

Viticulture

Grapevine enemies & diseases

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Patras 2022

Grapevine enemies & diseases

Diseases caused by fungi:

- **Downy mildew** (*Plasmopara viticola*)
- **Powdery mildew** (*Uncinula necator*)
- **Botrytis** (*Botrytis cinerea*)
- **Eutypa dieback** (*Eutypa lata*)
- **Phomopsis** (*Phomopsis viticola*)
- **Esca** (*Phaeoacremonium aleophilum*, *Phaeomoniella chlamydospora*, *Fomitiporia mediterranea*) & **Petri disease** (mainly *P. chlamydospora*)
- **Bot canker** (*Lasiodiplodia theobromae*, *Botryosphaeria rhodina*)
- **Aspergillus rot** (*Aspergillus niger*)
- **Black rot of grapes** (*Guignardia bidwellii*)
- **Ripe rot** (*Colletotrichum acutatum* spp. & *C. gloeosporioides* spp. complexes)

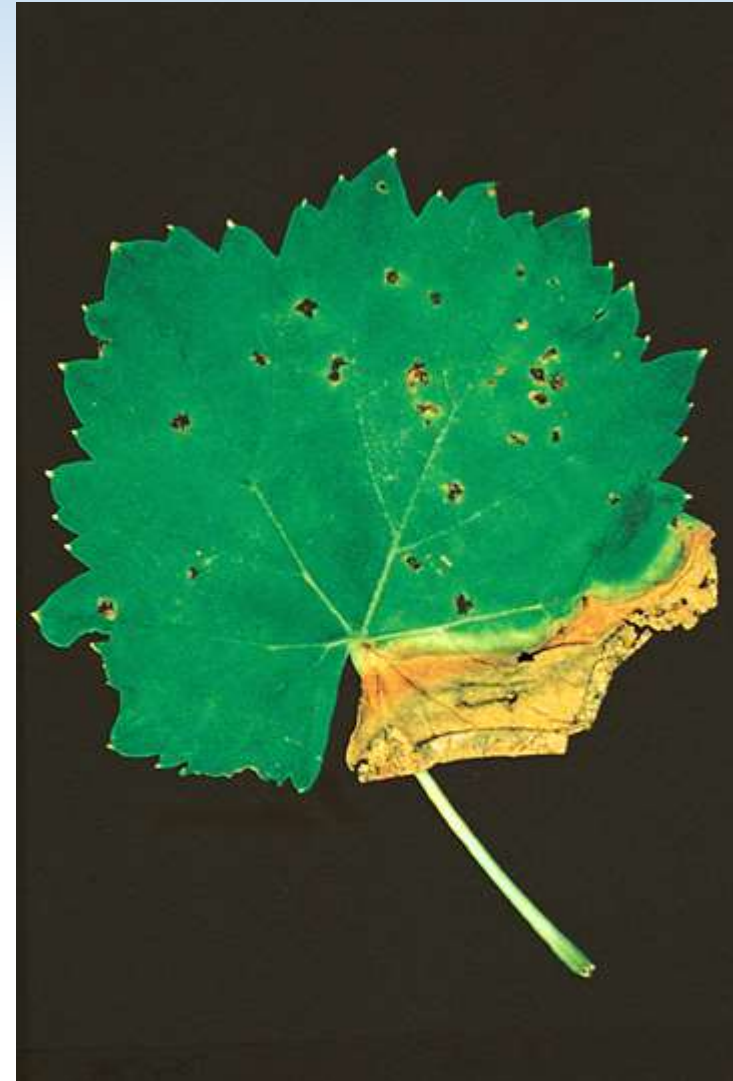


<https://www.agric.wa.gov.au/table-grapes/downy-mildew-grapevines>

Grapevine enemies & diseases

Diseases caused by bacteria:

- **Happy Disease** (bacterial necrosis)
(*Xylophilus ampelinus* / *Xanthomonas ampelina*)
- **Crown gall** (*Agrobacterium tumefaciens*)
- **Pierce's disease** (*Xylella fastidiosa*)
- **Bacterial inflorescence rot** (*Pseudomonas syringae*)

