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WINE GRAPE PRODUCTION INTEGRATED PEST MANAGEMENT GUIDELINES

Agriculture Directorate



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PLANT PROTECTION PRODUCT AUTHORISATION

Plant protection products (PPPs) need to be authorised by the MCCAА before they are placed on the Maltese market in accordance with the provisions of Regulation (EC) No. 1107/2009 implemented in Malta through Subsidiary Legislation S.L. 430.07, Plant Protection Products (Implementation) Regulations, issued under the Pesticides Control Act (Cap. 430).

A list of authorised PPPs can be found on the MCCAА website:
<https://mccaa.org.mt/Section/Content?contentId=1158>

It is the legal obligation of all farmers and professionals making use of PPPs to consult the list prior to the purchase or application of any products to ensure their authorisation, even if they are listed in this publication. If assistance is required, one can contact AgriConnect for further assistance.

For PPPs listed in this publication but currently not yet authorized, the Agricultural Directorate encourages farmers, farmer representatives and commercial entities to contact AgriConnect, for and assistance in the authorisation process of products containing such substances.

Colour code for substances listed in this guideline:

● Authorised for use in the Maltese Islands.

● Can be authorised for use.

🌿 Organic

🐝 Beneficial insect



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CONTENTS



European grapevine moth, <i>Lobesia botrana</i>	4
Grape Thrips, <i>Drepanothrips reuteri</i>	6
Phylloxera, <i>Daktulosphaira vitifoliae</i>	8
Grape mealybug, <i>Planococcus</i> sp., <i>Pseudococcus</i> sp., <i>Targionia vitis</i>	10
Vineyard leafhoppers, <i>Jacobiasca lybica</i> , <i>Empoasca vitis</i>	12
European red mite, <i>Panonychus ulmi</i>	14
Grape leaf rust mite, <i>Calepitrimerus vitis</i>	16
Snails, <i>Arion</i> sp	18
Flea Beetle (<i>Altica</i> spp)	19
Powdery mildew, <i>Oidium tuckeri</i>	22
Grey mould, <i>Botrytis cinerea</i>	25
Downy mildew of grapevine, <i>Plasmopara viticola</i>	27
Secondary fungal disease, <i>Penicillium</i> spp., <i>Aspergillus</i> spp.	30
Acid rot (yeast and bacteria)	31
Phomopsis cane and leaf spot, <i>Phomopsis viticola</i>	32
Petri Disease and Esca, <i>Phaeoacremonium aleophilum</i> , <i>Phaeomoniella chlamydospora</i> , <i>Fomitiporia mediterranea</i> , etc.....	34



European Grapevine Moth

Lobesia botrana

Lobesia botrana is one of the main insect pests affecting grape production. Larvae cause damage by feeding on inflorescence, on unripe berries and inside ripe/ripening berries, the latter causing the most damage. There are several generations during a year.

The adult moth is around 6 to 8mm in length with a wingspan of 11 to 13mm. The forewing is tan/cream and mottled with tan-brown, dark brown and grey-blue blotches. The rear wing is grey with a fringed border. Moth activity is commonly observed at dusk.

Females initiate oviposition on grapevine flowers or berries. Eggs are generally laid singly. Larvae in the initial stages of maturity are light yellow. Once mature, the larvae can reach a length of 10 to 15mm, and the body colour changes to light green or light brown, depending on nutrition.

○ Control and Management

Place the pheromone traps (sexual confusion devices), two to three traps per homogeneous plot, during March and April and start monitoring during this period.

Intervene only on the second and third generation. For the second and third generation, the time of the intervention must be determined based on the flight curve recorded using the pheromone traps the pesticide chosen for the control and where it is available from the trend of the oviposition revealed with specific surveys and forecast models.

***Bacillus thuringiensis*:** intervene 4–5 days after initial moth captures. Repeat the treatment after one week from the first intervention.

Growth regulators: intervene 3–4 days from when the first moth captures are recorded.

Other insecticides: Carry out sampling on 100 cluster per hectare for signs of moth infestation. Take action when the following threshold is exceeded: 3-4% of clusters infested with larvae or when presence penetration holes have been noted.

PEST PROTECTION SUBSTANCES AND DEVICES

- *Bacillus thuringiensis* 
- Sexual confusion pheromone 
- Spinosad (3) 
- Chlorantraniliprole (1)
- Emamectin benzoate (2)
- Spinetoram (1) (3)
- Tebufenozide (4)
- Methoxyfenozide (4)



Lobesia botrana adult moth¹

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Do not exceed one intervention per year regardless of disease or pest.
- (2) Do not exceed two interventions per year.
- (3) Not more than three interventions per year using Spinetoram and Spinosad regardless of disease or pest. Spinetoram can be used only for orchards not yet in production phase
- (4) Do not exceed two interventions per year regardless of disease when using Methoxyfenozide and Tebufenozide based products.



*Larva feeding on grape*²

Grape Thrips

Drepanothrips reuteri

Vine thrips or grape thrips are insects that cause leaf and shoot damage on grapevines, especially in spring. These parts of the plant, when bitten by the insect (both to feed and to lay eggs), impact its development, subsequently leading to necrosis, desiccation and blistering of the leaf. Inflorescences can also be attacked – punctures to the flower peduncles can cause desiccation and premature fall. The insect is small and cannot be seen well with the naked eye, with female adult size generally below 1 mm. Body colour of adults is yellow to brownish-yellow.

○ Control and Management

○ Chemical Interventions

Only intervene in the event of a severe infestation (5–6 thrips per leaf).

