



CITRUS
&
GRAPES



CITRUS

Important Diseases of Citrus

1. Gummosis
2. *Diplodia* Gummosis
3. Scab / Verucosis
4. Canker
5. Tristeza or quick decline (*CTV*)
6. Exocortis
7. Greening

Gummosis

Etiology:

***Phytophthora parasitica*, *P. palmivora*, *P. citrophthora*,
*P. syringae***

Intercellular & intracellular hyphae.

Sporangium attached with the sporangiophore at the right angle.

Sporangia are ovoid or ellipsoid

Sporangia **germinate and release zoospores** which are biflagellate and motile.



Symptoms:

- Profuse **gumming** on the surface of the bark.
- Bark gradually turns dark brown and develops **longitudinal cracks**.
- The disease **spreads on the main roots** and on the base of the trunk. As a result of severe gumming, the bark becomes **completely rotten** and the tree dries due to girdling effect.
- Prior to death, the plant usually blossoms heavily and dies before the fruits mature.
- The disease is called **foot rot or collar-rot**.
- The fungus produces blight symptom on the leaves and leaves drop off.
- Affected fruits develop brown rot.



Mode of spread and survival:

Soil inhabitants, **Sporangia** spread by splashing rain water, irrigation water and wind.

Epidemiology:

Noticed in sweet oranges, acid lime and lemon.

Heavy soil, high soil moisture, **soil pH of 5.4 to 7.5** and temperature of **25 to 28 °C** are conducive for disease development.

Low grafting, deep planting and nearness of bud union to ground level contact of trunk with water increases the chances for soil borne infection.

Management:

- 🍋 Preventive measures like selection of proper site with adequate drainage.
- 🍋 Use of **resistant root stocks**.
- 🍋 Avoid contact of water with the tree trunk by adopting **ring method of irrigation**.
- 🍋 Planting pits may be dusted with **Zinc sulphate**, copper sulphate and lime (5:1:4).

contd...

🌼Scrap the diseased portion and disinfect the cut surface with **Mercuric chloride (0.1%)** or **Potassium permanganate solution (1%)** .

🌼Painting the stem above the ground level (1 mt) with **Bordeaux paste** helps in controlling the disease.

🌼Spraying and drenching with **Metalaxyl** (Ridomil MZ 72)@ 2.75 g/l

Diplodia Gummosis

Etiology: ***Diplodia natalensis***

Pathogen produces **pycnidia**. **Pycnidiospores** are dark one septate and elliptical.

Symptom:

- **Gum oozes** from one or two spots near forks or bigger limbs.
- Infection is usually high above the ground.
- Bark is killed, gum oozes out, dries and become black.
- Large limbs are killed, some times branches break at the infected portion.



Vicent, IVIA

Vicent, IVIA

Mode of spread and survival:

Pathogen spreads through **pycnidiospores** with the help of wind and rain splashes.

Epidemiology:

Reduced **tree vigour**, **poor nutrients** to the trees and old age trees.

Management:

- 🟢 Proper nutrients should be supplied.
- 🟢 Wound in the bark especially on limbs should be scraped and protected with **Bordeaux paste**.
- 🟢 Broken limbs and forks has to be cut properly

Scab/Verucosis

Etiology: *Elsinoe fawcetti*

Ascospores are 1-3 septate, oblong to elliptical and hyaline to yellow.

Conidia are produced in **acervuli**.

Conidia are hyaline, oblong, elliptical with two minute droplets.

Symptoms:

- The lesions in early stages appear on the underside of the leaves as small **semi-translucent dots**, which finally become sharply defined **pustular** elevations.
- In later stages, leaves often become distorted, wrinkled, stunted and deformed.
- The opposite surface corresponding to the warty growth shows a **circular depression** with a **pink to red centre**.
- On the fruit, lesions consist of **corky** projections, which often break into scabs. The surface become rough and distorted.



by Riley, USDA

AD2U 8167 n2DV



Picture by H. Gomez- USDA

Mode of Spread and Survival:

The pathogen survive in off season as **ascospores** and spreads through **Conidia**.

Epidemiology:

Young leaves are highly susceptible. Conidia are formed between **7 and 30°C** with **66 to 100% RH**. The fungus infects tissues only when the surface is wet but prefers **16 to 23°C** temperature.

Management:

🌿 The diseased leaves, twigs and fruits should be collected and destroyed.

🌿 Spraying of **Carbendazim / Bordeaux mixture 0.1%** or **Copper oxychloride 0.3%** is quite effective

Canker

Etiology: *Xanthomonas axonopodis* pv. *citri*

It is Gram negative, non spore forming, **aerobic bacteria**. It is rod shaped and is motile by **one polar flagellum**.

Symptoms :

- Acid lime, lemon and grapefruit are affected.
- Affects leaf, twig and fruits.
- On leaves, lesions are typically circular with yellow halo appear on both sides of leaf, but usually on the lower surface. As the spots mature, the surface become white or greyish and ruptures in the centre giving a rough, hard, corky appearance.
- When lesions are produced on twigs, they are girdled and die.
- On fruits, cankerous spots are formed and scattered.



