VCR TECHNICAL BOOKLETS

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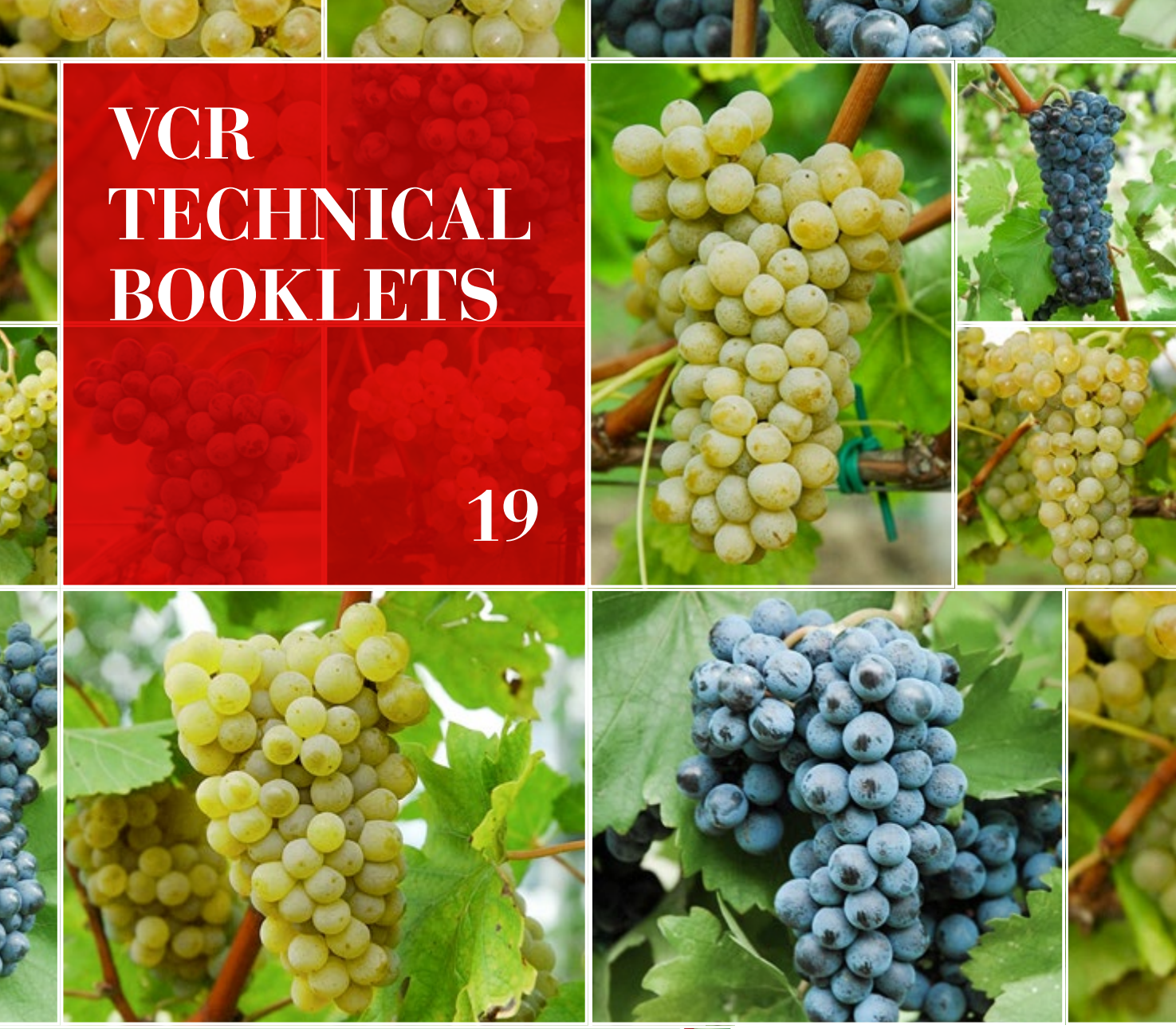
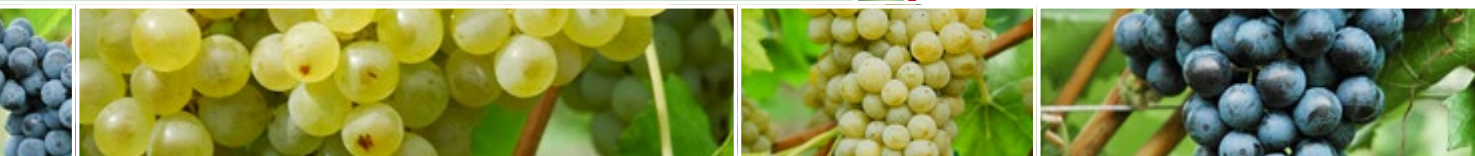


THE PHYTOSANITARY PROTECTION OF RESISTANT VARIETIES

VCR®
VIVAI COOPERATIVI RAUSCEDO

L'innovazione in viticoltura



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RESISTANT VARIETIES

The new generation resistant varieties represent a first positive approach to the sustainability of viticulture and wine production which is, to date, the main issue of world public opinion and professionals. The reduction in the use of copper compounds in agriculture, the withdrawal of numerous active ingredients, the stipulation of increasingly limiting rural police regulations together with the problems associated with climate change make the future of our viticulture uncertain. With this in mind, one of the most concrete answers available to our winegrowers is the use of varieties resistant to downy mildew and powdery mildew.

Already in 2006, the Vivai Cooperativi Rauscedo had perceived the importance of giving tangible answers to the emerging needs in terms of nursery-viticultural sustainability, and for this reason they started a fruitful collaboration with the University of Udine and the Institute of Applied Genomics with the aim of providing wine growers with new wine grape varieties resistant to the main diseases (downy mildew and powdery mildew).

The resistant varieties are obtained through interspecific crosses between susceptible *Vitis vinifera* varieties and a selection that bears the characteristics of resistance. These selections derive from 50, sometimes 100 years of re-crossing between European grapevines and hybrids made at the end of the nineteenth century and in the early decades of the twentieth century using American and / or Asian vines. By using these varieties, it is possible to reduce phytosanitary treatments by about 70%, limit water waste, avoid unnecessary soil compaction and reduce production costs. All this, without compromising the quality, healthiness and characteristics of the wine obtained, as demonstrated by the analyzes and tastings carried out, which highlighted that the aromatic and organoleptic profile of the wines obtained from these varieties is highly appreciated by the final consumer.

Assuming that organic farming, in order to be profitable, needs particular pedo-climatic conditions and therefore cannot be implemented in every territory, the use of these varieties can represent a concrete solution / option in compliance with the constraints imposed on Community level on the use of copper which increasingly limit the areas suitable for the aforementioned agriculture.

ENVIRONMENTAL SUSTAINABILITY

Ensuring environmental sustainability is one of the Millennium Development Goals-MDGs established by the United Nations, this goal should be achieved by stimulating sustainable development policies and programs aimed at reversing the current loss of environmental resources, reducing the process of biodiversity damage.
Viticulture, although it represents only 3% of the European agricultural area, uses 65% of all fungicides used in agriculture, or 68 thousand tons per year.
A worrying scenario that has prompted the European Commission to issue increasingly restrictive rules with the aim of halving the use of phytosanitary products by 2025. With this in mind, Vivai Cooperativi Rauscedo, world leader in the production of vine plants, is trying, through research and innovation, to provide effective and future-proof solutions to all winemakers as evidenced by the path undertaken together with the University of Udine and the Institute of Applied Genomics (IGA) for the creation of new varieties resistant to downy mildew and powdery mildew.
The concept of sustainability is made up of three elements: a) **economy**, b) **society**, c) **environment**.