PEST PROTECTION SUBSTANCES AND DEVICES

- *Beauveria bassiana* strain ATCC 74040 🌿
- Sweet orange essential oil 🌿
- Potassium salts of fatty acids 🌿
- Azadirachtin 🌿
- Spinosad (1) 🌿
- Acetamiprid (3)
- Etofenprox (2)
- Spinetoram (1) (3)
- Tau-fluvalinate (2)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Apply a maximum of three interventions per year from Spinetoram and Spinosad regardless of disease or pest.
- (2) At most one intervention per year with Pyrethroids regardless of disease or pest.
- (3) At most two intervention per year regardless of disease or pest.

Close up of plant with
leaves impacted by
Grape thrips²⁵



Palpita unionalis moth⁴



Phylloxera

Daktulosphaira vitifoliae

The grape phylloxera can cause significant economic damage to grapevines. The insect alternates between a root-feeding and a leaf-feeding form. Symptoms can be exhibited on the leaf surface in the form of small galls the size of half a pea. Numerous galls can be present on a single leaf. Gall formation on the leaves in severe infestations can cause leaves to drop. Knots can also form in the roots of grapevines, resulting in rotting leaves, yellowing of foliage, decreased vigour in the vines, and may lead to the eventual death of susceptible vines. The root-feeding stage of the grape phylloxera is what causes the most significant damage in vines, and hence, grafting on resistant rootstock significantly reduces the risk of infestation. In spring, when the leaves start to form, phylloxera sap-feeding nymphs and adults may be observed. These are yellow in colour, and adults are a bit larger than 1mm in length.

○ Control and Management

○ Chemical Interventions

Intervene at the appearance of the first galls.

PEST PROTECTION SUBSTANCES AND DEVICES

- Acetamiprid (1)
- Spirotetramat (2)
- Flupyradifurone (1)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Do not exceed two intervention per year regardless of disease or pest.
- (2) A maximum of two interventions per year regardless of disease or pest.
- (3) Do not exceed one intervention per year regardless of disease or pest.



Galls formed on leaves ⁵



Daktulosphaira vitifoliae
apterae feeding on roots ⁶

Grape mealybug

Planococcus sp., *Pseudococcus* sp., *Targionia vitis*

There are various Coccoidea scale insects that affect grape vines. *Planococcus* sp. and *Pseudococcus* sp. are mealybug species that include the grape mealybug (*Planococcus ficus*) and the long-tailed mealybug (*Pseudococcus longispinus*). Mealybugs are sap-feeding, soft-bodied, segmented scale insects that are coated with a powdery, white, wax secretion. Feeding causes the excretion of honeydew that may lead to sooty mould and damage the foliage and fruit. Mealybugs can often be found in colonies that would have various insect stages, including adults, nymphs and eggs. Adult females are flattened and do not fly. Infestations can be identified by observing white, waxy clusters on leaves, canes or grape bunches.

Coccoidea insects also include *Targionia vitis*, the grapevine black scale. It feeds on sap, causing a general deterioration, reduction of vegetative vigour and consequent reduction of production. *T. vitis* is able to have only one generation per year and overwinters as fertilized adult females, recognizable by the red colour of the body. In the spring, the nymphs within a month, they fix under the rhytidome of the stem, on the young shoots and, in some cases, also on leaves and shoots. Its control, made particularly difficult by the establishment of the insect in the smallest crevice of the bark and cracks of the lignified shoots, is based on the timeliness of the intervention.

○ Control and Management

Sexual confusion (put dispenser in the field in March or April).

○ Physical Interventions

Perform debarking and brushing of infested stumps.

○ Agronomic Interventions

Apply a balanced fertilization and irrigation. Never exceed the recommended nitrogen application to avoid instances of over-vigorous plants. Light leaf pruning around the clusters must also be carried out.

O Chemical Interventions

In the presence of outbreaks, intervene promptly only on the infested plants. Only if cases of generalized attacks have been detected in the previous year, treat the entire plot surface.

PEST PROTECTION SUBSTANCES AND DEVICES

- | | |
|---|-----------------------|
| ● Sexual Confusion Pheromones  | ● Pyriproxyfen (3) |
| ● Mineral oil  | ● Spirotetramat (1) |
| ● Acetamiprid (2) | ● Sulfoxaflor (2) |
| | ● Flupyradifurone (2) |

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Pest-related Limitation

With the exception of mineral oil, do not exceed one intervention per year against this adversity.

Product specific Limitation

- (1) A maximum of two interventions per year regardless of adversity; Active substance can also be used against *Planococcus ficus*.
- (2) A maximum of two intervention per year regardless of disease or pest.
- (3) At most one intervention per year.

Pseudococcus longispinus ⁷



Mealybugs in bark crevice ⁷

Vineyard Leafhoppers

Jacobiasca lybica, *Empoasca vitis*

Empoasca vitis and *Jacobiasca lybica* are both small leafhoppers, with the adult being around 3–4mm and 2.5mm respectively. They are green in colour. Adults fly or hop when disturbed. The eggs are laid in the veins on the underside of leaflets.

Leafhoppers cause damage to the foliage of grapevines. Adults and nymphs feed on leaves by puncturing cell walls. This results in small white/yellow spots appearing on the leaves, leaving a speckled effect due to the puncture marks. Leaves can become yellow at the edges. Severely affected leaves can drop prematurely. Leafhoppers can lead to a reduction of quality and quantity of harvest when defoliation and stunted growth occurs.