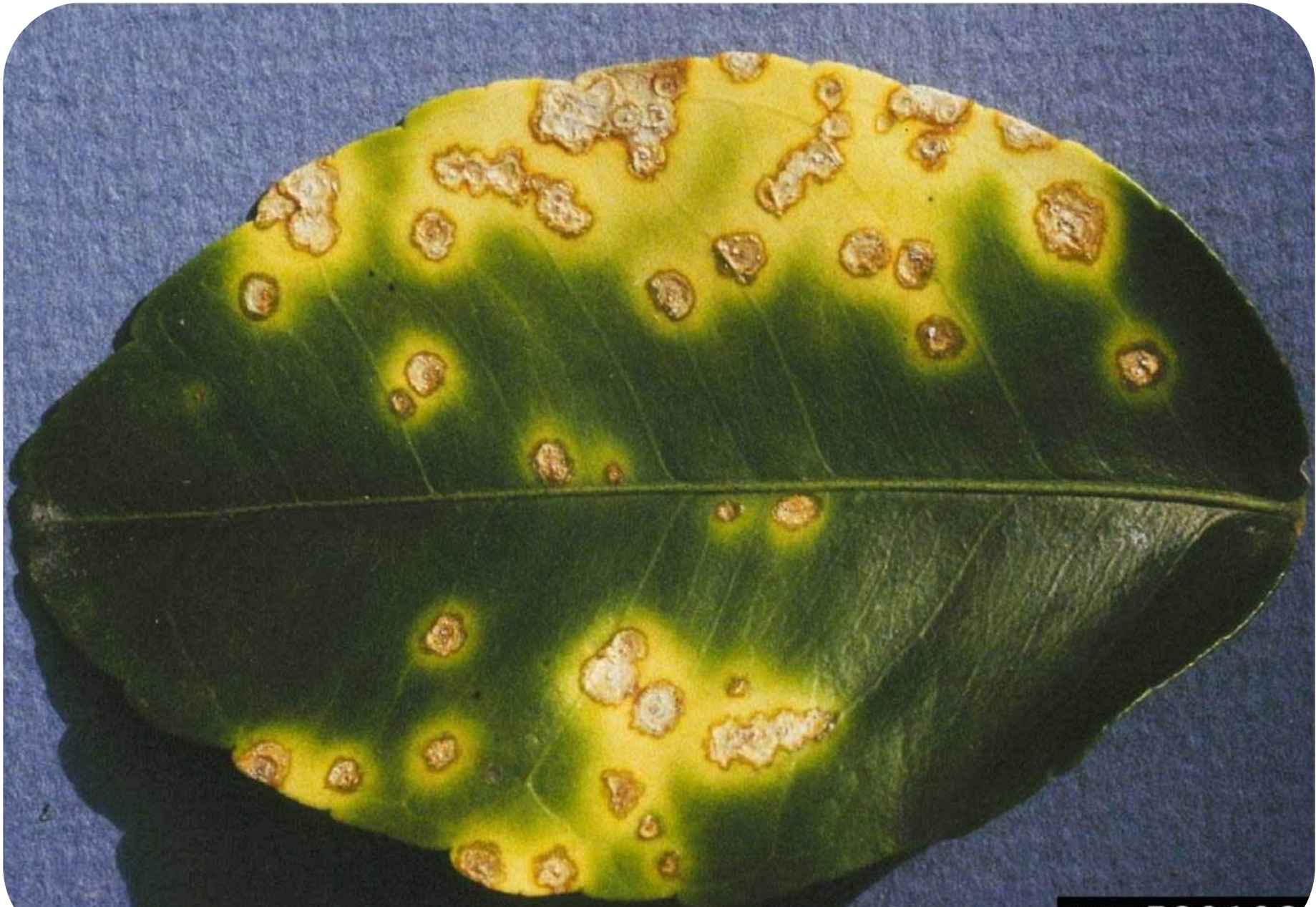
Moorthy Schubert, Florida Department of Agriculture and Consumer Services, Bugwood.org