It is therefore possible to speak of sustainability only when these three elements can work simultaneously, or rather by protecting the environment, promoting social equality and preserving economic growth and development.
The Brundtland commission, the world commission for the environment and development set up by the United Nations in 1987, gave a precise definition of sustainability, more precisely of sustainable development, stating that:

SUSTAINABLE DEVELOPMENT IS THE DEVELOPMENT THAT IS ABLE TO ENSURE THE SATISFACTION OF THE NEEDS OF THE PRESENT GENERATION WITHOUT COMPROMISING THE POSSIBILITIES OF FUTURE GENERATIONS.

In this perspective, agriculture plays a pivotal role, as it is called to meet the current needs of food and raw materials supply in a sustainable way without compromising the possibilities for future generations to satisfy their own needs (Agricultural Sustainability Institute, California).

These objectives must be pursued and achieved in parallel by facing the consequences related to climate change; the forecast statistical models developed for the next 30 years estimate an increase of 1.5 - 2.5 ° C in the average annual temperature, presumably leading to an advance of the various phenological phases of about 10-15 days.
In the long run, this new scenario will drastically change the physiology of plants causing phenomena of water shortages, shifting of phenological phases, oxidative effects on photosynthetic activity, imbalances in the synthesis of secondary compounds and greater virulence of pathogenic organisms.
Agriculture lives and thrives on the basis of the climate and the external environment, and for this reason it has always had to face the issues related to climate change at the forefront. The progressive increase in temperatures will lead to an elongation of the vegetative cycle of the plants but at the same time will also favor the biological cycles of pathogens and insects, in some cases increasing their virulence / aggressiveness towards host plants.

The answers and solutions to this scenario cannot be, as has happened in recent decades, exclusive to chemistry; by doing so, the goal of sustainability would fail but above all it would compromise the future of the generations to come.
The impact of agriculture on the environment is currently very high especially in terms of the use of plant protection products (**tables 1**, **2** and **3**). A very worrying scenario that has prompted the European Commission to issue increasingly restrictive rules with the aim of halving the use of protection products by 2025.

STATE	2011	2014
GERMANY	43.856	46.078
SPAIN	73.112	78.818
FRANCE	61.336	75.288
ITALY	70.250	64.071

Table 1: consumption in tonnes of plant protection products in the EU (Eurostat, 2011-14).

YEAR	COMMERCIAL FORM	ACTIVE SUBSTANCES
2002	167.000	95.000
2013	118.000	56.000
2015	136.000	63.000

Table 2: consumption in tons of plant protection products in Italy (Eurostat, 2002-15).

REGIONS	FUNGICIDES	INSECTICIDES AND ACARICIDES	HERBICIDES	PHYTOSANITARY PRODUCTS AND VARIOUS ACTIVE SUBSTANCES*	TOTAL
ITALY	54.536	22.410	21.066	18.795	116.808
NORTH	31.044	13.001	14.191	6.109	64.347
CENTER	6.574	1.884	2.053	2.971	13.484
SOUTH	16.917	7.524	4.820	9.713	38.976

Table 3: distribution for agricultural use of phytosanitary products in Italy (* the item includes organic products [Istat, 2017]).

THE ADVANTAGES OF THE MODERN RESISTANT VARIETIES

- Net **REDUCTION** in the use of pesticides
- Protection of the **HEALTH** of operators and citizens
- **HEALTHY** final product
- Greater **ENVIRONMENTAL SUSTAINABILITY**
- **REDUCTION OF PRODUCTION COSTS**
- Aid to the expansion of **ORGANIC VITICULTURE**
- Concrete response to **CLIMATE CHANGE**

CONCEPT OF RESISTANCE / TOLERANCE

Plants can be **IMMUNE**, **RESISTANT** or **TOLERANT** in response to the pathogen.

- **IMMUNE** plants are not recognized by the pathogen.
- **RESISTANT** plants carry one or more specific resistance genes to a pathogen, often based on the recognition and reaction of hypersensitivity / programmed cell death (Agrios, 2005.)
- **TOLERANT** plants do not carry specific genes for the pathogen, but make it difficult to access, spread or multiply (thick epidermis, presence of hair, plant compounds that interfere with the metabolism of the pathogen, etc.).

For the vine, the genetic improvement programs of the last 50 years have focused on the creation, through crossing and selection, of new varieties resistant to downy mildew and powdery mildew, the main diseases of this species both in terms of diffusion and damage caused.

▼ : Pathogen recognition and activation of the immune response

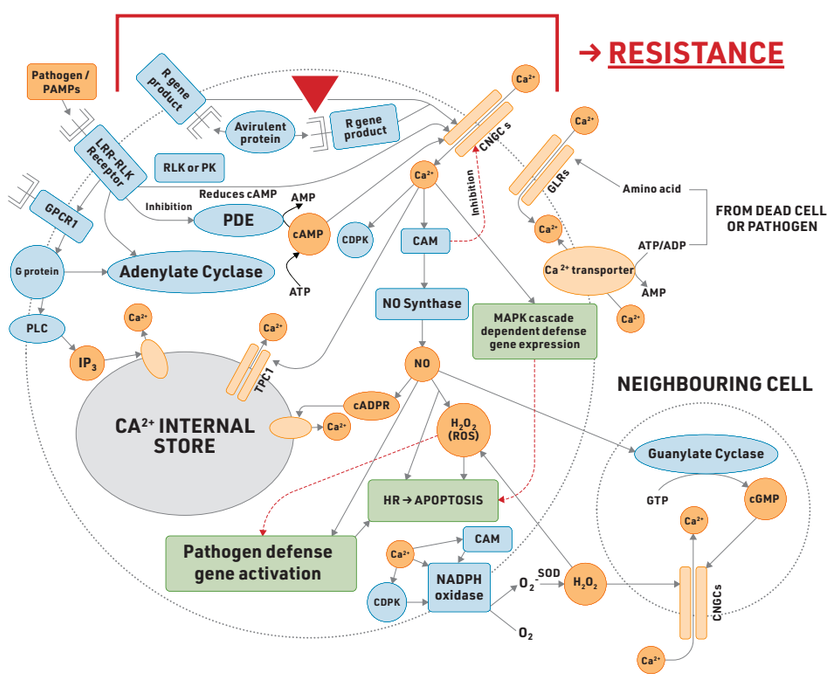


Figure 1: the presence, in resistant varieties, of specific resistance genes allows the recognition of avirulence factors of the pathogen and the activation of the mediated immune response [hypersensitivity response and activation of pathogenetic proteins] (from Ma W., 2007).

THE PHYTOSANITARY PROTECTION OF RESISTANT VARIETIES

TO SET A CORRECT PROTECTION OF RESISTANT VARIETIES IT IS NECESSARY TO TAKE INTO CONSIDERATION THAT:

1 All resistant varieties, in relation to the resistance genes present and their specific functioning in certain pedo-climatic conditions, exhibit different levels of effectiveness.

2 These varieties can still show spots and / or necrosis of downy mildew and / or powdery mildew but, unlike traditional varieties, the resistance genes present in them will allow the rapid recognition of the pathogen and the activation of specific defense mechanisms aimed at blocking the course of the disease.

3 Depending on the specific pedo-climatic conditions and, depending on the trend of the vintage, the use of these varieties allows for a significant reduction in the number of phytosanitary treatments but does not allow their complete elimination.

4 This concept is of fundamental importance in order to avoid the accumulation of inoculum and the appearance of new strains capable of overcoming the resistance of the vine and becoming highly aggressive.

5 The recommended treatments are also used to avoid the appearance of other diseases (black rot, dead arm, etc.) controlled by the treatments against downy mildew and powdery mildew in traditional vineyards.

