Project LIFE16 ENV/IT/000566 LIFE GREEN GRAPES

life GREEN GRAPES

New approaches for protection
in a modern sustainable viticulture:
from nursery to harvesting

REPORT

RESULTS OF APPLICATION PROTOCOLS

FOR ORGANIC TABLE GRAPE - CYPRUS

2nd Experimentation year 2019

Action B.5.

CREDITS

This Report has been elaborated by technical and scientific partners of the LIFE GREEN GRAPES project:

CUT Cyprus University of Technology (CY)

In cooperation with

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SUMMARY

REPORT RESULTS OF APPLICATION PROTOCOLS IN VINEYARDS FOR THE PRODUCTION OF ORGANIC TABLE GRAPES (Cyprus)

Second YEAR – 2019 – CYPRUS - Deliverable ACTION B.5: Demonstration of the effectiveness of protocols (treatments and management techniques) in vineyards for the production of organic table grapes (CYPRUS)

Abstract

Grapevine cultivation is among the most important cultivations in Cyprus, mostly for wine production but also for table grape production. From the beginning of this century, few table grape growers in the South – West are of the island (Alectora), decided to transform old conventional vineyards in to organic. This transformation was not easy since they had to face distractive diseases such as Downy mildew, Powdery mildew and Botrytis with the use of Copper and Sulfur in order to get a good quality final production. The forbiddance of chemical fungicides improved the micro ecosystem within the vineyards but in case of epidemic outbreaks, the use of Copper and Sulfur was not enough. In order to face these problem, some natural products (Biostimulants), believed to induce or improve the natural (genetic) resistance of the vine plants against disease, aiming to promote the "immune system" of the plants and thus make the plants more tolerant or resistant to diseases.

LIFE GREEN GRAPES is a demonstration project aiming to improve the pest control response of grape varieties using innovative natural products and increasing the microbial biodiversity associated to vines at both rhizosphere and leaf tissue level. The objective is to demonstrate and evaluate the effectiveness of application protocols of forecasting defense models (DSS) combined with foliar treatments on vine plants in both multiplication and production, based on the use of innovative products as resistance inducers/elicitors (Biostimulants). Biostimulants products were added to the organic pest control system used by a farmer in Alectora village, in order to minimize the use of copper and sulfur used as agrochemicals on grape vineyards. Biostimulants are tested on one table grape cultivar: *Sultanina* grown in South-West Cyprus (Alectora village – Zenonas Charilaou Vineyards), managed with three protocols: the Growers protocol (organic treatments, CY3) with no Biostimulants; the Growers protocol with a 50% reduction of treatments and Biostimulants addiction (CY2) and the Growers protocol with a strong treatments reduction and Biostimulants addiction (CY1). The following production parameters were detected: yield (kg per vine), TSS (°Brix). Data were implemented with Incidence and Severity of the principal disease on plants and fruits: Downy mildew (*Plasmopara viticola*), Powdery mildew (*Erysiphe necator*) and Botrytis (*Botrytis cinerea*). From all three treatments, samples were analyzed for the detection of chemical residues. Finally, soil, roots and leaf samples were shipped to CREA for micro- and fauna analysis.

Introduction

This report contains the overall presentation of the implementation of **the second year of testing of application protocols (treatments and management techniques) in vineyards for the production of organic table grapes (CYPRUS)** made in the 2018-2019 season, as required by **Action B.5. of the Life GREEN GRAPES Project.**

The document presents all the elements and conditions that have characterized the specific demonstration application, starting from the description of the experimental fields and the protocols defined in the start-up phase of the application in the field, up to the presentation of the implementation methods, the monitoring carried out and the results found at the end of the year.

The effectiveness of Green Grapes protocols has been evaluated by monitoring the three main foliar and cluster diseases (downy mildew, powdery mildew and botrytis) throughout the phenological cycle of the grapes and for Grapevine Trunk Diseases during the pruning period.

During harvesting, clusters are collected and send to the CUT laboratory in order to determine various parameters regarding the berry and cluster size, weight, sugar content (Brix), as also chemical analysis for the

The overall data for each year are subjected to statistical analysis to highlight the differences obtained from the treatments on the quality and health of the final products, in the specific case for the organic table grapes produced in vineyards in production, and to highlight the differences obtained in terms of quality, quantity, biodiversity and environmental impacts within the various experimental plots set at the participating field trials.

The analysis of the results of each year supports the identification of the best feasible strategies for a viticultural and nursery production with low environmental impact in the different stages of the productive chain and progressively allowing to verify and develop suitable management protocols for the different realities and products, in order to replicate the results obtained.