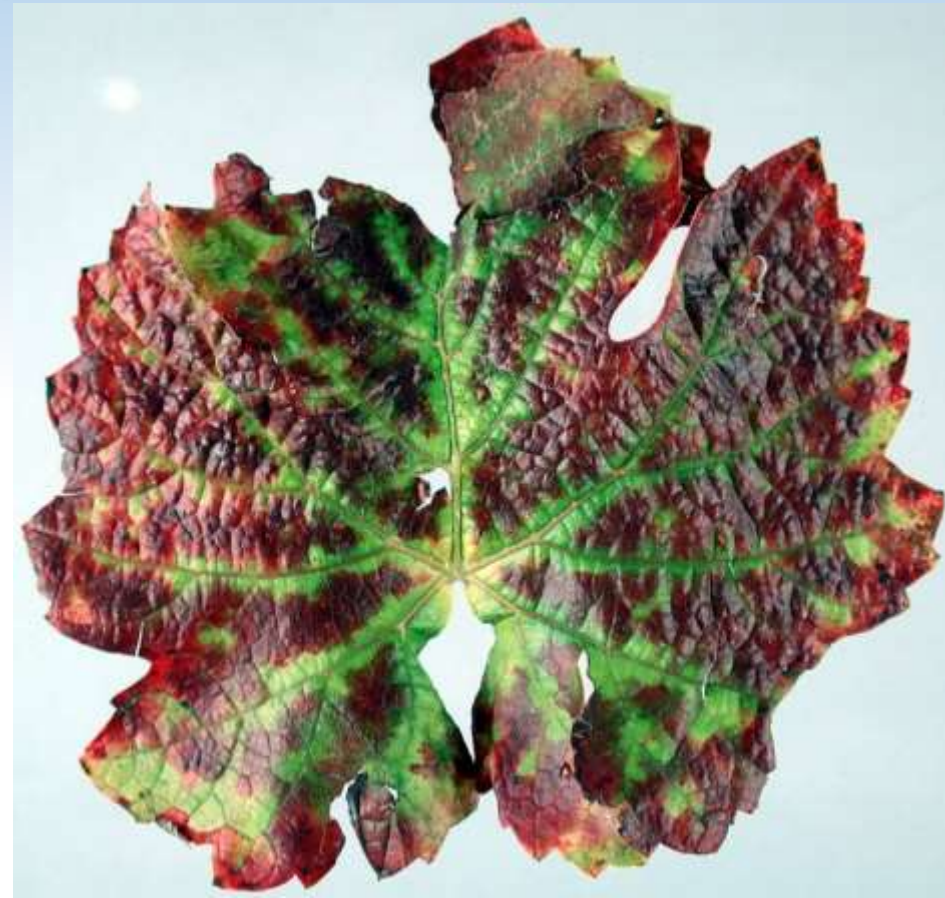


<https://www.plantdiseases.org/bacterial-blight-bacterial-necrosis-grape-1>

Grapevine enemies & diseases

Diseases caused by viruses:

- **Bois noir/black wood disease** (Candidatus Phytoplasma solani)
- **Corky bark** (Grapevine virus B)
- **Fanleaf degeneration (infectious degeneration and decline)** (Grapevine fanleaf virus)
- **Fleck (Marbrure)** (Undetermined, viruslike)
- **Grapevine red blotch** (Grapevine red blotch-associated virus)
- **Grapevine yellows** (Phytoplasma)
- **Leafroll** (Closterovirus-associated)
- **Shoot necrosis** (Undetermined, viruslike)
- **Strawberry latent ringspot** (Strawberry latent ringspot virus)
- **Tobacco necrosis** (Tobacco necrosis virus)
- **Vein mosaic** (Undetermined, viruslike)
- etc.



<https://pnwhandbooks.org/plantdisease/host-disease/grape-vitis-spp-virus-diseases>

Grapevine enemies & diseases

Pest enemies - Mites

- **Grape Erineum Mite**
(Grapevine blister mite)
(eriphyid mite, *Eriophyes vitis* or *Colomerus vitis*)
- **Grape rust mite**
(*Calepitrimerus vitis* Nalepa)
- **Spider mites**
(*Tetranychus urticae*, *Tetranychus pacificus*,
Eotetranychus willamettei, European red mite *Panonychus ulmi* K.)



<https://pnwhandbooks.org/insect/small-fruit/grape/grape-spider-mite>

Grapevine enemies & diseases

Pest enemies – Insects

- **Phylloxera** (*Daktulosphaira vitifoliae* F.)
- **European grapevine moth or European grape worm (moth)**
(Lepidoptera: *Tortricidae*; *Lobesia botrana*)
- **Grape mealybug (*Pseudococcus*)**
(*Pseudococcus maritimus*)
- **Cutworms** (Brassy cutworm: *Orthodes rufula*,
Spotted cutworm: *Xestia (Amathes) c-nigrum*,
Variegated cutworm: *Peridroma saucia*)
- **Black vine weevil (*Otiorhynchus sulcatus*)**
- **Leafhoppers** (Cicadellidae) (*Erythroneura vitis*)
- **Cicadas** (*Empoasca vitis*, *Scaphoideus titanus*)
- **Thrips** (*Drepanothrips reuteri*, *Frankliniella occidentalis*)
- **Vine leaf-roller** (Coleoptera: *Byctiscus betulae*)



<https://vinehealth.com.au/2017/10/european-grapevine-moth/>

Grapevine enemies & diseases

Diseases caused by fungi

Downy mildew (*Plasmopara viticola*)

- It infects all green parts of the host plant that bear stomata and causes yellow/reddish discoloration, necrosis and distortion
- Immediate reduction of production
- Its spores survive the winter in the soil
- They initially infect the lower leaves in spring
- Infects inflorescences, shoots, berries and shoots



A single Downy mildew oil spot on a grapevine leaf



Downy mildew oilspots with a chocolate covered halo that fades as it ages

Grapevine enemies & diseases

Diseases caused by fungi

Downy mildew (*Plasmopara viticola*)

Protection

Cooper

- Copper pesticides (copper sulfate or copper peroxide)
- Bordeaux mixture (created by Jean Ribereau Gayon in Bordeaux)
- ✓ It is prepared on the day of its use in a clay or wooden container because it is corrosive
- ✓ It is an excellent fungicide but with some disadvantages:
 - Caution is needed during its preparation
 - Its preparation takes time and must start the day before the day of use
 - Causes vegetation growth to slow down



Multiple Downy mildew infections can lead to several oil spots on a single leaf which can merge



A red Downy mildew oil spot, which may occur on red varieties

Grapevine enemies & diseases

Diseases caused by fungi

Downy mildew (*Plasmopara viticola*)