In general, taking into account the many pedo-climatic variables intrinsic to each microclimate, **the use of varieties resistant to downy mildew and powdery mildew can allow a reduction of phytosanitary product use equal to about 70% compared to those necessary for conventional varieties in the same vineyard**. In order to limit the number of interventions as much as possible and at the same time to favor their effectiveness, **it is strongly recommended to use forecasting models designed to identify the periods of greatest infectious risk**.
These preventive treatments are of fundamental importance both in order to avoid the appearance of hypervirulent / highly aggressive fungal strains and to ensure effective control of the main secondary diseases, in particular dead arm (*Phomopsis viticola*) and black rot (*Guignardia bidwellii*).
The correct phytosanitary management of resistant varieties must begin by taking into consideration all the intrinsic characteristics and criticalities of each territory but, above all, **must be set on the basis of vineyard histories concerning the number of treatments carried out on average and the incidence of individual pathogens in the different microareas**.
The use of these varieties and the consequent reduction in the number of total treatments must not exempt them from carrying out the treatments in the best possible way (proportional dosage, accurate coverage, possible use of recovery atomizers, etc.).

TECHNICAL TIPS

As is normally the case for traditional varieties, for effective and advantageous phytosanitary management of resistant varieties it is necessary:

- Know the specific degree of resistance of the variety (for example presence of one or more resistance genes to the same pathogen and type of genes present).
- Take into account, based on previous experience, the specific climatic conditions of the year and the area in which you operate, as these variables can significantly influence the resistance of the plant and the virulence of the pathogen.
- In the presence of inoculum, due to infections of previous years, it is necessary to implement early treatments and a more careful and prolonged management of the disease.
- The elimination of mummified clusters and / or wasted plants is a necessary and useful practice in combating secondary diseases.
- Manage fertilization and water availability in order to ensure the right vegetative-productive balance.
- Use crop protection products in rotation, preferably with multisite action, with a broad spectrum and with a different mechanism of action.
- Carry out treatments against dead arm, black rot, botrytis and parasitic / vector insects as in traditional management.
- In planting programs, the use of different resistant varieties allows to raise the resilience degree of the vineyard, due to the simultaneous presence of different resistance genes on the same variety or on adjacent varieties.

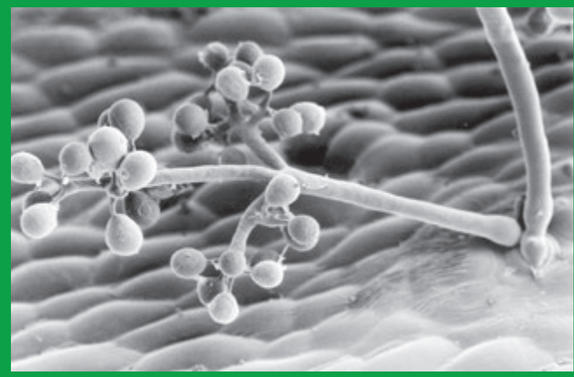
"We strongly believe in these varieties: our new cellar, aimed at the exclusive vinification of grapes from resistant vineyards, is a tangible sign of it"

Alessio and Stefano Gri
3zero.it

DESCRIPTION OF CRYPTOGAMIC DISEASES

Vitis vinifera Europea, as well known, did not develop resistance to powdery mildew (*Uncinula necator*) and downy mildew (*Plasmopara viticola*) since, until the end of the 1800s these diseases were not present in Europe and in the absence of infectious pressure it was not necessary to express any form of resistance, which instead happened in America for American vines and in Asia for Asian ones.
Oomycete *P. viticola* (downy mildew) is native to North America and was introduced in Europe in the second half of the nineteenth century, following the importation of American vines used for the reconstruction of European vines destroyed by phylloxera. Downy mildew appeared for the first time in France in 1878 and the following year it was identified for the first time in Italy. The disease spread rapidly throughout Europe, to Turkey and the wine-growing areas of southern Russia, and later to Africa.
Similarly, to what happened with downy mildew, the causative agent of powdery mildew was also introduced to the old continent from North America; the disease was reported in France in 1847 and since then spread rapidly in the various European wine-growing regions, to the point that in the years 1850-1851 it was present throughout the Mediterranean basin, where it caused considerable damage to production.
Other diseases, defined as secondary, such as black rot and dead arm, can attack the European vines in more or less aggressive and harmful forms depending on the soil-climatic conditions and varietal susceptibility. *Guignardia bidwellii*, the causative agent of black rot, also originally from America, was found and described for the first time in France in 1855. Much later it was also identified in some wine-growing areas of northern Italy and, subsequently, in Central Italy. The disease, currently also present in France, Switzerland and Croatia, is spreading to other areas characterized by hot-humid climatic conditions.
In the same historical period (late nineteenth century) another fungal disease also appeared in Europe, the dead arm, which spread in the following years in various countries including Italy.
Like all varieties of *Vitis vinifera*, even the new varieties resistant to downy mildew and powdery mildew have a certain susceptibility to black rot (*Guignardia bidwellii*) and dead arm (*Phomopsis viticola*). This knowledge is fundamental in the planning of phytosanitary protection programs especially in the areas historically predisposed to the presence of these pathogens. In pedo-climatic situations favorable to the development of the disease, the containment of these microorganisms, in particular with regards to the black rot, must be implemented in a preventive form and not only after the manifestation of the first symptoms, in order to limit as much as possible, the presence of inoculum.
The fight against downy mildew and powdery mildew, initially conducted through the exclusive use of copper and sulfur, has subsequently exploited the numerous synthetic molecules made available by chemistry in recent decades. The research and development of new active substances, more and more performing, has facilitated the control of these two pathogens, consequently favoring the development of our viticulture.
The uncontrolled use of these products, however, has selected resistant strains of downy mildew and powdery mildew within the populations that are difficult to control even through the use of the most sophisticated and effective active ingredients.
Considering the very high costs that the manufacturers are required to bear for the registration of new molecules, the continuous revocation of the active ingredients currently available and the increasingly stringent limits imposed by the rural police regulations, the use of varieties resistant to downy mildew and powdery mildew can result one of the main solutions for our viticulture.

Figure 2: sporangiophore branch of *P. viticola* emerging from the stomata, on the underside of a vine leaf.



DOWNY MILDEW
(PLASMOPARA VITICOLA)

STANDARD CONDITIONS FAVORABLE FOR INFECTION

Average daily temperature ≥ 10 °C, rainfall in the last 24-48 hours ≥ 10 mm and the presence of shoots of at least 10 cm. For the initiation of secondary infections, one has to keep in mind that the phenological requirements for plant development and the minimum temperature conditions are practically always respected and that such infections can also start following precipitation of less than 10 mm.

GUIDELINES

- Recommended interventions in conjunction with maximum infectious pressure (recurrent rains) and at least one in pre-flowering.
- Restraining vigor and excesses of production allows the plant to concentrate more lignin in the cell walls making it more resistant.
- In years that are particularly favorable to the pathogen, the application of a late treatment is recommended to avoid the onset of attacks on the lateral shoots (more receptive leaf) and to ensure complete lignification of the main shoots.
- Pay more attention to varieties with moderate or medium resistance.
- Use multisite products during periods of maximum infectious pressure.

CONVENTIONAL DEFENSE

- Use cover products (dithiocarbamates / copper) in the initial (budding) and final phases of the season (veraison).
- Use products that bind to the cuticular wax of the leaves before strong and repeated rain events to limit their washout.
- Use systemic / cytotropic / translaminar active ingredients in the periods of maximum vegetative growth and strong virulence of the pathogen.

BIOLOGICAL DEFENSE

- Copper is still the main product that can be used in organic farming. It is of fundamental importance, in order to reduce its use and maximize its effectiveness, one should know how to choose the most suitable formulation according to the pressure and the meteorological trend:
- Hydroxide = speed of action (++ / +++) persistence (+ / ++). Oxychloride = speed of action (++) persistence (++). Bordeaux mixture = speed of action (+) persistence (+++). Cuprous oxide = speed of action (+++) persistence (+++).
- Alternative / complementary products are represented by zeolite (prolongs copper activity and decreases leaf wetness time), resistance inducers such as laminarins, yeast extracts, chitosan and horsetail.

