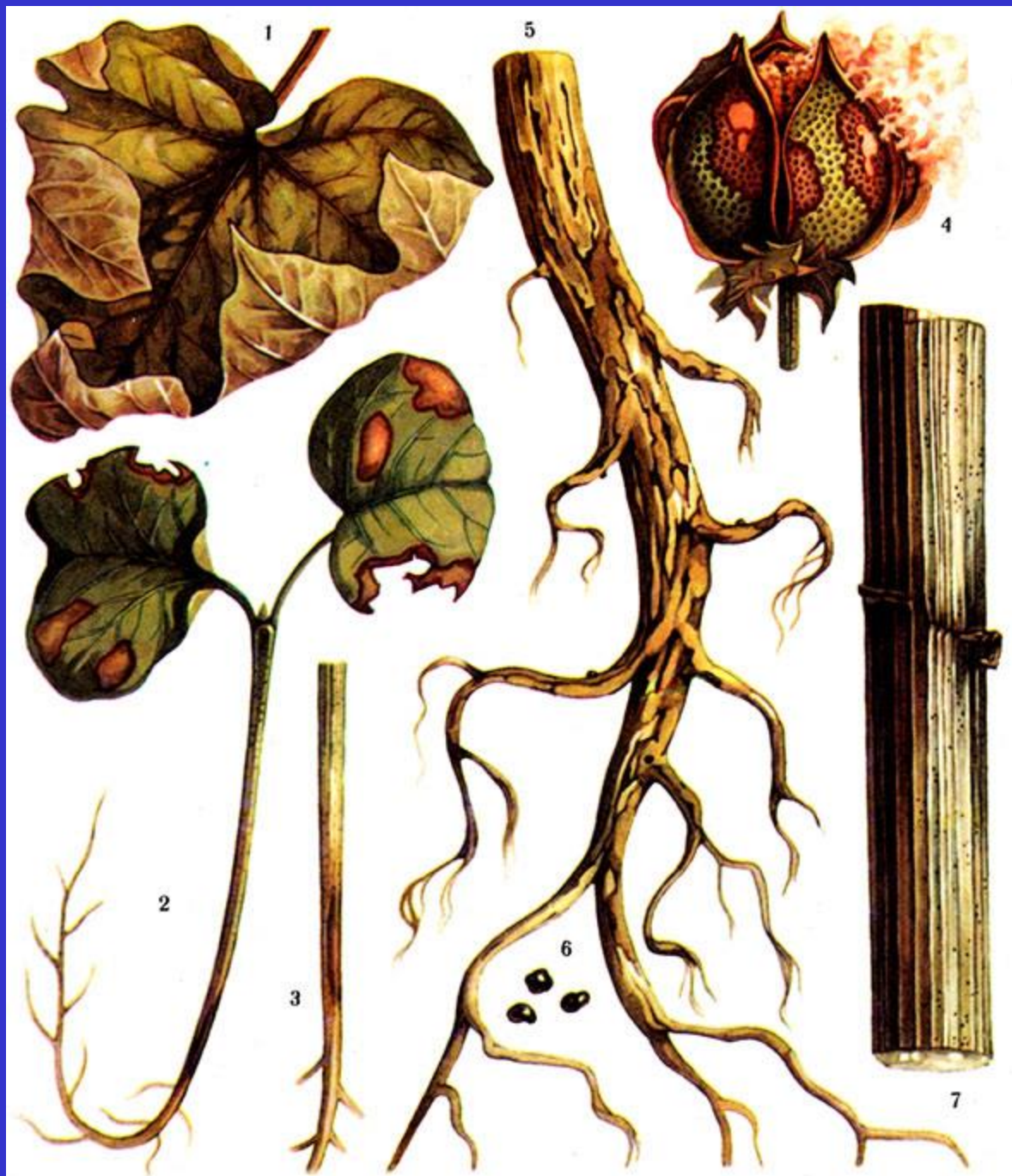
Cotton leaf curl virus

Symptoms

- First reported in Nigeria-1912
- Deep downward cupping of inner leaves upward or downward curling of the leaf margins and swelling.
- CLCrV infect dicotyledonous plants and are whitefly-transmitted