Protection

Cooper

■ Bordeaux mixture (1%) preparation

- ✓ Previous day: 1 kg of copper sulfate (CuSO_4) is powdered, placed in a canvas bag, and hung in the middle of a 100 L container with 90 L water
- ✓ Applying day: prepare a calcium hydroxide ($\text{Ca}(\text{OH})_2$) solution by dissolving 1 kg of solid lime in 10 L of water
- ✓ The prepared “lime milk” is added with stirring to the copper sulfate mixture
- ✓ Check the pH with a pH-paper and add extra lime milk until the pH becomes 7
- ✓ In the same way 0.5 and 2% solutions are prepared (same quantities of copper sulfate and lime)



<https://www.heritagefruittrees.com.au/bordeaux-spray/>

https://en.wikipedia.org/wiki/Bordeaux_mixture

Grapevine enemies & diseases

Diseases caused by fungi

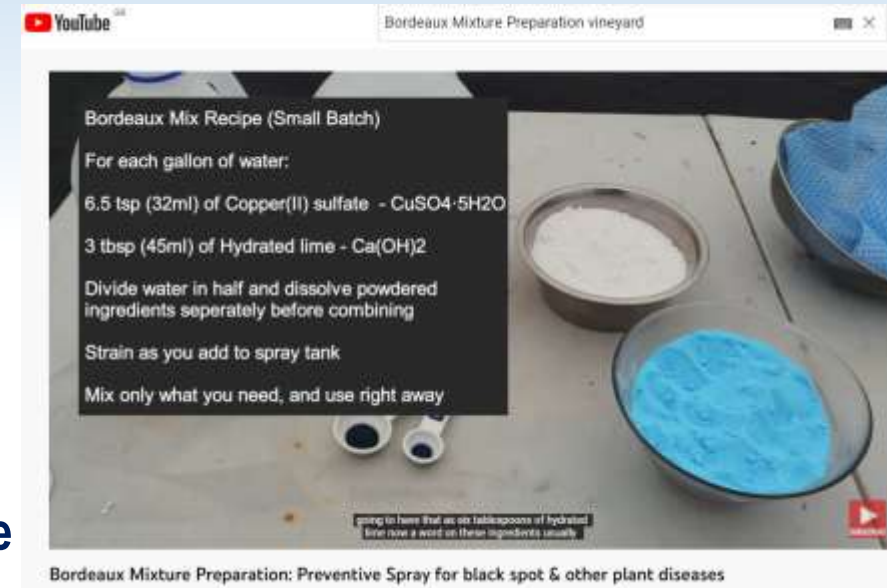
Downy mildew (*Plasmopara viticola*)

Protection

Cooper

■ Spraying with Bordeaux mixture

- ✓ Every time it rains after April 15th
- ✓ The tips and small leaves are not sprayed
- ✓ Spray with 0.5% mixture when the leaves are small and with 2% when they have grown
- ✓ If it does not rain, 3-4 sprays are enough, but not more than 12 when it rains frequently
- ✓ We do not spray during days with great heat and it is preferable just before nightfall
- ✓ After veraison we should not spray because there will be residues left on the grapes to be harvested



Check out videos on Bordeaux mixture preparation

<https://www.youtube.com/watch?v=hhrWy9NvHwE>

https://www.youtube.com/watch?v=TaCAjsL0_mA

Grapevine enemies & diseases

Diseases caused by fungi

Downy mildew (*Plasmopara viticola*)

Protection

Cooper

- Spraying with Bordeaux mixture
- ✓ For each acre, 50-100 L of mixture are needed depending on the growth phase
- ✓ We do not spray during the flowering period
- ✓ May cause burns on the vine
- ✓ Can be replaced with copper hydroxide solutions with a maximum number of sprayings 4, and at least 20 days away from harvest
- ✓ Synthetic pesticides are also used in conventional grape cultivation



<https://www.bordeauxcognactourguide.com/en/7-revolutionary-inventions-that-wre-born-in-bordeaux>



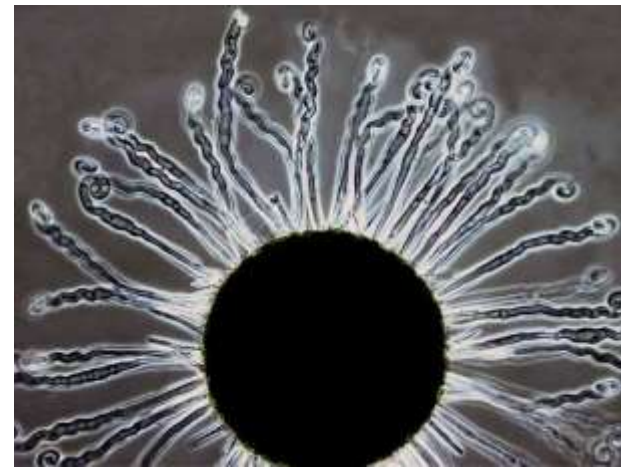
Caution: Do not smoke while spraying!!!!