○ Control and Management

○ Agronomic Interventions

- Apply a balanced and even input of fertilizer and irrigation throughout growth cycle;
- Carry out light leaf pruning around the clusters;
- Avoid excessive vegetative growth and hanging vegetation blocking airflow through the vines;
- Tie the shoots firmly around the trellis system, leaving enough gaps between each neighbouring vine to allow circulation to flow.

Detect the presence of adults using 3 per hectare of yellow chromotropic traps, from mid-May to October, positioned on the middle wire of the trellis. Traps are to be replaced every two weeks.

To assess the degree of leafhopper infestation, collect about 100 leaves per hectare and record the presence of juveniles and nymphs present on the bottom side of leaves around the central part of the plant during the summer period (July to August).



Empoasca vitis adult¹³

O Chemical Interventions

Green leafhoppers, especially in young plants and in the presence of more sensitive vines, can cause the total desiccation of the leaf parenchyma and lead to the incomplete lignification of the shoots and alteration to the reopening pattern of the cluster.

Intervene when the following thresholds are exceeded:

Green leafhopper (*E. vitis*), 1–2 nymphs/leaf

PEST PROTECTION SUBSTANCES AND DEVICES

- Azadirachtin
- Sweet orange essential oil (2) 
- Mineral oil 
- Pyrethrins 
- Potassium salts of fatty acids 
- Acetamiprid (1) (2)
- Etofenprox (2) (3)
- Tau-fluvaliante (2) (3)
- Flupyradifurone (1) (2)
- Sulfoxaflor (1) (2)



Jacobiasca lybica adult ¹⁴

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Pest-related Limitation

Do not exceed one intervention against this adversity.

Product specific Limitation

- (1) A maximum of two intervention per year regardless of disease or pest
- (2) To be used against *Empoasca vitis* only
- (3) At most one intervention per year with Pyrethroids regardless of disease or pest.

European Red Mite

Panonychus ulmi

The European red mite affects a number of plant species, one of which is the grapevine. The adult female mites are around 0.4 mm in length, dark red and have long hairs at the base of which are white spots. The male mites are smaller and lighter in colour and have an elongated abdomen. Eggs are also reddish in colour.

The adults and nymphs damage leaves by piercing through the cells to feed, leaving small yellow/white spots on the undersurface of leaves. Under more severe infestations, the speckle spots coalesce to form a yellowing or bronzing appearance of grapevine leaves.

○ Control and Management

○ Agronomic Interventions

Take action when the following threshold is exceeded:

- 30% of leaves infested with mobile forms coupled with insufficient presence of the predator
- *Stethorus punctillum* is observed

PEST PROTECTION SUBSTANCES AND DEVICES

- *Beauveria bassiana* strain ATCC 74040 
- Potassium salts of fatty acids 
- Abamectin
- Bifenazate (1)
- Exitiазox (Also known as Hexythiazox)
- Fenpyroximate
- Tebufenpyrad

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Pest-related Limitation

Do not exceed more than one intervention a year against this adversity.

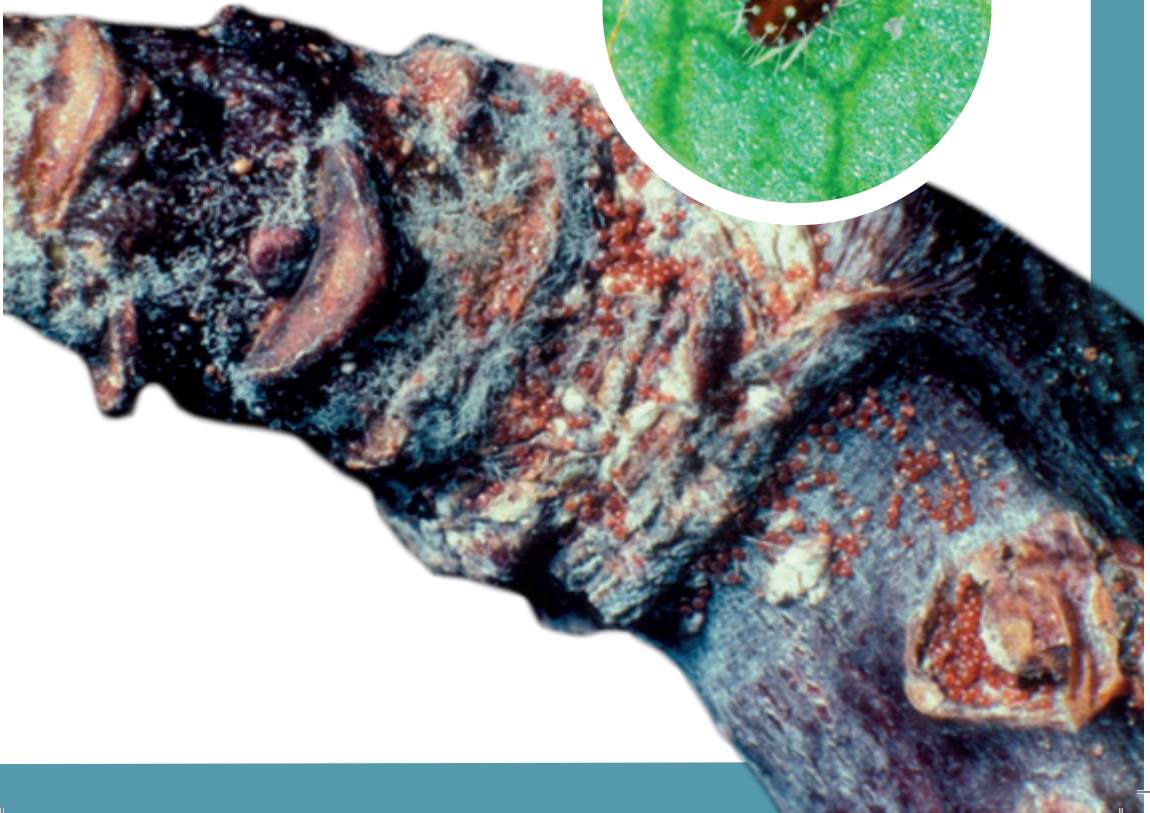
Product specific Limitation

(1) At most one intervention per year regardless of disease or pest.