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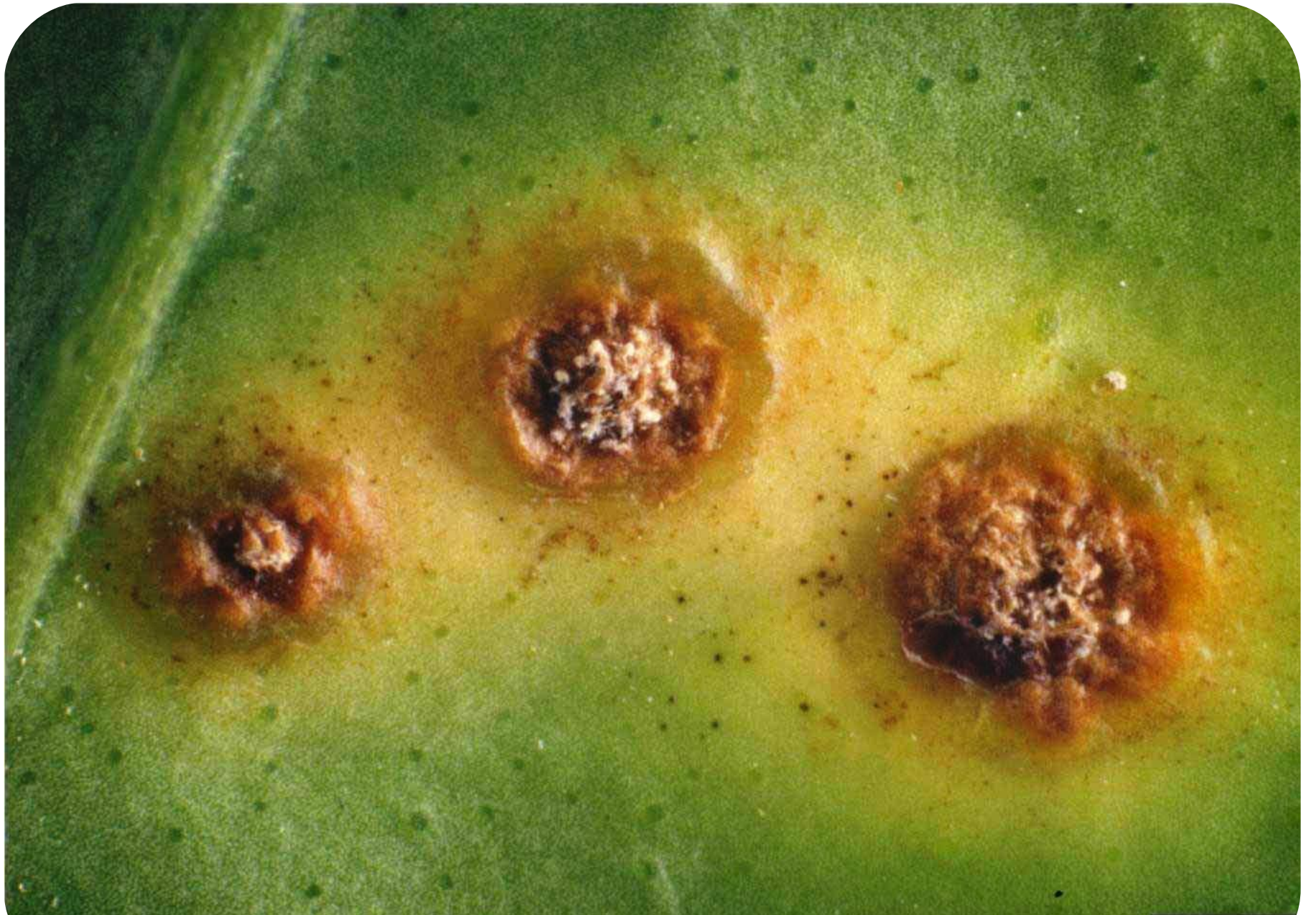
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Water-soaked
ring



Mode of spread and survival:

Spreads through **wind and rain splashes**.

Survives in **infected leaves** for 6 months and in twigs up to **76 months**.

Injury caused by leaf miner helps the entry of the bacterium.

Epidemiology:

The disease is serious in acid lime, lemon and grapefruit. Temperature between **20 to 35°C** with evenly distributed rains favour the disease.

Presence of free moisture for **20 min.** on the host surface is essential for successful infection.

Management:

- Spraying of **Streptomycin sulphate 500-1000 ppm** or Streptomycin 100 ppm + Copper oxychloride 0.3 % at fortnightly intervals.
- Spraying with **neem cake solution** will be effective.
- **Prune** badly infected twigs before the onset of monsoon.