VARIETIES TO BE MANAGED WITH GREATER CARE

- Sauvignon Rytos®.

Figure 3: epidemiological cycle of grape **downy mildew** (modified from Goidanich, 1964).

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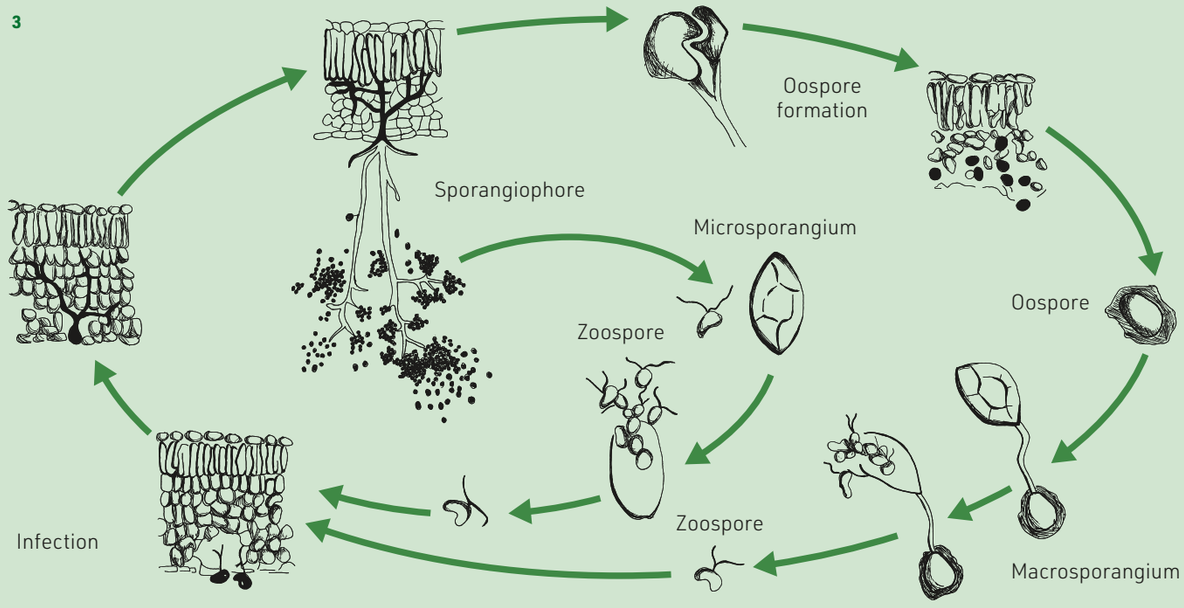

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Figure 4, 5, 6, 7: typical symptoms of **downy mildew** on bunches, leaves and bunches on lateral shoots.

POWDERY MILDEW
(UNCINULA NECATOR)

STANDARD CONDITIONS FAVORABLE FOR INFECTION
Temperature range between 6 and 35 ° C with an optimum at 20-25 ° C and high relative humidity values (at least ≥ 20%). Leaf wetness and rainfall in general represent limiting factors.

GUIDELINES
- Interventions concentrated in the most susceptible phenological phases (flowering-fruit set-veraison) and in the periods most favorable to the biological cycle of the pathogen.
- In situations of high disease pressure, it is advisable to intervene early (2nd-3rd leaf) reducing the presence of fungal inoculum.
- Late infections must undergo curative treatment in order not to carry a large amount of inoculum the following spring.
- Pay attention to the defense especially in the varieties with moderate / medium resistance.

CONVENTIONAL DEFENSE
- Wettable sulfur is recommended in periods of low susceptibility (budding).
- Specific products such as IBS (inhibitors of sterol biosynthesis), strobilurins, benzophenones, carboxamides, etc. are recommended from the fruit setting period to veraison.

BIOLOGICAL DEFENSE
- Wettable sulfur and powdered sulfur represent the main usable formulations.
- Orange oil and potassium bicarbonate can amplify the effect of sulfur treatment.
- *Ampelomyces quisqualis*, laminarin and yeasts can be used with the necessary precautions.

VARIETIES TO BE MANAGED WITH GREATER CARE
- Sauvignon Kretos®, Cabernet Volos®, Merlot Khorus® and Volturnis®.

Figure 8: Epidemiological cycle of **powdery mildew** in the vine.
(http://www.horta-srl.it/wp-content/uploads/2018/04/Rossi_oidio_DEMOdays_2018-ilovepdf-compressed.pdf).

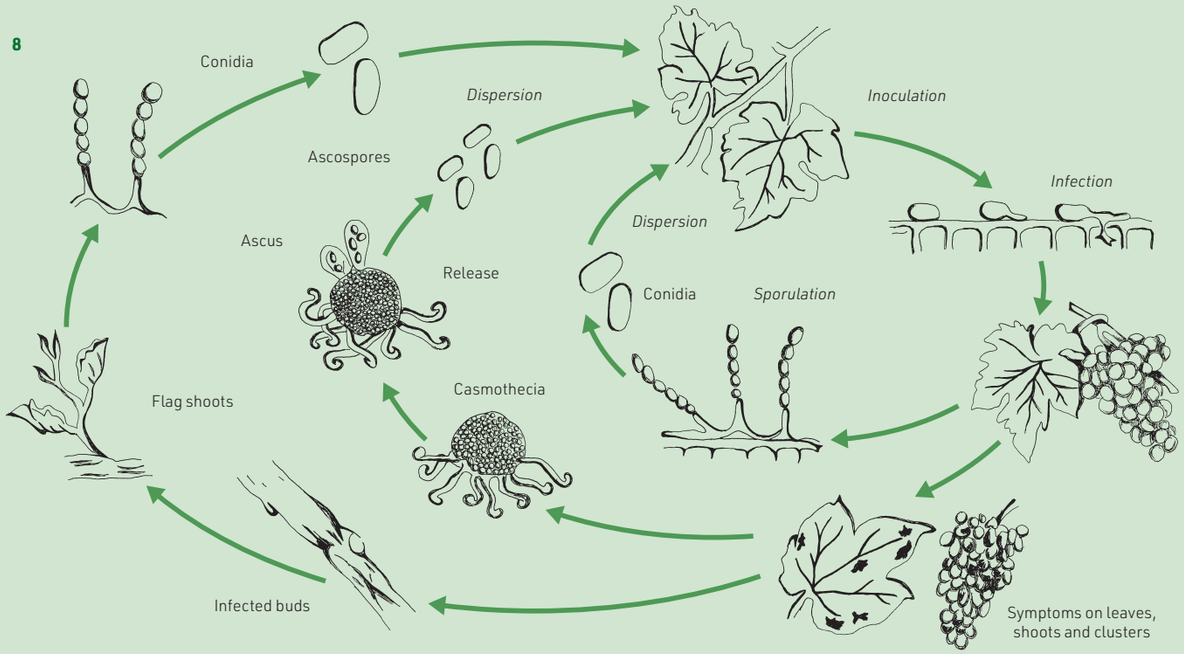


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Figure 9, 10, 11, 12: typical symptoms of **powdery mildew** on bunches, shoots, berries and leaves.

BLACK ROT
(GUIGNARDIA BIDWELLII)

STANDARD CONDITIONS FAVORABLE FOR INFECTION
Leaf wetness of at least 6 hours and temperatures between 9 and 32 ° C (optimum at 20-25 ° C). Hot and dry climates are unfavorable to the course of the disease.

GUIDELINES
- Applications in pre-post flowering of broad-spectrum products (with anti-downy mildew and anti-powdery mildew mode of action).
- In the presence of pedo-climatic conditions favorable to the pathogen, the vine is susceptible up to the phenological phase of veraison.
- Preventive and early interventions (shoots 2-5 cm in length) are indispensable in environments historically favorable to the pathogen.
- The susceptibility of the clusters is maximum from flowering up to the following two weeks.
- Burning / eliminating of mummified clusters (pay attention to mechanical harvesting).