European red mite eggs on bark ¹⁵



European red mite adult ¹⁵



Grape Leaf Rust Mite

Calepitrimerus vitis

The grape leaf rust mite can cause a variety of symptoms depending on the growth stage of the vine. The mite attacks the buds and shoots and can result in leaf curling and distortion in early spring. Symptoms can also include shortening of internode and bunched foliage. Later in the season, in mid to late summer, the mite causes leaves to turn rust-brown. The pest can cause economic impact on a vineyard if there is a high population density, by reducing grapevine yield. The mite is not visible to the naked eye, with an adult being 0.15mm in length.

○ Control and Management

○ Chemical Interventions

Only intervene in case of a severe attack at the beginning of the vegetative restart if the presence of mites has been recorded in the previous year or in case of ascertained/prolonged presence on the leaves. This is important to avoid damage on the bunches.

PEST PROTECTION SUBSTANCES AND DEVICES

- Potassium salts of fatty acids 
- Sulphur 
- Bifenazate (1)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Do not exceed more than one intervention per year regardless of disease or pest.

Sulphur has anti-oidium activity and thus can also be applied also against mites.



Leaf discoloration caused by C. vitis ²⁶



Adult on grapevine ²⁷

Slugs

Arion spp.

Slugs can cause damage in a vineyard, especially in early spring, by feeding on buds, shoots and new foliage. They are not considered a major pest on vineyards, except in the case of infestations, in particular periods of the year and on young seedlings or vine shoots. The slugs develop during the seasonal rains and wet periods and remain active throughout the year, sheltering during the harsh summer months. After mating, slugs lay numerous eggs in holes dug in the soil. After 2–4 weeks, the eggs hatch and the adults appear after 2–3 months. The slugs feed on green and succulent organs, devouring leaves, leaf midribs, flower heads, seedlings, berries and fruits. Feeding leaves exposed wounds that can lead to other pathogenic diseases (for example development of bacterial rot).

O Control and Management

Intervene in the presence of slugs on the stump and at the detection of the first signs of damage.

PEST PROTECTION SUBSTANCES AND DEVICES

- Ferric Phosphate 

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Distribute the product near the vine stump.

Slug feeding on foliage ¹⁷





Flea Beetle

Altica spp

Altica of the vine *Haltica lythri* Aubé var. *ampelophaga* (Guerin). *Haltica lythri* is a chrysomelid beetle native to central Spain (Andalusia) and is widespread in many vine-growing areas around the Mediterranean. The leaf beetle lives from the vine itself. In spring, the adults attack the leaves and cause irregular erosion on the leaf parenchyma along the main veins. In the process, this can cause sometimes damage to the shoots. The larvae develop normally on the underside of the leaves, along the upper epidermis which then causes drying and perforation. Significant damage can occur in young vines under cultivation. Altica adults are of metallic green colour. The leaf beetle have characteristic small heads with filiform antennae reaching one third of the length of the elytra which are irregularly dotted. The total length of the insect ranges from 4.5-5mm. Their larvae are ellipsoidal yellowish in form. Larvae are yellow at birth, later become blackish with tubercles bearing long hairs. The altica overwinters as an adult and completes three generations in one year. The leaf beetle tends to winter in the crevices of the bark and the dry leaves or other shelters present near the vine. At budding phase, the adults appear, feed and mate. When the average temperatures reach 15-16°C the females begin to lay their eggs on the underside of the leaves. Overall, an average of 150-200 eggs are laid in small groups of a few units or at most of a few dozen elements. The duration of embryonic development depends on the temperatures and can range from 19 days at 16°C up to 4 days at 32°C. The larvae live gregarious only the first age. When ripe, the larvae drop to the ground where they pupate in earthy cells at a depth of 2-5 cm. The adults of this first generation appear in June-July, those of the second at the end of August and those of the third generation in the first half of October. The latter, with the lowering of temperatures, take shelter to overcome the winterization phase.

○ Control and Management

○ Agronomic Interventions

Remove any spontaneous weeds growing within the vines.