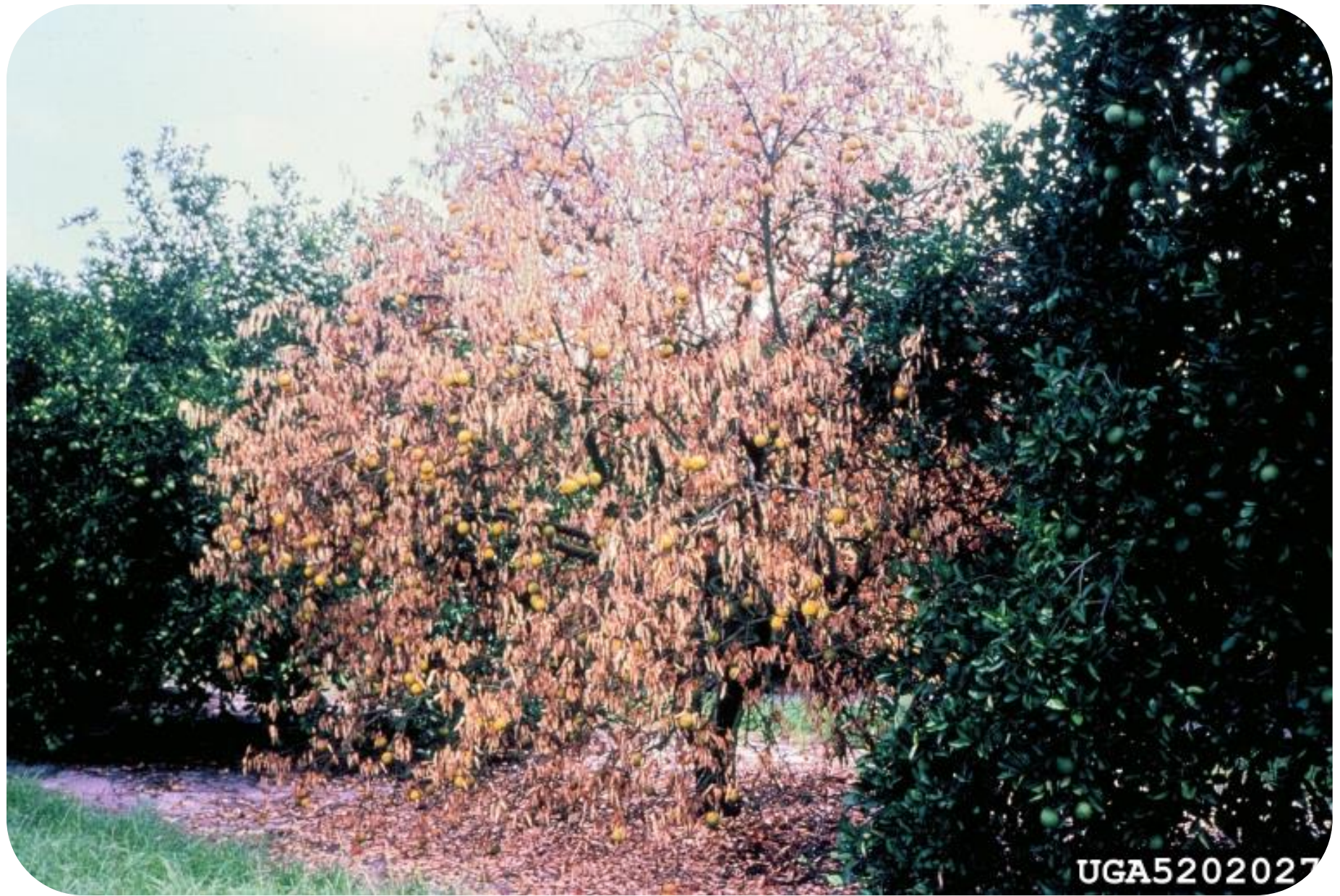
Tristeza or quick decline

Etiology: *Citrus tristeza virus (CTV)*

It is a long, **flexuous rod**. Three strains *viz.*, mild, severe and seedling yellow are reported.

Symptoms:

- Roots decay, twigs **die back**.
- Fruit set diminishes; only skeleton remains.
- **Fine pitting of inner face of bark** of sour orange stock. Grapefruit and acid lime are susceptible irrespective of root stock.
- Acid lime leaves show large number of vein flecks (elongated translucent area).
- Trees stunted and dies.
- Fruits are small in size and yield is very much reduced.



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Mode of spread and survival:

Use of **infected bud wood**. *Toxoptera citricidus* (aphid), *T.aurantii* are the important vectors. It is transmitted in a non persistent manner.

Epidemiology:

Presence of abundant insect vector increases the disease incidence.

Lime is susceptible both as seedling or budling on any root stock. But mandarin and sweet orange seedlings are tolerant.

On susceptible root stocks, leaves develop deficiency like symptoms.

Management:

- Removal and destruction of infected trees.
- Fresh planting is done with virus free planting materials.
- For sweet orange and mandarin, avoid susceptible root stocks. For acid lime, use seedling **pre-immunized** with mild strain of tristeza virus.
- Nucellar seedlings of sweet orange remain free from infection for more than 6 years after planting.
- Periodical spraying with systemic insecticides reduces the secondary spread.

Exocortis / scaly butt

Etiology: *Viroid*

Viroid is free RNA without protein coat.

Symptoms:

- Vertical cracking and scaling of the bark in the entire root stock.
- First appears near the soil line and gradually extends upwards to the bud union and down to the roots.
- The bark becomes dead and dries.
- Extreme stunting of trees.





Mode of Spread and Survival:

Transmission normally occurs through infected bud wood and contaminated tools. Not through vector and seed.

Management:

🍋 Use viroid free certified bud woods.

🍋 Use tolerant stocks like rough lemon, sweet orange or sour orange.

🍋 Periodically wash budding knife with disinfecting chemicals.