CONVENTIONAL DEFENSE
- Dithiocarbamates have good activity and are recommended as preventive contact products for the first post-budding phases.
- Strobilurins (especially piraclostrobin and trifloxystrobin) are recommended in the grape growth phase where they perform preventive and curative activity on the bunch given their affinity to the waxes present on the skin [action on both black rot and downy mildew].
- Triazoles (especially difeconazole) are recommended in the phases between pre-flowering and fruit set.

BIOLOGICAL DEFENSE
- The association of copper and sulfur significantly improves the preventive efficacy against Black rot (Le Roux, 2015).

VARIETIES TO BE MANAGED WITH GREATER CARE
- Sauvignon Kretos®, Merlot Kanthus®, Merlot Khorus®, Cabernet Volos® and Soreli®.

Figure 13: epidemiological cycle of **black rot** (modified from Wayne, 2003).

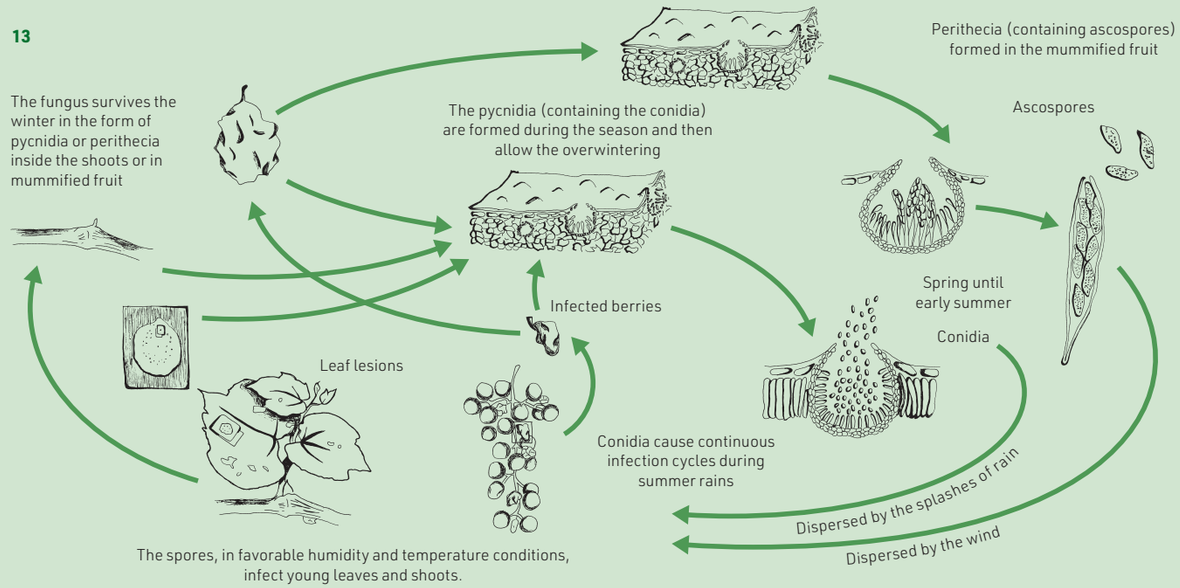


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Figure 14, 15, 16, 17: symptoms of **black rot** on the shoot, leaf, bunch and berry.

DEAD ARM DISEASE
(PHOMOPSIS VITICOLA)

STANDARD CONDITIONS FAVORABLE FOR INFECTION
Leaf wetness of at least 6 hours and relative humidity of about 95%. Sporulation is particularly abundant in spring and decrease over the course of the year.

GUIDELINES
- It is advisable to carry out a treatment at the phenological stage of 2-3 true leaves.
- In areas and in years favorable to the disease, evaluate the possibility of performing a second treatment after about 10 days.
- As the year continues, the anti-downy mildew interventions are sufficient for adequate control of the disease.

CONVENTIONAL DEFENSE
- Dithiocarbamates are the most effective products in controlling the disease.

BIOLOGICAL DEFENSE
- Sulfur is the only active ingredient that is truly effective in the biological fight against dead arm disease.

VARIETIES TO BE MANAGED WITH GREATER CARE
- Soreli®, Sauvignon Kretos®, Cabernet Volos® and Merlot Khorus®.

Figure 18: epidemiological cycle of **dead arm**
(modified from Associação para or Desenvolvimento from Viticultura Duriense [ADVID], 2010.

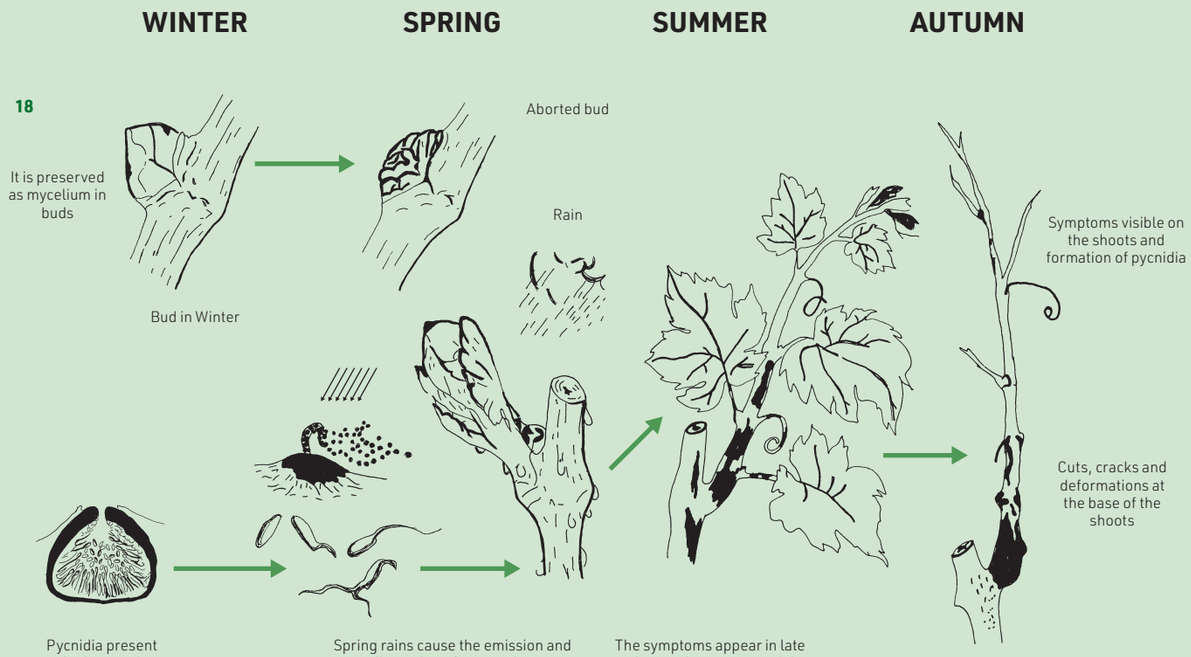


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Figure 19, 20, 21, 22: typical symptoms of **dead arm** on berries, leaf and shoot.

PROTECTION STRATEGY OF RESISTANT VARIETIES

	PRECIPITATION (MM)				CONVENTIONAL VARIETIES								RESISTANT VARIETIES							
					DOWNY MILDEW				POWDERY MILDEW				DOWNY MILDEW				POWDERY MILDEW			
MONTH	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**	**2016**	**2017**	**2018**	**2019**
APRIL	3	36	45	185	3	2	1	3	3	2	1	3								1
MAY	78	111	53	313	3	3	3	4	3	3	4	4	1		1	1	1		1	
JUNE	169	136	54	44	4	4	3	3	4	4	3	3	1	2		1	2	2	1	2
JULY	161	19	52	122	2	2	3	3	2	2	3	3	1		1	1		1	2	1
AUGUST	430	32	62	136	2	1	1	2	1	1	1	1				1				
TOTAL	841	334	266	800	14	12	11	15	13	12	12	14	3	2	2	4	3	3	4	4
% RESISTANT VS. CONVENTIONAL													**-78%**	**-83%**	**-82%**	**-73%**	**-77%**	**-75%**	**-67%**	**-71%**
4-YEAR AVERAGE													**-75%**							

Table 4: comparison of the phytosanitary protection in the 2016, 2017, 2018 and 2019 vintages on traditional / conventional varieties and on resistant varieties in Fossalon di Grado (Gorizia).