Grapevine enemies & diseases

Diseases caused by fungi

Powdery mildew (*Uncinula necator*)

- ✓ It is the most important disease in Greece and occurs every year
- ✓ Infects green berries that tear (because their skin cells stop growing while the flesh continues to grow), and then they rot
- ✓ Survives winter on the leaves and bark of the vine shoots and in dormant buds
- ✓ Initially it appears on the upper parts of the shoots as an ash-white coating
- ✓ It is fought by sulfur sprayings



Grapevine enemies & diseases

Diseases caused by fungi

Powdery mildew (*Uncinula necator*)

Protection

Sulfur

- ✓ It is used in the form of fine-grained yellow powder
- ✓ Each acre requires 1-5 kg of sulfur depending on the growth phase
- ✓ There is also the form of "wetable sulfur" with a special composition that is dispersed in water in a ratio of 0.5-1% (150 gr per acre are required)
- ✓ Sulfur application should begin early when the shoots acquire the second leaf and is repeated 4-5 times every 8-10 days until flowering.



<https://www.stuff.co.nz/marlborough-express/editors-picks/9411585/Sulphur-spray-irritant-but-not-allergen-or-poison>



Sulfur powder

<https://www.indiamart.com/proddetail/sulfur-powder-18910794791.html>

Grapevine enemies & diseases

Diseases caused by fungi

Powdery mildew (*Uncinula necator*)

Protection

Sulfur

- ✓ The sulfur efficiency decreases at temperatures $<20^{\circ}\text{C}$ and $>40^{\circ}\text{C}$.
- ✓ Powdery mildew infestation is greater in years with little rainfall.
- ✓ Sulfur should be dispersed in a fine powder with a suitable sulfur sprayer (for powder or wettable sulfur) so as not to cause burns on the vine.
- ✓ At low temperatures sulfur does not work and synthetic pesticides are required



https://ucanr.edu/sites/Postharvest_Technology_Center_/files/222783.jpg

Grapevine enemies & diseases

Diseases caused by fungi

Phomopsis (*Phomopsis viticola*)

- ✓ Together with Esca and Eutypa dieback, they are diseases of the vine wood
- ✓ It causes problems mainly in the vine shoots but also infects the vine arms and leaves.
- ✓ It is observed in the annual vegetation but also in the old wood
- ✓ It is favored by relatively low temperatures and wet weather (frequent rainfall)
- ✓ In spring, at the lower 5-6 internodes of the vine shoots, appear brown-black necrotic spots that often merge and create irregular black necrotic surfaces
- ✓ In winter, the infected shoots die from the spread of the fungus and turn white or light gray in color.



Grapevine enemies & diseases

Diseases caused by fungi

Phomopsis (*Phomopsis viticola*)

- ✓ It affects most parts of the grapevine, including canes, leaves, inflorescences, tendrils, and berries
- ✓ On the leaves, black spots with a yellow perimeter are formed
- ✓ On inflorescences it leads to premature fruit drop
- ✓ Infections occur in spring with the presence of water in the organs of the vine
- ✓ Fungicides: **Bordeaux mixture / Copper**
- ✓ In vineyards with a large spread of the disease 2-3 sprays are recommended depending on the weather conditions during the growing season, with approved fungicides
- ✓ The 1st spray is done as soon as the buds break, the 2nd after the formation of the first leaf and the 3rd at the stage of 2-3 leaves



<https://ohioline.osu.edu/factsheet/plpath-fru-47>

<https://www.agric.wa.gov.au/table-grapes/phomopsis-viticola-prohibited-disease>

Grapevine enemies & diseases

Diseases caused by fungi

Eutypa dieback (Eutypa lata)

- ✓ Causes necrosis of arms, heads, or even the entire vine plant
- ✓ Particularly susceptible to the disease in Greece are the varieties Cardinal, Sultanina and Razaki
- ✓ Infection begins at unhealed pruning incisions
- ✓ Symptoms:
 - The fungus causes ulcers on the trunks and arms of the affected vines
 - A brown discoloration appears in a longitudinal section of the affected wood
 - The leaves are cupped, yellowish and small



https://www.canr.msu.edu/ipm/diseases/eutypa_dieback#gallery

<https://ohioline.osu.edu/factsheet/plpath-fru-11>

Grapevine enemies & diseases

Diseases caused by fungi

Eutypa dieback (*Eutypa lata*)

- In diseased vines, delayed vegetation is observed, with chlorosis, small leaves, dwarfed shoot internodes, reduced fruit yield, deformation and peripheral necrosis of the leaves
- Removal and burning of the affected heads, arms, and trunks is best done in dry weather during spring, when the symptoms in the young shoots are still characteristic
- The final incision should appear completely healthy and be smeared with a suitable fungicide



Leaf and shoot symptoms of *Eutypa dieback*

Grapevine enemies & diseases

Diseases caused by fungi

Esca

- The disease is due to a fungal complex infection
- It is found in vines of all ages
- Infections are caused by large pruning incisions
- The first symptoms appear on the lower leaves of the shoots
- Peripheral chlorosis is observed which results in drying, is observed
- Irregularly shaped chlorotic, yellowish and brown spots appear at the spaces between the veins, which then die, merge, and cover the entire leaf, except for a green stripe along the main veins



<https://www.evinyardapp.com/blog/2016/06/06/esca-devastating-trunk-disease-of-grapevines/>

[https://en.wikipedia.org/wiki/Esca_\(grape_disease\)](https://en.wikipedia.org/wiki/Esca_(grape_disease))