Greening

Etiology: *Candidatus Liberobacter spp. (L. asiaticum)*
(Spiroplasma citri)

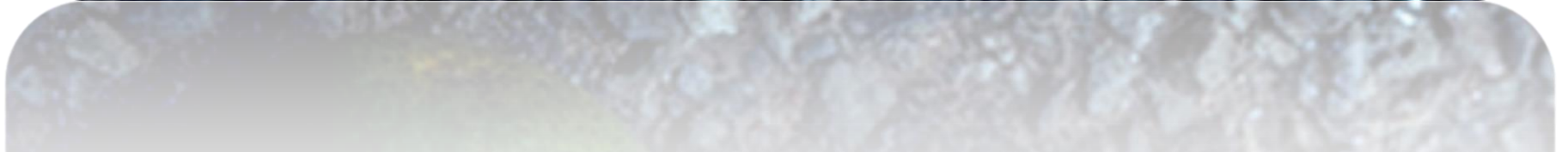
Phloem limited bacteria.

Symptoms:

- This disease affects almost all citrus varieties irrespective of root stock.
- Stunting of leaf, sparse foliation, twig die back.
- Infected leaves are upright and having chlorotic mottling resembling zinc deficiency symptom. In severe cases, the leaves become chlorotic with scattered dark green island.
- Internodes becomes shorter, plants are very stunted and many of them never yield any fruits.

- Symptom may appear on a part of the canopy or even only in a branch.
- Infected fruits are small, misshapen, may fall prematurely and contain aborted seeds.
- Fruits are small, lopsided with curved columella.
- The side exposed to direct sunlight develops full orange colour but the other side remain dull olive green.
- Low in juice and soluble solids, high in acid.





Mode of spread:

Infected bud wood

vector psyllid - *Diaphorina citri*

Management:

- 🍋 Use pathogen free bud wood for propagation.
- 🍋 Removal and destruction of unproductive trees.
- 🍋 Spray tetracycline 500 ppm at fortnightly intervals.
- 🍋 Control psyllids with insecticides.

Other Diseases:

- *Ganoderma* root rot : *Ganoderma lucidum*
- Dry root rot : *Diplodia natalensis*, *Macrophomina phaseolina* and *Fusarium sp.*
- Powdery mildew : *Acrosporium tingitaninum* (*Oidium tingitaninum*)
- Pink disease : *Pellicularia salmonicolor*
- Psorosis : Capillovirus
- Sooty mould : *Capnodium citri*
- Twig blight : *Colletotrichum sp.*, *Diplodia sp.* and *Fusarium sp.*

- Fruit rots : Blue moulds - *Penicillium italicum*,
Green mould - *P. digitatum*,
Soft rot : *Aspergillus niger*
Stem end rot
Brown rot
Alternaria fruit rot
Sour rot
Trichoderma rot
Fusarium rot

- Red rust and Loranthus

GRAPES

Important diseases of Grapes

1. Downy mildew: *Plasmopara viticola*
2. Powdery mildew : *Uncinula necator*
3. Bird's Eye Spot/Anthracnose: *Gloeosporium ampelophagum (Elsinoe ampelina)*
4. Rust : *Phakopsora vitis*
5. Brown spot : *Cercospora viticola*
6. Root disease : *Rosellinia necatrix / Poria barbaeformis*

Downy mildew

Etiology: *Plasmopara viticola*

Mycelium is intercellular with spherical haustoria, coenocytic, thin walled and hyaline.

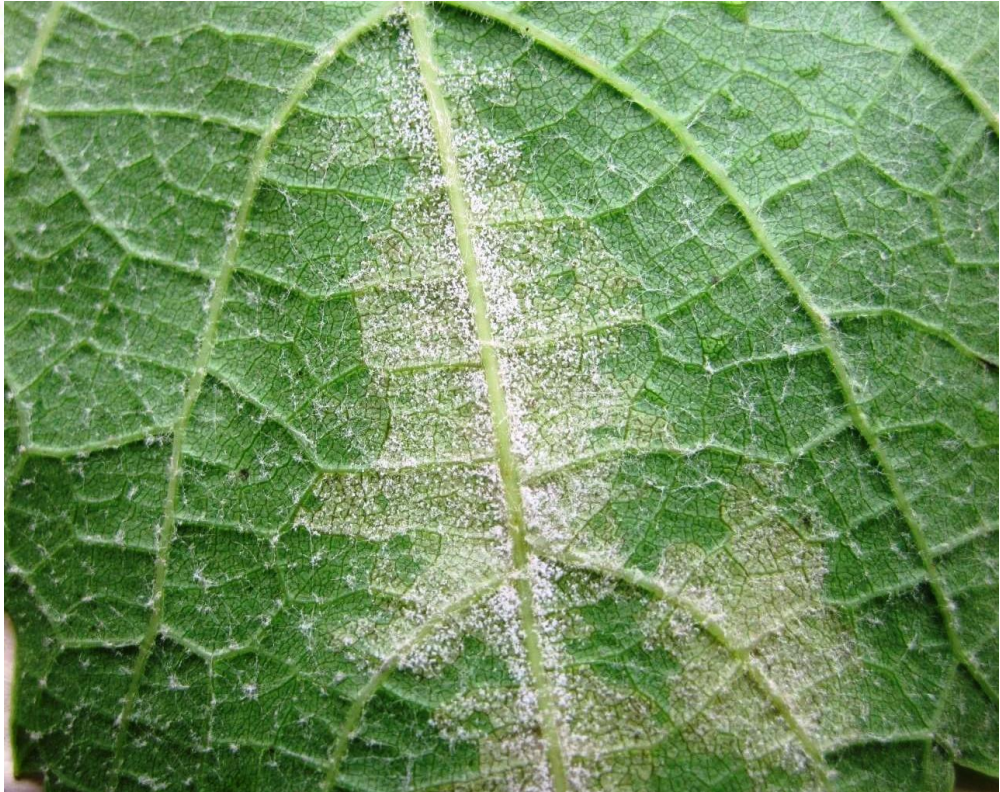
Sporangiophores arise from hyphae in the sub stomatal spaces. It branched at right angle to the main axis and at regular intervals.