	2-5 LEAVES*	PRE-FLOWERING OR FLOWERING	BERRY GROWTH	RIPENING
DISEASES	▸ Erinose ▸ Phomopsis ▸ Black rot	▸ Downy mildew ▸ Powdery mildew ▸ Black rot	▸ Downy mildew ▸ Powdery mildew ▸ Black rot	▸ Botrytis
PRODUCTS	▸ Dithiocarbamates (Metiram, Folpet) ▸ Sulfur	▸ Dithiocarbamates (Metiram, Folpet) ▸ Dimetomorf**, Copper*** ▸ Sulfur and/or Methyl Dinocap	▸ Dithiocarbamates (Metiram, Folpet) ▸ Dimetomorf**, Copper*** ▸ Strobilurins (Trifloxystrobin) ▸ Triazole (Difenoconazole)	▸ Boscalid**** ▸ Potassium bicarbonate**** ▸ Tebuconazole + Fluopyram*****
ORGANIC VITICULTURE	▸ Sulfur, Copper***	▸ Sulfur, Copper*** ▸ Inducers of resistance	▸ Sulfur, Copper*** ▸ Inducers of resistance	▸ Inducers of resistance

Table 5: main active substances that can be used in the phytosanitary protection of resistant varieties.

* Early intervention in particular areas / vintages. ** In the case of heavy rain events. *** Copper from tribasic sulphate.
**** Recommended for its anti-powdery mildew action (pay attention to the periods of micro elements' shortage and residues).
***** Anti-powdery mildew product with collateral activity on botrytis.

PROTECTION STRATEGY OF RESISTANT VARIETIES IN ORGANIC VITICULTURE

AS WELL KNOWN, THE BIO MANAGEMENT OF THE VINEYARD IS VERY COMPLICATED IN THE AREAS WITH CLIMATIC CONDITIONS PREDISPOSING TO DISEASES AND / OR IN CONCOMITANCE OF IMPORTANT AND LONG-LASTING PRECIPITATIONS (KHAFIZOVA ET AL., 2019). EARLY TREATMENTS AGAINST BLACK ROT EXPLAIN A CERTAIN EFFECTIVENESS EVEN AGAINST DOWNY MILDEW AND POWDERY MILDEW DEPENDING ON THE PRODUCTS USED.

	DISEASE	TREATMENT*	PROTECTION AGAINST BLACK ROT (LE ROUX, 2015)		
			VINEYARD WITHOUT SYMPTOMS	VINEYARD WITH SOME SYMPTOMS	VINEYARD WITH MANY SYMPTOMS
2-5 LEAVES	▸ Dead arm ▸ Powdery mildew	Sulfur	**COINCIDES WITH THE PROTECTION STRATEGY AGAINST DOWNY MILDEW AND POWDERY MILDEW**	From the maturity of the perithecians, before a suspected rainy contaminant episode with 300 g of copper and 6 kg of wettable sulfur	
7-10 DAYS AFTER**	▸ Dead arm	Sulfur		Repeat the treatment before the next rain, do not let it exceed 10 days	
BEFORE OR DURING FLOWERING	▸ Downy mildew ▸ Powdery mildew	Sulfur, Copper		Switch to 600 g of copper and 8 kg of wettable sulfur	
GROWTH OF BERRIES**	▸ Downy mildew ▸ Powdery mildew	Sulfur, Copper, Potassium bicarbonate[1]		300 g of copper and 6 kg of wettable sulfur / ha	
AFTER THE MAJORITY OF BERRIES TOUCHING**	▸ Downy mildew ▸ Powdery mildew	Sulfur, Copper, Potassium bicarbonate[1]		Coincides with the protection strategy against downy mildew and powdery mildew	300 g of copper and 6 kg of wettable sulfur / ha - last treatment against complete veraison

Table 6: possible biological protection strategy of resistant varieties for the containment of the main fungal diseases.

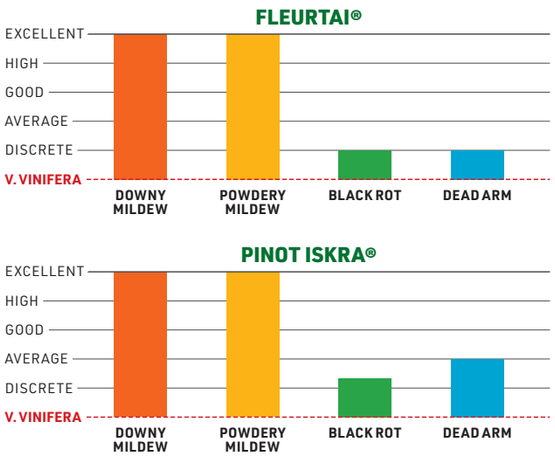
* The treatment, in conditions of high infectious pressure, must be carried out at the maximum dose of the label.
** Repeat treatments in case of high pressure of the disease.
[1] Action on botrytis and powdery mildew (be careful in periods of heavy rainfall due to easy washout).

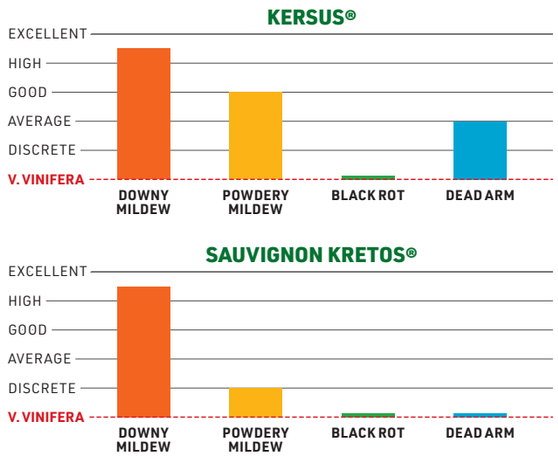
GIVEN ALL THIS...

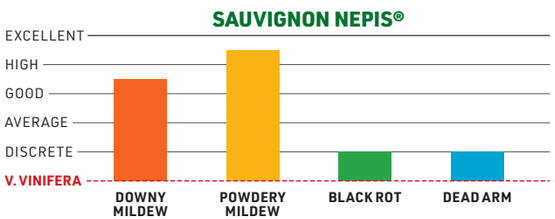
THE FIRST USEFUL REFLECTION TO DO IS TO UNDERSTAND HOW MANY TREATMENTS WILL HAVE TO BE CARRIED OUT. TO OBTAIN AN ACCURATE PHYTOSANITARY MANAGEMENT OF RESISTANT VARIETIES, ONE MUST NECESSARILY TAKE INTO CONSIDERATION THE HISTORICAL AVERAGE OF THE TREATMENTS PERFORMED ON THE VINEYARD, CONSIDERING THAT THE USE OF THESE VARIETIES CAN ALLOW A REDUCTION BETWEEN 60% AND 80% DEPENDING ON THE PEDO-CLIMATIC CONDITIONS PRESENT.