○ Chemical Interventions

Only intervene in case of a severe attack

PEST PROTECTION SUBSTANCES AND DEVICES

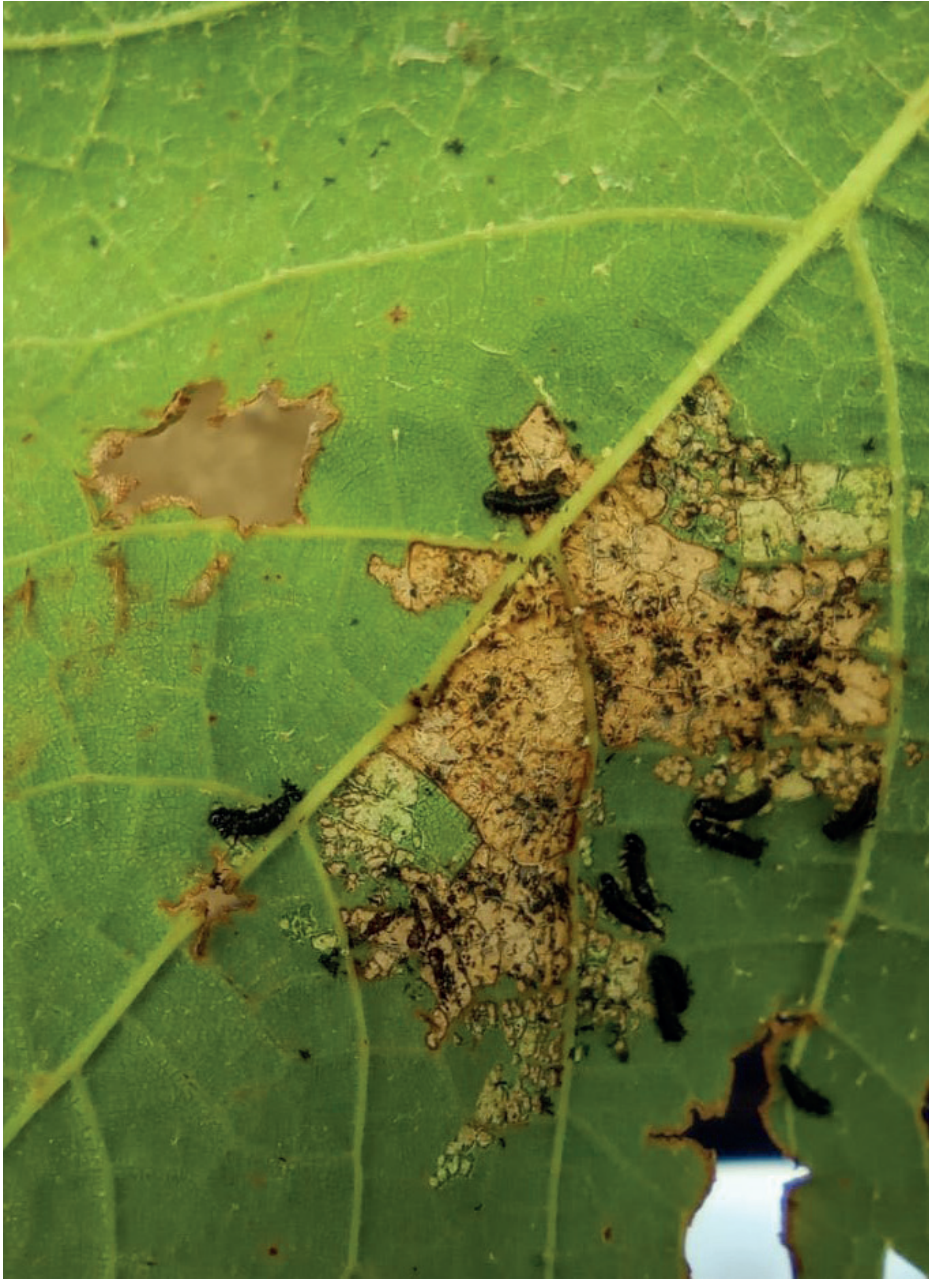
- Cypermethrin (1)
- Deltamethrin (1)
- lambda-Cyhalothrin (1)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) At most one intervention per year with Pyrethroids regardless of disease or pest.



Altica lythri adult insect ²⁹



Altica spp damage on vine leaf ³⁰

Powdery Mildew

Oidium tuckeri

Powdery mildew is the most widespread fungal vine disease. The fungal pathogen affects the green tissue of the grapevine, including leaves, shoots and berries. In the early stages of infection, leaves exhibit yellow blotching. This further develops to form conidia that appear like a white/grey powder on foliage. Green shots may exhibit brown patches. Berries can also exhibit white powdery growth and scarring on the skin. *Oidium tuckeri* thrives in environments with high humidity.

○ Control and Management

○ Agronomic Interventions

- Allow air circulation by tying the shoots around the trellis system separately. Arrange shoots and tie them.
- Carry out light leaf pruning around the clusters.
- Apply a balanced and even input of fertilization and irrigations.

○ Biological/Organic Interventions

Use *Ampelomyces quisqualis* in periods of lower disease pressure in alternation with other permitted fungicides. Do not mix this product with sulfur - containing substances as these reduce the effectivity of the *A. quisqualis*. Wait at least 5 days after treatment with *A. quisqualis* before application of chemical-based substances. In case of rainfall exceeding 6mm, it is recommended to repeat the treatment once more.



Powdery mildew forming on grapes¹⁷

○ Chemical Interventions

High risk areas:

- up to pre-flowering: intervene in advance with covering products;
- from pre-flowering to veraison: intervene by alternating systemic and covering products.

Low-risk areas:

- take precautionary measures in the immediate pre-flowering stage and continue alternating systemic and covering products. Use sulfur compounds in the coolest hours to avoid phytotoxicity phenomena.