Secondary branches arise from lower branches. The sporangia are thin walled, oval or lemon shaped.

The Zoospores are pear shaped, biflagellate. The oospores are thick walled.

Symptoms:

- Irregular yellowish, translucent spots on the upper surface of the leaves.
- Correspondingly, on the lower surface white downy growth on leaves.
- Affected leaves become yellow, brown and gets dried and premature defoliation occurs.
- Dwarfing of tender shoots. Brown sunken lesions on the stem.
- White downy growth of fungus on berries which subsequently becomes leathery and shrivels. Later infection of berries result in soft rot symptoms.
- No cracking of the skin of the berries.



Epidemiology:

The most favourable tem. for germination of sporangia is between 10 and 23°C.

Disease development is favoured during rainy season when there is a heavy dew, relative humidity is above 80 per cent and temperature is between 23 and 27°C.

Mode of Spread and Survival:

Through **sporangia** by wind, rain etc. As **oospores** present in the infected leaves, shoots and berries.

Also as dormant mycelium in infected twigs. Optimum temperature: **20-22°C**. **Relative humidity: 80-100 per cent.**

Management:

✚ Removal and burning of all infected plant parts containing oospores.

✚ Vines should be planted in proper spacing and should be trained – leaves should not remain near the ground.

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✦ After pruning, spray ***Bordeaux mixture 1 %*** or Metalaxyl + Mancozeb 0.4 % or Chlorothalonil 0.2%.

✦ When the new flushes formed spray Difolatan 0.2% or Chlorothalonil 0.2% at weekly intervals.

Powdery mildew

Etiology : *Uncinula necator*

White growth consists of mycelium, conidiophores and conidia.

Mycelium is external, septate and hyaline. **Conidiophores** are short and arise from external mycelium. **Conidia** are produced in chain. They are single celled, hyaline and barrel shaped. The fungus is **oidium** type.

Symptoms:

- Powdery growth mostly on the upper surface of the leaves.
- Malformation and discolouration of affected leaves.
- Discolouration of stem to dark brown.
- Floral infection results in shedding of flowers and poor fruit set.
- Early berry infection results in shedding of affected berries.
- Powdery growth is visible on older berries and the infection results in the Cracking of skin of the berries.



Mode of Spread and Survival:

It spread through **air-borne conidia**. Through dormant mycelium and conidia present in the infected shoots and buds. **Sultry warm conditions with dull cloudy weather**, highly favourable.

Epidemiology:

- The disease occurs in severe during **Oct – Nov** in North India and **Feb-June in South India**.
- Disease is favoured by warm sultry weather and retarded by sunshine.
- Disease development is adversely affected by rain.

Management:

Overcrowding should be avoided by proper pruning,
Spray wettable sulphur 0.2 % or Dinocap 0.05 % or
Karathane 0.07%

Characters	Downy Mildew	Powdery Mildew
Pathogen	<i>Plasmopara viticola</i>	<i>Uncinula necator</i>
Mycelium	Intercellular, Aseptate	Ectophytic, Septate,
Asexual stage	Sporangia (Zoospores)	Conidia (Chain)
Sexual stage	Oospores	Ascospores
Symptom	White downy growth on lower surface	White powdery growth on upper surface

Characters	Downy Mildew	Powdery Mildew
Symptom	premature defoliation of affected leaves	Infected leaves malformed
	No cracking of skin in berries	Cracking of skin in berries
Favourable conditions	Heavy dew and high humidity during rainy season	Warm sultry weather
	development favoured by rain	Development affected by rain



**Downy
Mildew**

**Powery
Mildew**

Bird's Eye Spot/Anthracnose

Etiology:

Gloeosporium ampelophagum (Elsinoe ampelina)

Mycelium is septate and dark coloured.

Conidia single celled oval and hyaline.

Asci are globular and the ascospores are three celled and hyaline.