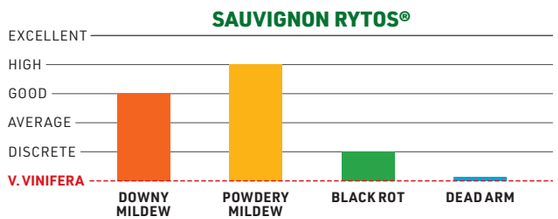
DEGREE OF RESISTANCE OF VARIETIES

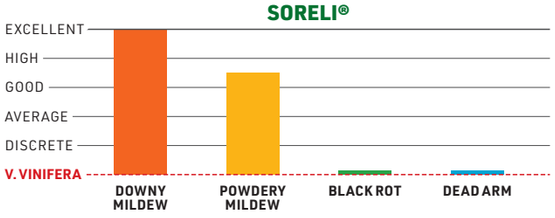
The UNIUD / VCR varieties have different degrees of resistance to powdery mildew and downy mildew and susceptibility to secondary diseases as described below:

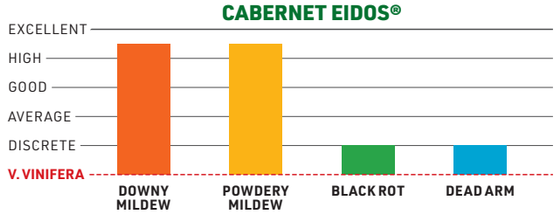


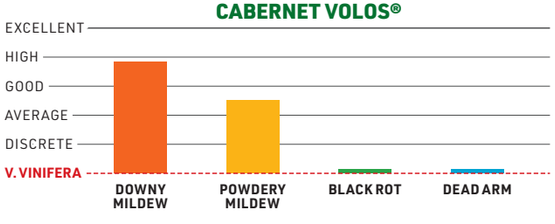


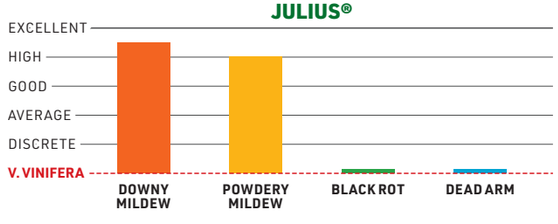






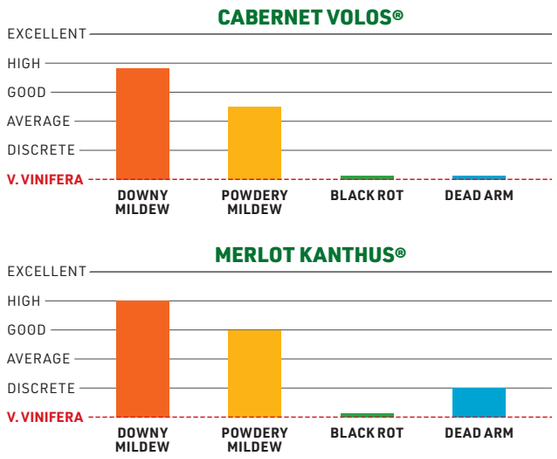


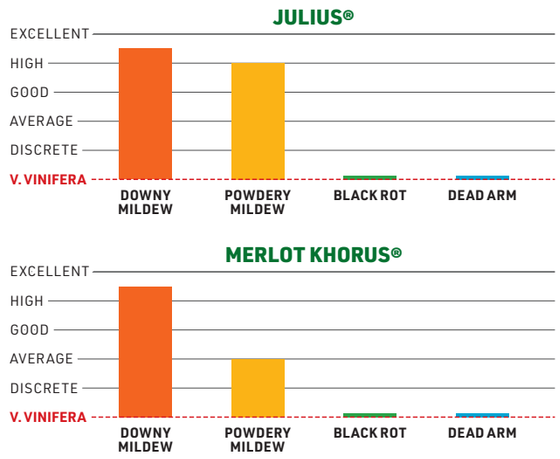


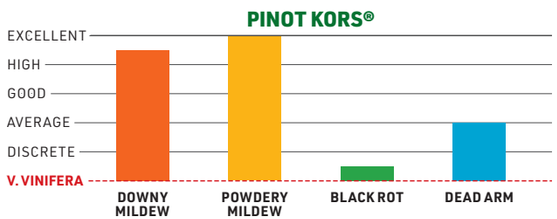


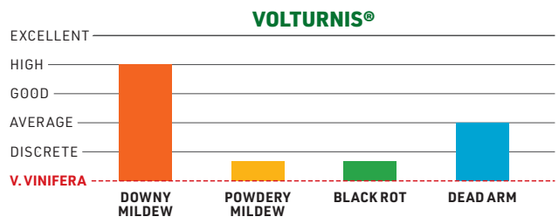
NOTES NOT TO FORGET FOR CORRECT MANAGEMENT OF RESISTANT VARIETIES

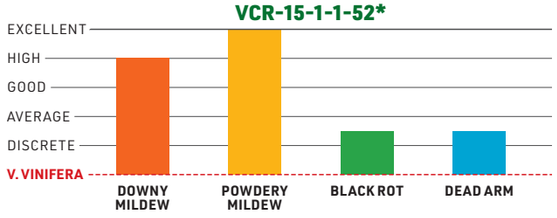
SORELI®: attention to dead arm and black rot.
SAUVIGNON KRETOS®: careful management of powdery mildew.
SAUVIGNON RYTOS®: careful management of botrytis.
MERLOT KANTHUS®: attention to black rot and magnesian chlorosis.

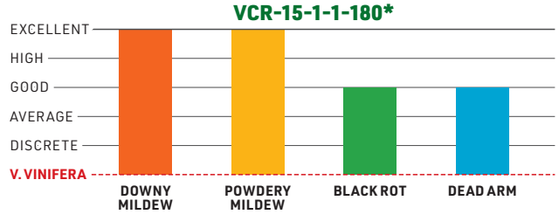


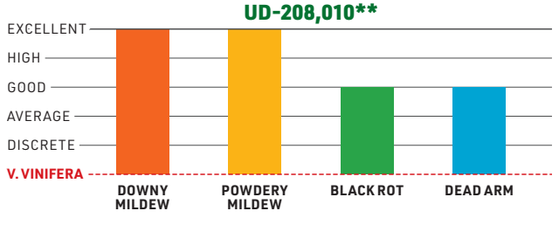












* Variety obtained from the cross with Glera, data being validated
** Variety obtained from the cross with Traminer, data being validated

RESISTANCE GENES / QTL

BREEDER'S REFERENCE	NAME	NOBLE PARENT	RESISTANCE DONOR	RESISTANCE GENES PRESENT					
				DOWNY MILDEW			POWDERY MILDEW		
				RPV1	RPV3	RPV12	RUN1	REN3	REN9
34.111	Fleurtai®	Tocai friulano	20/3	-	-	+		+	+
34.113	Soreli®	Tocai friulano	20/3	-	+	+	*		
76.026	Sauvignon Kretos®	Sauvignon	20/3	-	-	+	*		
55.098	Sauvignon Nepis®	Sauvignon	Bianca	-	+	-		+	+
55.100	Sauvignon Rytos®	Sauvignon	Bianca	-	+	-		+	+
58.083	Cabernet Eidos®	Cabernet Sauvignon	Bianca	-	+	-	*		
32.078	Cabernet Volos®	Cabernet Sauvignon	20/3	-	-	+	*		
31.125	Merlot Khorus®	Merlot	20/3	-	-	+	*		
31.122	Merlot Kanthus®	Merlot	20/3	-	+	-	*		
36.030	Julius®	Regent	20/3	-	-	+		+	+
109.033	Pinot Iskra®	Pinot Bianco	SK-00-1/7	+	-	+	+	+	+
109.052	Kersus®	Pinot Bianco	SK-00-1/7	-	-	+		+	+
156.537	Pinot Kors®	Pinot Nero	99-1-48	+	-	+	+	-	-
156.312	Volturnis®	Pinot Nero	99-1-48	-	-	+	*		
156.869	Being defined	Pinot Nero	99-1-48	-	-	+	*		
156.1017	Being defined	Pinot Nero	99-1-48	+	-	+	+	-	-
156.680	Being defined	Pinot Nero	99-1-48	+	-	+	+	-	-
VCR-15-1-1-52	Being defined	Glera	SK-00-1/7	+	+	+	+	+	+
VCR-15-1-1-180	Being defined	Glera	SK-00-1/7	+	+	+	+	+	+
UD-208,010	Being defined	Traminer	SK-00-1/10	+	-	+	+	+	+

Table 7: list of resistance genes present in VCR-UNIUD-IGA varieties.
*: possible presence of DNA regions containing resistance genes not yet identified.