PEST PROTECTION SUBSTANCES AND DEVICES

- | | |
|--|------------------------------------|
| ● <i>Ampelomyces quisqualis</i>  | ● Cyflufenamid (5) |
| ● <i>Bacillus amyloliquefaciens</i>  | ● Difenoconazole (4) (10) |
| ● <i>Bacillus pumilus</i>  | ● Fluxapyroxad (2) |
| ● Potassium Bicarbonate  | ● Meptyldinocap (6) |
| ● Cerevisane  | ● Metrafenone (7) |
| ● COS-OGA  | ● Proquinazid (3) |
| ● Sweet orange essential oil  | ● Pyraclostrobin (1) |
| ● Laminarin  | ● Pyraclostrobin (1) + Metiram (8) |
| ● Sulphur  | ● Pyriofenone (3) (7) |
| ● (Eugenol + Geraniol + Thymol) (11)  | ● Spiroxamine (9) |
| ● Azoxystrobin (1) | ● Trifloxystrobin (1) |
| ● Boscalid (2) | ● Tetraconazole (4) |
| ● Bupirimate (3) | |

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Apply a maximum of three interventions per year between Azoxystrobin, Pyraclostrobin and Trifloxystrobin regardless of disease or pest;
- (2) Between Boscalid, Isofetamid and Fluxapyroxad only apply a maximum of two interventions per year regardless of disease or pest.

- (3) Do not exceed a maximum of two interventions per year between Bupirimate, Proquinazid and Pyriofenone;
- (4) Do not exceed a maximum of three interventions per year with the azole-type sterol inhibitor compounds.
- (5) Apply a maximum of two interventions per year.
- (6) Apply a maximum of three interventions per year.
- (7) Apply a maximum of three interventions per year from Metrafenone and Pyriofenone.
- (8) Apply a maximum of three interventions per year regardless of adversity; Product is to be used until fruit set. fruit set.
- (9) A maximum of three interventions per year.
- (10) At most one intervention per year.
- (11) A maximum of four interventions per year regardless of disease or pest.



Yellow blotching on grapevine leaf ¹⁸

Grey Mould

Botrytis cinerea

Botrytis cinerea is a fungal pathogen that infects a variety of plant species, including the grapevines. Grey mould or bunch rot may reduce the quantity and quality of berries, resulting in poor quality wine due to changes in composition. The fungus also produces toxic compounds that affect the fermentation process. The fruit are most prone to infection when they are ripe and close to their harvesting period. Infected berries become soft and watery, and under humid conditions are covered with grey mould.

○ Control and Management

○ Agronomic Interventions

- Carry out a systematic arrangement of the shoots around trellis system.
- Carry out light leaf pruning around the clusters.
- Balanced input of fertilizer and irrigation.

○ Biological/Organic Interventions

Carry out an intervention at veraison and one in the pre-closure of the cluster. For late-ripening varieties (Italy, etc.) and for those covered agricultural management systems, action must be taken when the relative humidity is high. In order to prevent resistance phenomena, it is recommended to alternate fungicides with different mechanisms of action.



Botrytis cinerea mould forming on grapes ¹⁸



Bunch affected by grey mould ¹⁹

PEST PROTECTION SUBSTANCES AND DEVICES

- *Aureobasidium pullulans* ✓
- *Bacillus subtilis* strain QST 713 (6) ✓
- *Bacillus amyloliquefaciens* ✓
- *Metschnikowia fructicola* strain NRRL Y-27328 ✓
- *Pythium oligandrum* strain M1 ✓
- *Saccharomyces cerevisiae* ✓
- *Trichoderma atroviride* SC1 strain ✓
- Potassium Bicarbonate ✓
- Cerevisane ✓
- Eugenol + Geraniol + Thymol (7) ✓
- Laminarine ✓
- Boscalid (1)
- Cyprodinil (2)
- Cyprodinil (2) + Fludioxonil (3)
- Fenhexamid (4)
- Fenpyrazamine (5)
- Fluazinam (5) (8)
- Fludioxonil (3)
- Isofetamid (1) (5)
- Pyrimethanil (2)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Pest-related Limitation

A maximum of three interventions are allowed per year for uncovered cultivation systems and four maximum interventions for grapes cultivated using covered systems. The latter applies only for instances where harvest occurs between November and December.

Products allowed in organic farming are exempted from this limitation.

Product specific Limitation

Between Boscalid, Isofetamid and Fluxapyroxad, apply a maximum of maximum two interventions per year regardless of disease or pest;

- (1) Between Pyrimetamil, and Cyprodinil at most one intervention per year independently from adversity;
- (2) A maximum of two interventions per year regardless of disease or pest;
- (3) A maximum of two interventions per year
- (4) At most one intervention per year.
- (5) A maximum of four interventions per year regardless of disease or pest.
- (6) A maximum of four interventions per year regardless of disease or pest.
- (7) Between Ditanon, Fluazinam and Folpet apply a maximum of three interventions per year independently from adversity;

Downy Mildew of Grapevine

Plasmopara viticola

Plasmopara viticola is an oomycete that infects all green parts of a vine, but symptoms are first visible on leaves, causing discolouration, necrosis and distortion. Yellow circular spots (in some red varieties these spots are red) appear on young leaves with 'oil spots' with a chocolate-brown halo. These oil spots can grow and coalesce, and as they mature they dry and become necrotic. White, cottony, fungal-like growth may appear on the surface of the leaves.

Inflorescence or young berries turn yellow or grey if infected and may exhibit spores. The young berries may turn brown and wither. Two to three weeks after blossoming; the berries do not support sporulation but would still become discoloured, and shrivel.

Control and Management

It is recommended to intervene through the application of contact products when the following conditions and stages ensue:

- Pre-flowering phase and;
- Climatic conditions predisposing infection (rain/high relative humidity).

In the presence of the first symptoms (oil spots) intervene with cytotropic active ingredients or systemic, alone or mixed with contact products. If the weather conditions remain favourable to the disease, intervene with longer-lasting anti-peronospora type products.