Grapevine enemies & diseases

Diseases caused by fungi

Esca

- This is followed by drying of the tips of the shoots and grapes
- Drying of the arms or whole vines may also be observed
- The infected wood is brittle, has a spongy texture and yellow-white color
- Large pruning incisions should be avoided and, where mandatory, they must be smeared with a suitable fungicide
- Infected vines should be marked in the summer, uprooted, and burned



Grapevine enemies & diseases

Diseases caused by fungi

Botrytis bunch rot (*Botrytis cinerea*)

- It has a worldwide spread and infects almost all cultivated plants
- It is a real threat to marketable production, because in addition to quantitative losses it also degrades the quality of products
- It has a negative effect on wine making and the quality of the wine, because it has an effect on fermentation efficiency
- It also causes losses in production after harvest, transport and storage of the grapes
- Infects all green aboveground parts of the vine, inflorescences (drying) and especially the grapes



<https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/insects-and-plant-diseases/grapes/botrytis-bunch-rot-of-grape>

Grapevine enemies & diseases

Diseases caused by fungi

Botrytis bunch rot (*Botrytis cinerea*)

- A dark spot first appears on the grape berries, which spreads and eventually causes rot
- Eventually, the affected tissues turn brown, shrink, and are often "mummified"
- With a moist atmosphere, the affected organs are covered with a gray mold (conidia of the fungus)
- Tender shoots, leaves and flowers are affected only when high humidity conditions prevail in spring
- Infections manifest in the form of brown areas on the internodes and tender tips, which cause rot and dryness



Grapevine enemies & diseases

Diseases caused by fungi

Botrytis bunch rot (*Botrytis cinerea*)

- In the leaves the disease appears in the form of large necrotic spots that start from the periphery
- Humidity is a key condition for the development of the disease, while temperature does not play a role, because the fungus can grow in a wide range of temperatures
- Infection of young grapes is mainly due to previous infestation of the inflorescences, while mature grapes can be infected directly by fungal spores
- Rains during the ripening of the grapes, especially in dry vineyards, create ideal conditions for fungal infestations



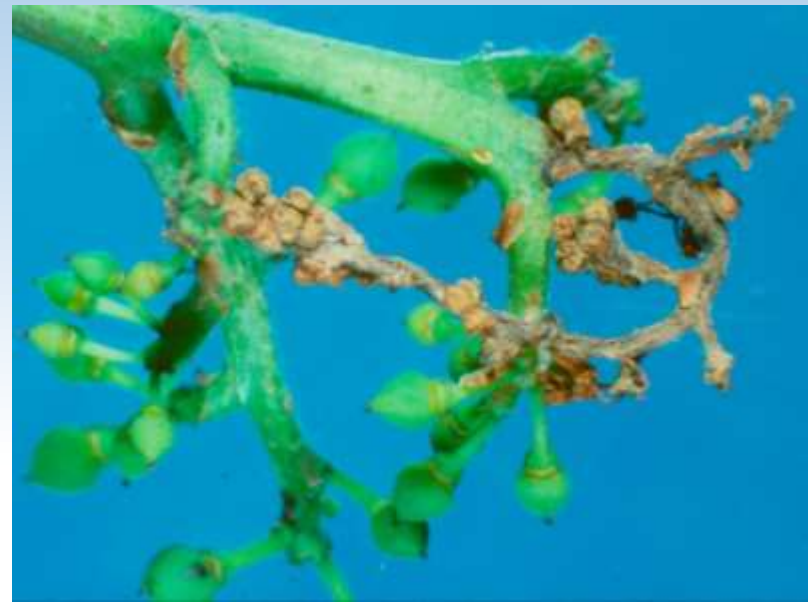
Fig.: Left to right, resistant, moderately resistant, and susceptible grape cultivars 7 or 5 d after inoculation with *Botrytis cinerea* on leaves (A) and berries (B), respectively (Naegele, 2018).

Grapevine enemies & diseases

Diseases caused by fungi

Botrytis bunch rot (*Botrytis cinerea*)

- To deal with botrytis, it is recommended to apply a program of preventive interventions depending on the climatic conditions
- In areas with "early" botrytis infection, it is recommended that the sprays start from the flowering period
- In addition, measures should be taken to avoid wounds when performing canopy management and to apply appropriate leafing for better aeration of the grapes
- To prevent the development of botrytis resistance, it is recommended to alternate or mix antifungal preparations with different mechanisms of action