N.B.: some resistant varieties, as ascertained in these years of experimentation, even if they do not have resistance genes known and identified to date, however, carry out a certain degree of resistance towards pathogens. This most likely depends on the presence of minor QTLs (Quantitative Trait Locus) or as yet unknown QTLs that have resistance genes within them.

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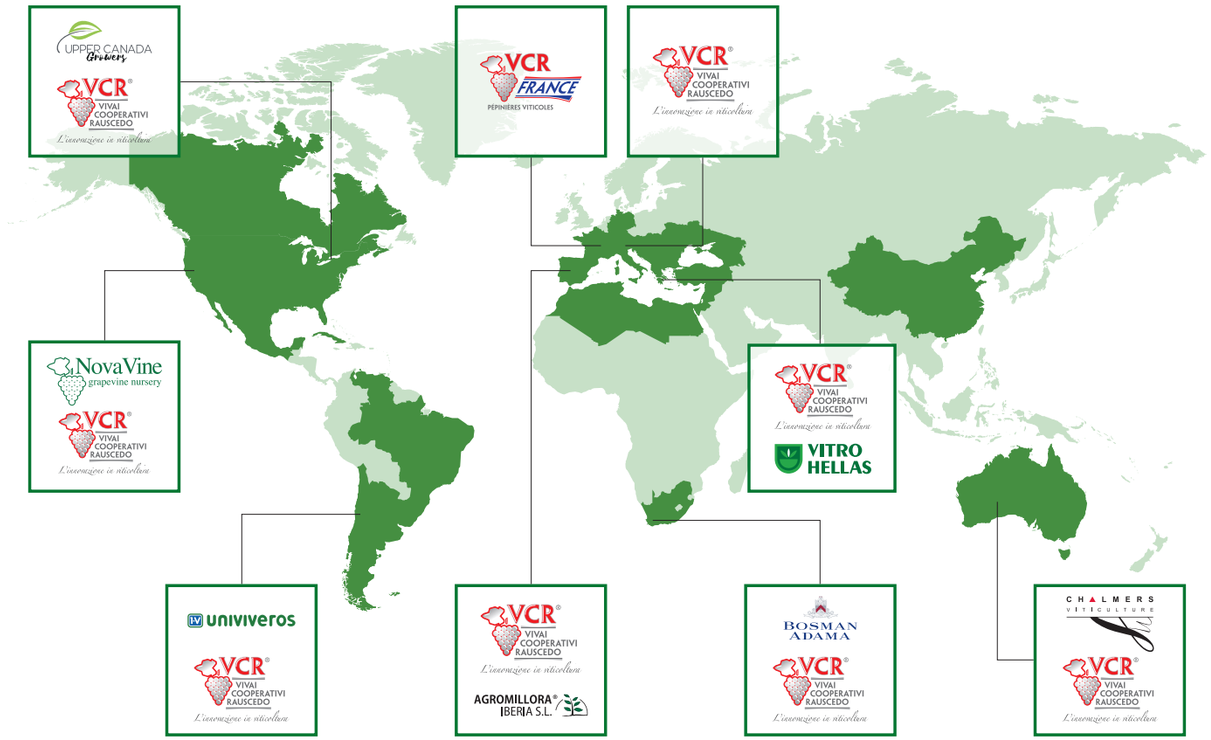
We are grateful to Dr. Olivier Viret, Agroscope, route de Duillier 50, CP 1012, 1260 Nyon, Suisse, who has kindly granted us the photographs.

N.B.: the data reported in the two publications by Belvini et al. cited above, whether they refer to resistance to primary and / or secondary diseases, or to agronomic parameters (cluster weight, production, quality, etc.) must be related to phytosanitary management used in said experiment. The test, in fact, did not foresee the implementation of any phytosanitary treatment in the first two years; this condition, although it did not cause direct damage to the crops in the first two years, favored the accumulation of inoculum of various fungal species which then began to manifest from the third year and inevitably influenced the average weight data of the bunch and production levels as well as on the incidence of secondary diseases.

VIVAI COOPERATIVI RAUSCEDO

Two thousand employees, two hundred and thirteen members, over 80 million grafted vines per year and presence in 30 countries around the world. These are the numbers of a company, Vivai Cooperativi Rauscedo, which has been able to transform a poor land into a prime district in the world for the production of grafted vines.
VCR was founded in 1920 at the base of the Carnic Prealps foothills. Since then the cooperative has grown consistently by encouraging individual independence while providing the benefits of a large cooperative. The foresight of adopting this model and the benefits of an ideal environment provided by soil composition and climate presented the ideal way for the company to develop.
Today Vivai Cooperativi Rauscedo operates on 1550 ha of rootstock mother plants; 1350 ha of scion mother plants; and 1200 ha of nursery.

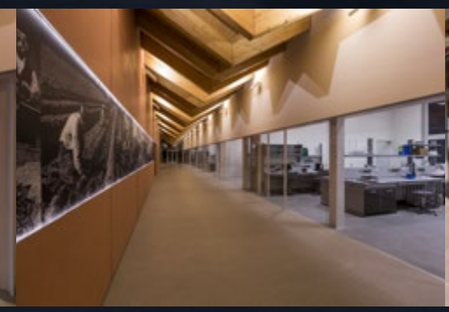
In 1965 the Experimental Centre 'VCR' was established to support this prodigious production and to clone the grapevine varieties cultivated in Italy and abroad.
Today there are almost 400 licensed clones, anticipated to reach 900 in the near future. The ongoing strategy is to offer new disease resistant varieties and new generation rootstocks that will perform significantly better than those currently in use.
With this in mind, VCR has initiated a farsighted program of genetic improvement of the vine which will bring together all the world's scientific discoveries and innovations in the field of viticulture and enology.
Today, winegrowers can already have 14 resistant varieties and "M" rootstocks and thus create vineyards with high environmental sustainability capable of producing wholesome wines of impeccable enological level.

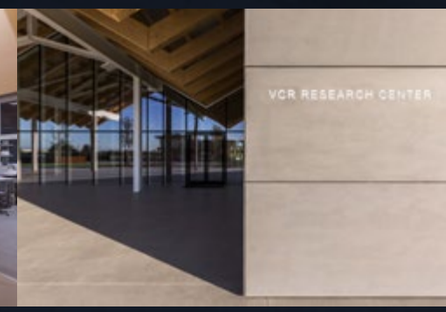


VCR RESEARCH CENTER

Research and innovation will increasingly represent the distinctive feature of VCR products, as evidenced by the opening of the new "**VCR RESEARCH CENTER**" equipped with eight hyper-technological laboratories where all control, research and development activities will be enhanced and perfected. Inside, equipped with the latest generation tools and machinery, there are specific rooms used for immunoenzymatic and bio-molecular diagnostics, micropropagation, tissue culture, embryo rescue, microscopy and the development of chemical-physical protocols ad hoc for any future need.

This important and far-sighted investment of resources made by the VCR aims to ensure, to all winegrowers, innovative and advantageous solutions that meet the real needs of the wine sector and that represent concrete help for all future challenges.
The widespread use of all these techniques in every single production process will allow VCR to further raise the quality and health status of their grafted vines in compliance with all the constraints imposed by the nursery-viticultural legislation in force.





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