PEST PROTECTION SUBSTANCES AND DEVICES

- | | |
|--|--|
| ● Cupric products (11)  | ● Benthialavdicarb (9) (5) + Copper |
| ● Cerevisane  | ● Cymoxanil (4) |
| ● Sweet orange essential oil  | ● Cyazofamid (2) + Disodium phosphonate (12) |
| ● Laminarine  | ● Dimethomorph (5) |
| ● Ametoctradin | ● Dithianon (10) |
| ● Ametoctradin + Metiram (1) | ● Fluopicolide (7) |
| ● Amisulbrom (2) (14) | |
| ● Benthialavdicarb (9) (5) | |

- Folpet (10)
- Fosethyl Aluminum (12)
- Potassium phosphonates (12)
- Disodium phosphonate (12)
- Iprovalicarb (5)
- Mandipropamid (5)
- Metalaxyl – M (3)
- Metiram (1)
- Pyraclostrobin (6) + Metiram (1)
- Valifenalate (formerly Valiphenal) (5) + Folpet (10)
- Zoxamide (8)
- Oxathiapiprolin (13)
- Folpet (10) + Potassium Phosphonates (12)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) A maximum of three interventions per year regardless of adversity. Product is to be applied until fruit set developmental phase;
- (2) A maximum of three interventions per year from Amisulbrom and Cyazofamid;
- (3) At most one intervention per year;
- (4) A maximum of three interventions per year;
- (5) A maximum of four interventions per year from Benthiavalicarb, Dimetomorf, Iprovalicarb Mandipropamid and Valifenalate;
- (6) A maximum of three interventions per year from Azoxystrobin, Pyraclostrobin and Trifloxystrobin regardless of adversity and crop;
- (7) A maximum of two interventions per year.

Yellowing and oil spot formation on leaves²⁰



- (8) A maximum of four interventions per year.
- (9) A maximum of two interventions per year.
- (10) Between Ditanon, Fluazinam and Folpet apply a maximum of three interventions per year independently from adversity;
- (11) Do not exceed the cumulative application of 28kg of copper per hectare over 7 years and it is recommended not to exceed the quantity average of 4kg of copper per hectare per year;
- (12) Apply a maximum of ten interventions per year between Phosphonates and Fosethyl Aluminum, excluding vines used for propagation purposes;
- (13) A maximum of two interventions per year. Product is to be applied as a mixture of active substances with different modes of action;
- (14) Should be mixed with contact fungicides.



Fungal-like growth on leaf surface ²⁰

Secondary Fungal Disease

Penicillium spp., *Aspergillus* spp.

Penicillium spp., *Aspergillus* spp. cause secondary fungal diseases in grapevines. *Penicillium* rot is identifiable due to the presence of whitish powdery mould that is followed by the formation of dusty blue/green spores. Berries are infected generally due to skin damage or splitting from rains. *Aspergillus* fungus can cause different symptoms. *Aspergillus niger* is visible on berries in the form of brown/black sooty spore mass. The manifestation of these secondary fungal diseases on grapes may be different since the pathogens can either be on their own or in combination with other pathogens. These fungi produce toxins that are harmful to human health. These fungal agents cause rot even in the post-harvest stage.

O Control and Management

O Chemical Interventions

At veraison or pre-harvest.

PEST PROTECTION SUBSTANCES AND DEVICES

- Cyprodinil (1) + Fludioxonil (2)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

- (1) Between Pyrimetanil and Cyprodinil at most one intervention per year regardless of the adversity;
- (2) A maximum of two interventions per year regardless of disease and crop type



Penicillium rot on grape bunch ²¹

Acid Rot

Caused by yeast and bacteria

Sour rot is caused by the joint action of naturally-occurring yeast and acetic acid bacteria, and results in berries emitting a vinegary odour. Symptoms in the early stage of infection and during ripening of the berries may be confused with *Botrytis cinerea*. Sour rot decreases the sugar content in the berries, resulting in a change of composition that would affect the final quality of the wine.

Control and Management

Agronomic Interventions

- Balanced input of fertilization and irrigation
- Carry out light leaf pruning around the clusters.
- Apply anti-parasite agents to prevent damage to the grape cluster.

PEST PROTECTION SUBSTANCES AND DEVICES

- *Bacillus amyloliquefaciens* 
- *Bacillus subtilis* strain QST 713 (1) 

LIMITATIONS OF USE AND SPECIAL CONDITIONS

The use, if necessary, of copper-based fungicides helps in strengthening the cuticle of the berries which can prevent lesions.

- (1) A maximum of ten interventions per year regardless of the adversity.



Acid rot on white grapes variety ²⁸

Phomopsis Cane And Leaf Spot

Phomopsis viticola

Phomopsis cane and leaf spot is a disease caused by a fungal pathogen. Phomopsis can infect most parts of the grapevine. Most prominent symptoms include dark spots of around 1mm diameter with yellow halos forming on the leaves. If badly affected, the leaves can turn yellow and fall off. On green shoots, black elliptical lesions appear on internodes. Cracks can appear on shoots giving a scabbing appearance. Infected canes may experience discolouration and bleaching in winter. Berries can become infected, but generally, this happens following previously mentioned symptoms exhibited on foliage.

○ Control and Management

○ Agronomic Interventions

- Always remove infected parts during pruning stage.
- Carry out light leaf pruning around the clusters;
- Do not store pruned shoots. Burn any vine shoots after pruning.