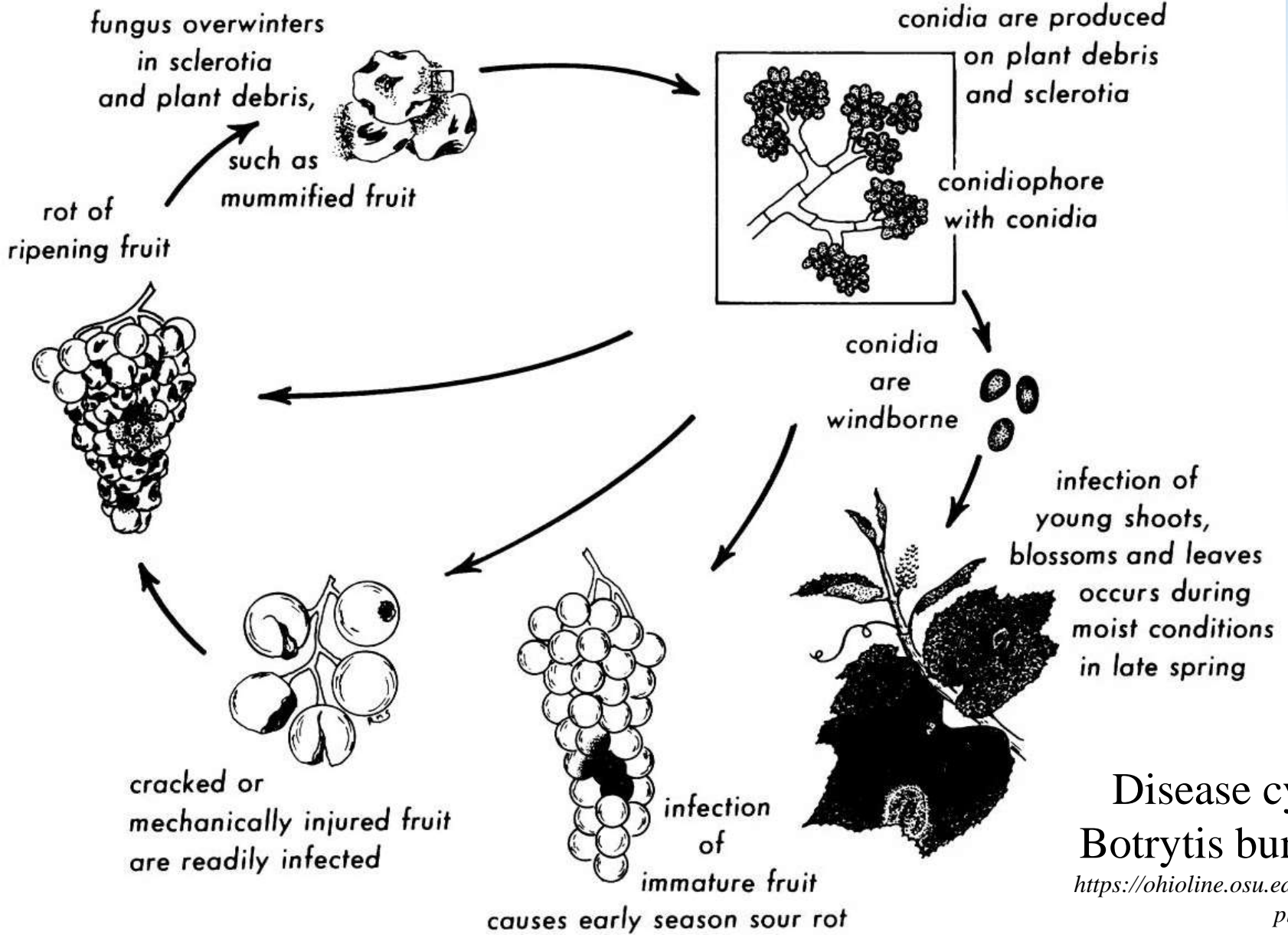
<https://www.flickr.com/photos/99758165@N06/36548046980>



<https://pnwhandbooks.org/plantdisease/host-disease/grape-vitis-spp-botrytis-bunch-rot>

Grapevine enemies & diseases

Diseases caused by fungi - Botrytis



Disease cycle of Botrytis bunch rot
<https://ohioline.osu.edu/factsheet/plpath-fru-03>

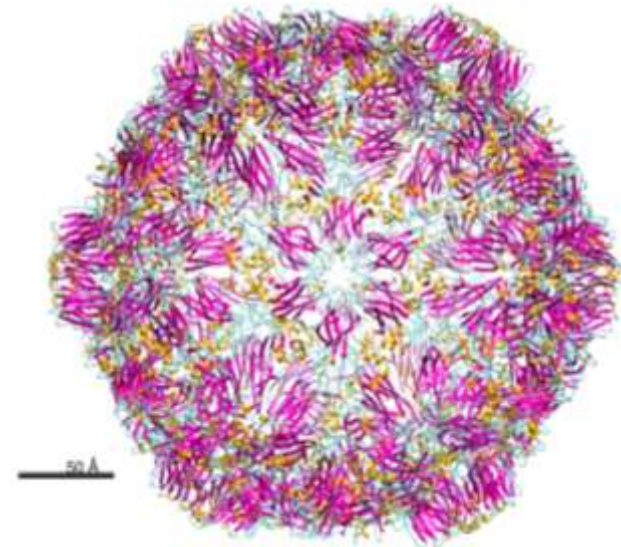
Grapevine enemies & diseases

Diseases caused by viruses - Grapevine fanleaf virus (GFLV)

- It belongs to the group of Nepovirus
- Two nematodes *Xiphinema index* and *X. italiae* have been shown to transmit the pathogenic virus
- GFLV affects only the vine, it is not transmitted by grape seeds and has no insect carriers so the transmission of the disease to new vines is done by the propagating material
- It causes distortion of leaves and chlorotic (yellow) patterns. Infected plants may be smaller in size. Grape quality and is often reduced. Fruit losses of up to 80% may occur.
- Like all viruses, it is not possible to fight the infected vines. The only viable solution is to plant healthy cuttings (propagating material) in disease-free soils. In the soils to be replanted, the nematodes must be destroyed before planting the new cuttings. This can be done with prolonged land rest (fallow), and modern weed control by applying large doses of nematicides deep in the soil, and a combination of both