Symptoms:

- Symptom is visible on leaves, stem, tendrils and berries.
- Numerous spots occur on the young shoots. These spots may unite to girdle the stem, causing death of the tips.
- Spots on petioles and leaves cause them to curl or become distorted.
- On the leaves circular, greyish black spots with yellow halo appears.
- Later, the centre of the spot become grey and fall off resulting in 'shot hole' symptom
- The dark red spots are seen on the berry , these spots are circular, sunken, ashy-grey and in later stages these spots are surrounded by a dark margin (bird's-eye).



Mode of Spread and Survival:

Pathogen survives as dormant mycelium in the infected **stem-cankers**. Secondary spread is through **conidia** via wind and rain water.

Epidemiology:

The disease is severe during **July – Aug** and **Nov- Dec** months. Infection in new sprouts takes place during rainy season. Heavy rains after pruning leads to more incidence. Incidence will be severe in warm wet weather, low lying and badly drained soils.

Management:

Pruning and burning of infected leaves and twigs.

Spray **Bordeaux mixture 1.0 % or Copper oxychloride 0.25 %** or Carbendazim 0.1% or Chlorothalonil 0.2 % or Mancozeb 0.25% at 10 – 15 days interval.

Use resistant varieties.

Black rot

Etiology:

Guignardia bidwelli

Mycelium is hyaline when young and becomes brown after maturity. **Perithecia** are globose.

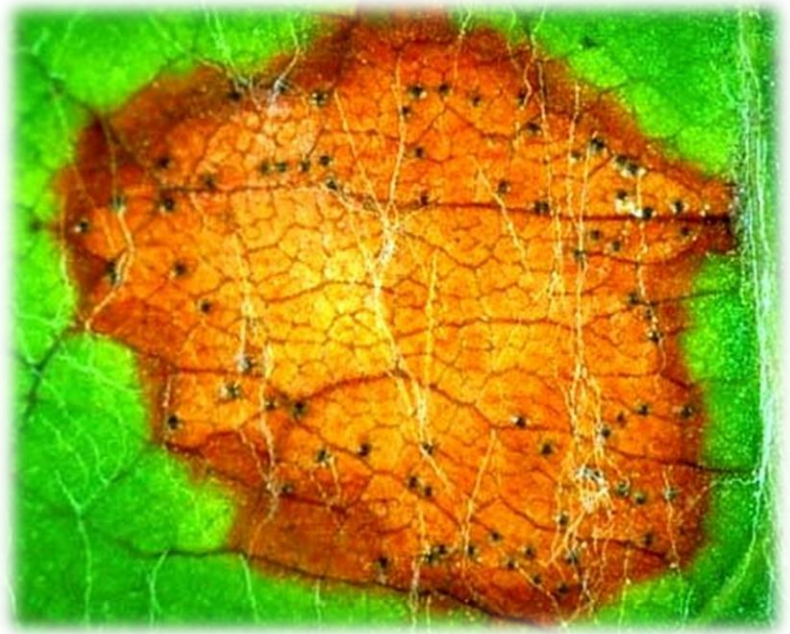
Asci are thick walled.

Each **ascus** contain 8 ascospores. Ascospores are bicelled, unequal size. **Pycnidiospores** are produced inside the pycnidia.

Symptom:

- Light brownish soft circular spots on berries.
- Affected berries discoloured, decayed, shrivelled and transformed into hard black shrivelled mummies.
- On leaves circular red spot appear and margin become black.
- Minute black dots representing the fruiting body of the fungus are arranged in a ring near the outer edge.





Mode of spread and survival:

- **Perithecia** develop on mummified berries and the ascospores are discharged when mummies are wet.
- **Ascospores** produce germ tubes and penetrate directly through the cuticle.
- **Pycnidia** are rapidly produced.
- **Pycnidiospores** spread through splashing rain water.

Epidemiology:

Frequent rains and humid climate are conducive for disease development.

Management:

🍇Diseased berries and leaves should be collected and destroyed.

🍇Spraying of **Bordeaux mixture** 1% / Chlorothalonil 0.2% / Captan 0.2% should be done when the new shoots are 15 – 25 cm long and repeated before bloom and 10 – 15 days after bloom.