(Brown *et al.*, 1983)

- Darkening and formation of enations on the veins
- Develop into cup-shaped, leaf-like structures





CLCuV

**Mottling and
mosaic
symptoms**



Upward cupping of leaves

CLCuV – Vein Thickening



CLCuV - Enation on leaf



CLCuV – Multiple Enations





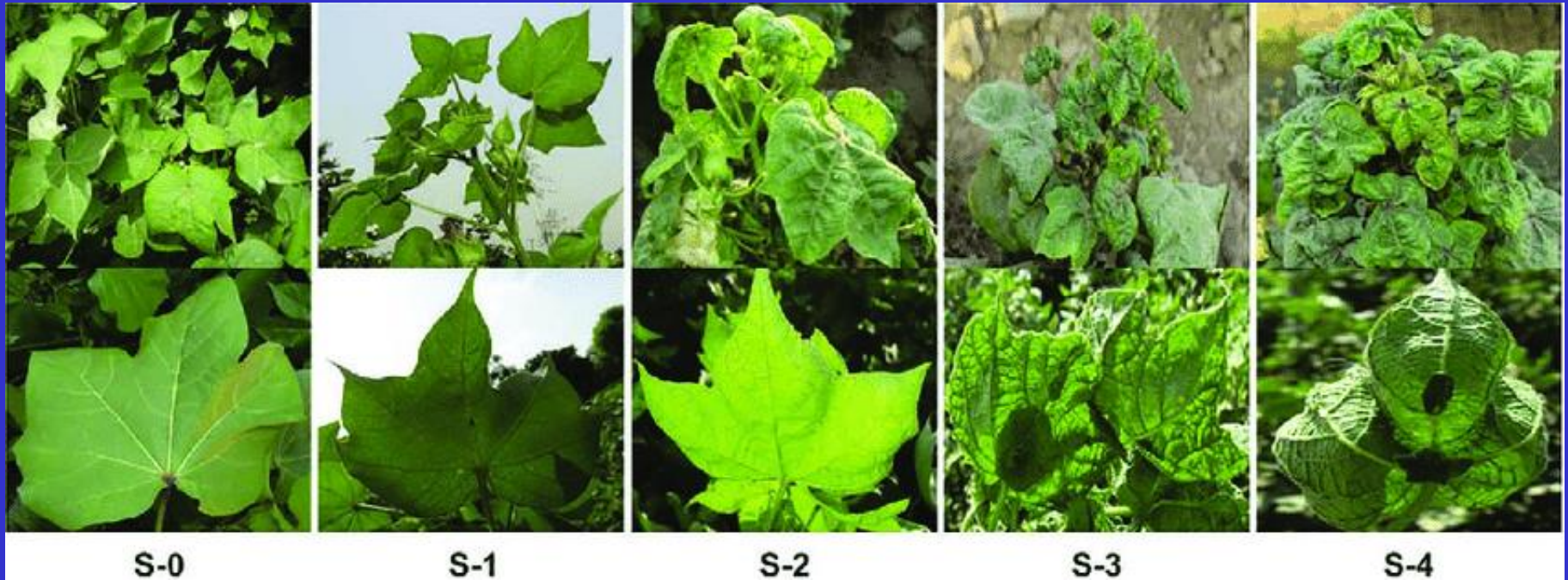
Severe symptom

**Transmission Through
Whiteflies
*Bemisia tabaci***









Disease severity scale for CLCuD affected cotton. The disease scale runs from 0, no symptoms of infection, up to 4, severe stunting, leaves small and severely twisted, all leaves of plant showing symptoms. See text for a more detailed explanation.

Cotton Phyllody – Suvin



**Clustering of leaves,
reduction in leaf size**



THANK YOU