<https://extension.okstate.edu/programs/digital-diagnostics/plant-diseases/site-files/grapevine-fanleaf-virus/gflv2.jpg>



https://en.wikipedia.org/wiki/Grapevine_fanleaf_virus

Grapevine enemies & diseases

Insects *European grapevine moth: Lobesia botrana* (Eudémis de la vigne)



https://blog.farmacon.gr/media/k2/gallery/1071/evdemida_ampeli2.jpg



https://www.blendspace.com/lessons/x_WSHgyCQxbLpg/the-european-grapevine-moth-lobesia-botrana



<https://vinehealth.com.au/2017/10/european-grapevine-moth/>

Grapevine enemies & diseases

Insects *European grapevine moth: Lobesia botrana* (*Eudémis de la vigne*)

- Species: *Lobesia botrana*; Order: *Lepidoptera*; Family: *Tortricidae*
- The European grapevine moth is the most serious entomological problem of viticulture because it destroys both flowers & grapes
- It causes quality degradation to grapes due to larval feces and tissues and the transfer of other pathogens (botrytis, etc.) to the affected berries
- The 1st generation larvae are usually flower eaters. They eat the stamens and pistils, and the infected flowers are connected with silk threads
- The 2nd generation destroys the unripe grapes berries, which are often connected with threads
- The 3rd generation larvae cause the most serious damage because they affect the mature grape berries



https://www.canr.msu.edu/ipm/diseases/grape_berry_moth#gallery



<http://ephytia.inra.fr/en/ContentDiagnosics/view/2072>

Grapevine enemies & diseases

Insects *European grapevine moth: Lobesia botrana* (*Eudémis de la vigne*)

- It mainly affects the European vine while its larvae can grow on some other plants (e.g. olive, plum, kiwi) but can not complete all its generations on these plants.
- In the vineyard it completes 3 generations per year in most areas
- The 1st generation moths spawn on the grape bunches and the 2nd generation larvae (June-July) feed on unripe grape berries causing them to drop
- The 3rd generation larvae (July-August or until October in North Greece) infect the maturing grapes
- In some areas (e.g. Attica, Crete, Peloponnese), a 4th generation is also observed
- The latest generation of larvae overwinter under the dry bark of the vines, in the ground, or in other natural shelters



Grapevine enemies & diseases

Insects

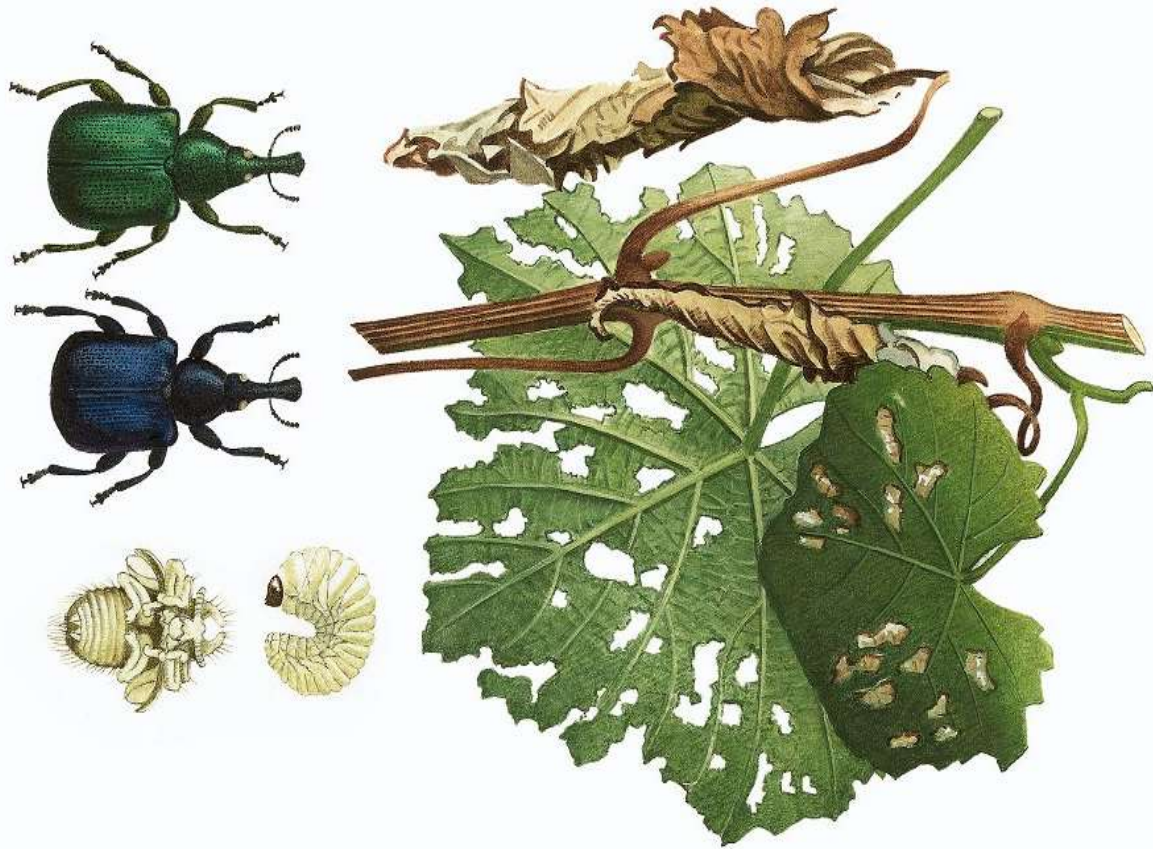
*Vine leaf-roller: **Byctiscus betulae*** (Cigarier de la vigne)