On the basis of these analyses, the ability of companies to implement strategies and the validity of protocols and tools for monitoring results is progressively evaluated. Through the Green grapes project we intend to minimize further the application of chemicals in organic table grape production following the new rules and legislations of the EU, with emphasis on the reduction of copper, with the use of DSS (Decision Support System forecasting defense models). In Cyprus, the use of forecasting models or support systems to diseases (DSS) is of limited use because of the limited surfaces of agricultural areas, and also the lack of active services monitoring. The careful use of meteorological data can still be a valid support in the management of decisions.

Characteristics of experimental fields for the production of organic table grapes at Cyprus University of Technology

The action B.5. concerned activities carried out in the management of ZENONAS CHARILAOU ORGANIC VINEYARD located in ALECTORA in the municipality of LIMASSOL in CYPRUS. Zenonas Charilaou is one of the most experienced Table grape growers in Cyprus, cultivating ≈15ha of the variety Sultanina all as organic production. The vines are more than 60 years old and have a "CUP" shape (fig. 1). The grapes are irrigated only in dry seasons and harvesting periods is in late July and early August. The grapes are packed and shipped to European Countries, mostly in Germany.

Fig 1. Sultanina table grape during maturation phase

For the needs of Life Green Grapes, CUT used 1,5 ha of Zenonas Charilaou vineyards. The 1,5 ha was divided into 3 plots (≈0,5ha each) in which the three protocols are applied (Fig. 2).

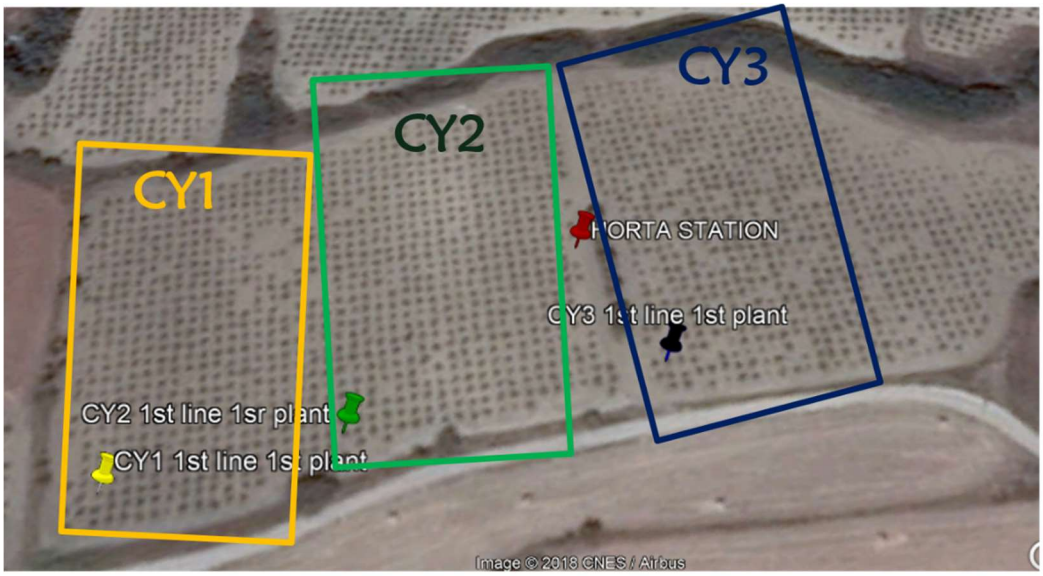


Fig 1. Image of the three grape vine plots located in Alectora village. CY1 = 100% reducing pesticides, CY2 reducing 50% of treatments with pesticides and CY3 = Organic following the TDRs.

Objectives of the demonstration application

The use of substances of natural origin (plant or microbial) in place of or in combination with the usual antifungal treatments can have a significant impact on the stimulation of the response of defence. In this direction but also the use of manure, thanks to its fundamental role in maintaining a good state of health of the

ground and therefore the capacity of the reaction of the plant to pathogens and parasites, can have an important role in the effectiveness of the defence.

In the management of biological defence there is a need to reduce the use of copper, following the EU regulations. For this purpose, we assess, also on table grapes bio and in an environment geographically very different (Cyprus and Italy), the use of leaf products of induction of resistance.

The second year (2019) application protocols

For the year 2019 we continued the second year of protocol application in the vineyard of Zenonas Charilaou in Alectora village. As CUT we participate in five actions: A, B, C, D and E. The Work package (WP) B5 which includes implementation actions for the definition and implementation of application protocols for foliar treatments on vine plants, in multiplication and production phases, based on the use of resistance inducers/elicitors (Table 1). The techniques were applied in the vineyard for the production of table grapes in Cyprus, aiming in the improvement of the effectiveness of the protocols and in the reduction of pesticides (exp. Cooper). WP B has 2 sections for CUT

B5. Demonstration of the effectiveness of protocols (treatments and management techniques) in BIO/ORGANIC vineyards for the production of table grapes (CY)
The Cyprus trial is divided in three different comparing protocols.
The 1st protocol (labeled CY3 in the field and in the DSS), is the organic farm protocol in which every treatment is done under the indication based on the Decision Support System advices.