○ Chemical Interventions

Chemical interventions are to be carried out in the following phenological phases:

- Beginning of budding (bud break) phase
- Leave at least 8–12 days before applying next treatment.

PEST PROTECTION SUBSTANCES AND DEVICES

- Cupric products (3) 
- Azoxystrobin (1)
- Folpet (2)

Phomopsis viticola
lesions on shoot²²



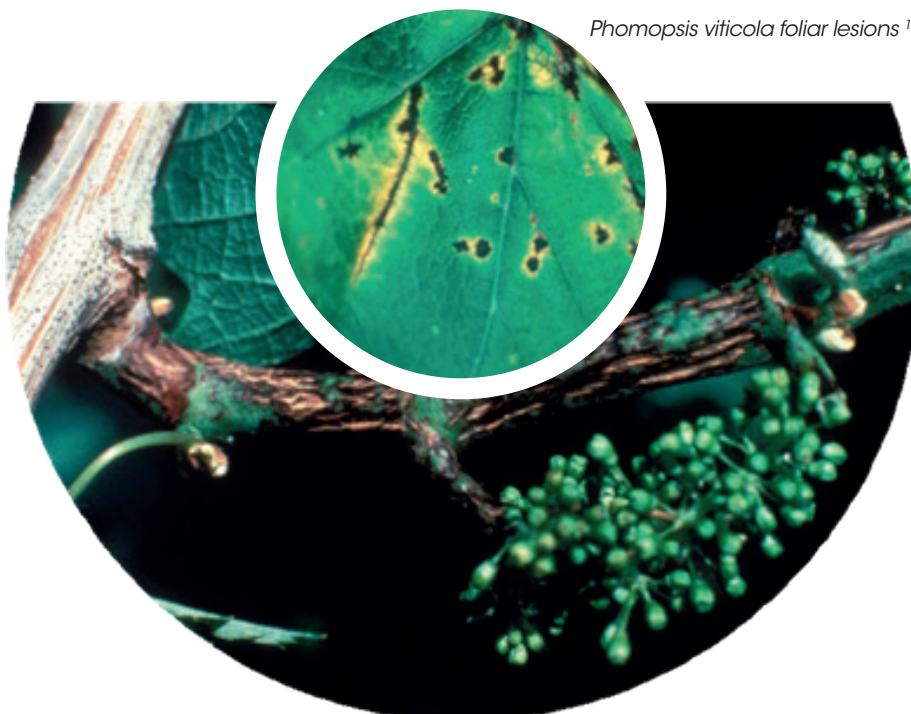
LIMITATIONS OF USE AND SPECIAL CONDITIONS

Pest-related Limitation

Application of chemical compounds must be restricted to sensitive cultivars only. Products allowed in organic farming are exempted from this limitation.

Product specific Limitation

- (1) A maximum of three interventions per year from Azoxystrobin, Pyraclostrobin and Trifloxystrobin; regardless of disease or pest.
- (2) Between Dithianon, Fluazinam and Folpet apply a maximum of three interventions per year regardless of disease or pest.
- (3) Do not exceed the cumulative application of 28 kg of copper per hectare over 7 years and it is recommended not to exceed the quantity average of 4 kg of copper per hectare per year.



Phomopsis viticola foliar lesions ¹⁶

Elliptical lesions at basal internodes ¹⁶

Petri Disease and Esca

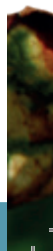
Phaeoacremonium aleophilum, *Phaeomoniella chlamydospora*, *Fomitiporia mediterranea*, etc.

Petri disease and esca are caused by fungal pathogens. Petri disease affects grapevines that are usually between 1 to 5 years. Symptoms are interveinal chlorosis and stunted growth. Esca affects more mature vines with symptoms depending on the severity of the infection. Leaves exhibit chlorosis like in the Petri disease, foliage wilts on the entire plant, necrosis occurs and early defoliation may occur. In chronic infections, the berries develop brown/purple spots on the surface. The trunk exhibits dark brown streaks and necrosis. Dissection of the vine would show that xylem vessels have turned brown due to gum formation and tylosis, and are partially blocked. This leads to water stress and insufficient nutrient supply throughout the plant.

○ Control and Management

○ Agronomic Interventions

- When symptoms appear, cut and burn infected plants.
- The surface where cutting will be effected must be smooth and sloping.
- Disinfect cutting and grafting tools with sodium hypochlorite or quaternary ammonium salts.
- Mark plants with symptoms and prune them separately from healthy plants.
- Avoid applying measures to accelerate the growth of young plants.
- Use healthy propagation material that does not contain browning spots in the interior at the point of cut.
- In the presence of partially attacked plants, remove the damaged parts and leave new growth around the cut area to sprout.
- Treat large pruning cuts with healing substances and waxes.



PEST PROTECTION SUBSTANCES AND DEVICES

- *Trichoderma asperellum* + *Trichoderma gamsii* 
- *Trichoderma atroviride* 
- Boscalid + Pyraclostrobin (1)

LIMITATIONS OF USE AND SPECIAL CONDITIONS

Treatments involving copper-based products used against downy mildew of grapevine have a protective action against this disease. Consequently such products are considered effective against this disease.

(1) Apply pruning sealer on freshly pruned cuts.

Esca on fruit ²³



Esca symptoms on leaves ²¹



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Handwriting practice lines on page 37.

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This image shows a single page of white paper with horizontal green lines. The lines are evenly spaced and run across the width of the page, typical of notebook paper or a template for writing. There are no margins, text, or other markings on the page.



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