[http://jmeg.fi/InsectsOnBirch/Packed.
Byctiscus.betulae.Oulu.27.6.2005.jpg](http://jmeg.fi/InsectsOnBirch/Packed.Byctiscus.betulae.Oulu.27.6.2005.jpg)



[https://upload.wikimedia.org/wikipedia/
commons/9/9b/Byctiscus_betulae_m.jpg](https://upload.wikimedia.org/wikipedia/commons/9/9b/Byctiscus_betulae_m.jpg)



https://glossary.wein.plus/uploads/editor/images/6739/597099a49occa_q80.jpg

Grapevine enemies & diseases

Insects

Black vine weevil: Otiorhynchus sulcatus (Charançon noir de la vigne)



<https://www.cabi.org/isc/portfolio/compedia/300x300/16963.img>



UGA2130078

The black vine weevil.

From a photo by Kent Loeffler, Cornell University, Bugwood.org

<https://glossary.wein.plus/vine-weevil>

Grapevine enemies & diseases

Mites

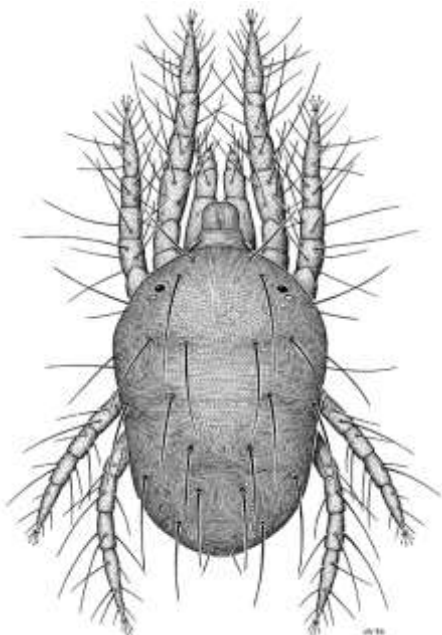
Spider mites: *Tetranychus urticae* (Tétranyques de la vigne)



<https://alchetron.com/Tetranychus-urticae>



https://commons.wikimedia.org/wiki/File:Spider_mites_on_a_pepino_leaf.png



https://en.wikipedia.org/wiki/Tetranychus_urticae#/media/File:ACAR_Tetranychidae_Tetranychus_urticae.png



<https://www.sciencephoto.com/media/1168564/view/red-spider-mite-tetranychus-urticae>

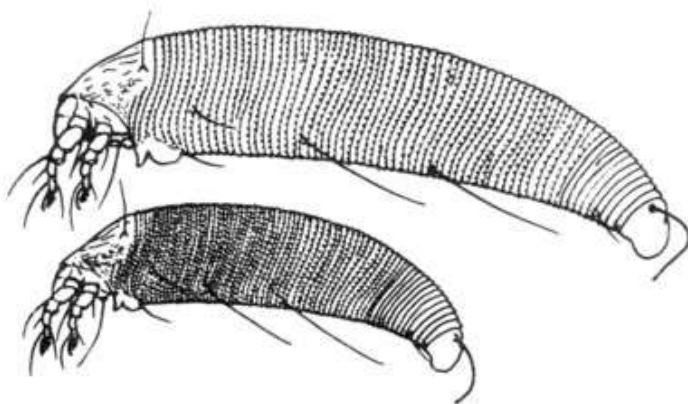
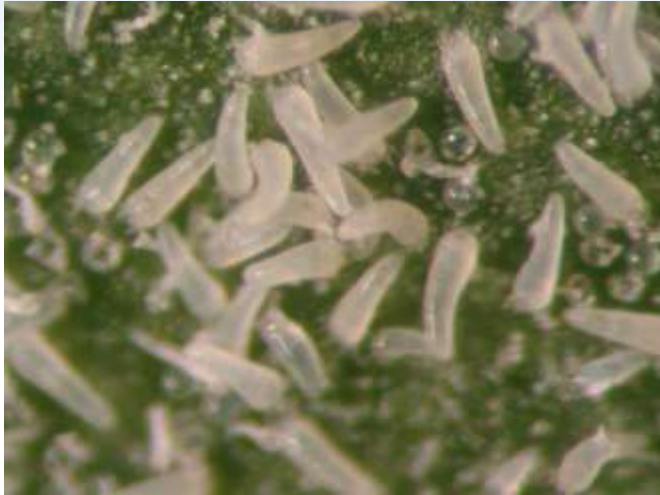


[https://commons.wikimedia.org/wiki/File:Red_spider_mite_\(Tetranychus_urticae\).jpg](https://commons.wikimedia.org/wiki/File:Red_spider_mite_(Tetranychus_urticae).jpg)

Grapevine enemies & diseases

Mites

Grape Erineum Mite (Blister mite): *Eriophyes vitis* (Le phytotype de l'érinose)



https://www.sun.ac.za/english/faculty/agri/conservation-ecology/ipm/Documents/Bud%20mite_ENG.pdf

https://www.dpi.nsw.gov.au/_images/topic-images/about-us/services/collections/scientific-illustrations/eh-zeck/grape-leaf-blister-mite.jpg

https://commons.wikimedia.org/wiki/File:Erinose_de_la_vigne,_vue_de_dessous-dessus.jpg



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Thank you!