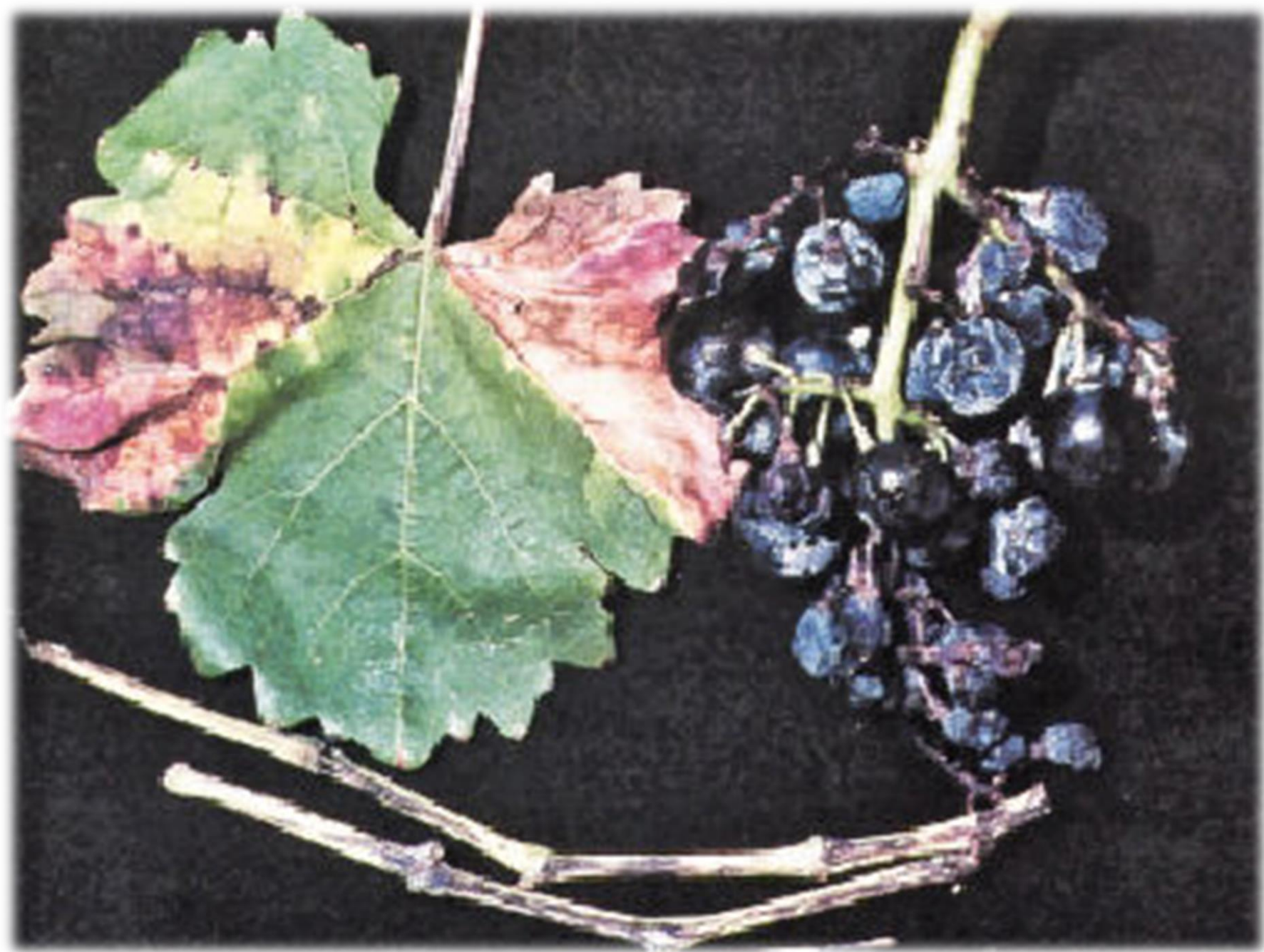
Bacterial Canker

Etiology: *Xanthomonas campestris* pv. *viticola*

Gram negative, rod shaped with rounded ends motile by single polar flagellum.

Symptom:

- Starts as small water soaked spots surrounded by yellowish halo. Spots enlarges, become dark brown and angular.
- Then coalesce to form large patches. Leaves show vein infection. After drying remains to the stem.
- In petioles and canes, lesions are of brown to black, elongated and cankerous. Shows stunting, cracking and abnormal growth of canes, on later stage.
- Brown to black lesions on berries. Becomes small and shriveled.



Mode of spread and survival:

Alternate hosts – Neem, mango, *Phyllanthus maderaspatensis*.

The bacterium survives up to 65 days on infected dry leaves. **Secondary spread** through wind splashed rain. Distant spread through diseased planting materials.

Epidemiology:

Favourable temp. for disease development is **25 – 30°C**.

Disease frequency is positively correlated with number of rainy days.

Management:

 Regular inspection.

 Destruction of infected plant materials.

 Using **disease free** cuttings.

 **Pruning** on late October.

 Spraying with **Streptocycline 300 ppm** from two leaf stage up to 70 days stage at fortnightly interval.

Grey mould rot *Botrytis cinerea*

Symptom:

Affected area turn light brown. Inner flesh results in soft watery mass of decayed tissue. In moist atmosphere the pathogen sporulates on the surface of fruits and the typical, powdery grey mould stage become evident. Fruits shrivel and dark brown.

Management:

Spray with Captan 0.2% at monthly intervals (3 times) before rain fall.





Fan Leaf virus

Grapevine fan leaf virus

Symptom:

- Young leaves show **variegated mottling**.
- Reduction of areas between the veins gives the impression of a **half closed fan**.
- Affected leaves stand upright and become cup like.
- Leaf surface become rough.
- Leaves are small.
- Distance between **internodes** reduced.
- Growth become more **zig-zag** at the nodes.

Vector: **Nematode** – *Xiphinema index* and *X. italiae*

Management:

Soil application of **Carbofuran**.





Thank You
So Much