The 2nd protocol (labeled CY2 in the field and in the DSS),is a 50% organic fungicide's one that means that the vineyard is supposed to be treated with half the amounts of fungicides at the end of the year.
For this purpose some different elicitor based products are introduced between normal spray fungicide's distributions. Since it is not possible to cut down the fungicide's labeled doses it was decide to reduce the amount of fungicides simply using the alternation between fungicides, applied at normal doses by label, and the elicitor products.

The 3rd protocol (labeled CY1 in the field and in the DSS), is a less than 50% organic fungicide's one, that means that we try to use fungicide's as less as possible, apart from the first two crop protection sprays as well as the second protocol too.

We started all the protocols simultaneously at first, using the same organic fungicides at the same dose and added in the protocol 2 and 3 an elicitor product accordingly.
From the third crop protection spray on we divide the standard organic crop protection from the innovative one, using elicitors (see protocol for 2019)
- in the second protocol (CY2) we avoid to spray fungicide unless necessary (based on DSS), and we used elicitors instead.

In action C (Impact monitoring actions), CUT is participating in three (3) sections:
C1. Monitoring the effectiveness of treatments (Observation, monitoring and analysis of the field trials)

C2. Socio-economic impact monitoring (measurement of environmental impacts on biodiversity, water, soil and use of pesticides for the quantification of benefits achievable by reducing the use of herbicides and pesticides in the vineyard for the production of table grapes (fresh and dry).
C3. Monitoring of the performance indicators verification and demonstration of environmental impact in terms of strengthening plants protections, reducing the use of agrochemicals, valorization of water resources, soil conservation, possible support to farms conversion to organic production and improving the quality of final products of the sector
In action D (Communication actions) CUT is participating in two (2) sections:
D1. Processing and production of dissemination materials and tools
D2. Implementation of the dissemination plan at local, national and European level
During action D for the year 2019, CUT presented LIFE Green Grapes to the general public in Cyprus, an event Organized by the Department of Environment, in the 2nd of June in Nicosia.

Application protocols for organic vine grapes in Cyprus

Table 1. Suggested protocol used for the 2019 applicationin Sultanina vineyards, Cyprus - Company Zenonas Charilaou , Alectora (Limassol), total area 1.5 hectares

Treat. N.	Phenological phase	Thesis description and doses expressed in kg / Ha		
		THESIS n.1	**THESIS n.2**	**THESIS n.3**
		Standard organic farm management according to DSS*	**Organic management with 50% reduction of fungicides added with elicitor use**	**Organic management with high reduction of fungicides added with elicitor use**
1	shoots length 5-10 cm	Copper kg 0,8 Ampelomyces quisqualis grams 40,6	Copper kg 0,8 Ampelomyces quisqualis grams 40,6 Dinamico Liters 2,5	Copper kg 0,8 Ampelomyces quisqualis grams 40,6 Dinamico Liters 2,5
2	Visible clusters	Copper kg 0,8 Sulphure kg 6,4	Copper kg 0,8 Sulphure kg 6,4 Dinamico Liters 2,5	Copper kg 0,8 Sulphure kg 6,4 Dinamico Liters 2,5
3	Separated bunches in lengthening	Copper kg 0,8 Sulphure kg 6,4	Pur'Avant Liters 1,5	Pur'Avant Liters 1,5
4	pre-flowering (floral buttons)	Copper kg 0,8 Sulphure kg 6,4	Copper kg 0,8 Sulphure kg 6,4	Pur'Avant Liters 2
5	Flowering	Copper kg 0,8 Sulphure kg 6,4	Frontiere 2.0 Liters 0,75 Oomisine kg 2 Evidence kg 2	Frontiere 2.0 Liters 0,75 Oomisine kg 2 Evidence kg 2
6	Fruit set	Copper kg 0,8 Sulphure kg 6,4	Copper kg 0,8 Sulphure kg 6,4	Frontiere 2.0 Liters 0,75 Oomisine kg 2 Evidence kg 2 Botrisine kg 3
7	Pepper grain grape	Copper kg 0,8 Sulphure kg 6,4	Dinamico Liters 2,5 Bio-D Liters 2	Dinamico Liters 2,5 Bio-D Liters 2
8	Grape growth/Pre-bunch closure	Sulphure kg 6,4 Zeolites kg 3	Sulphure kg 6,4 Zeolites kg 3	Dinamico Liters 2,5 Bio-D Liters 2
9	Bunch closure	Sulphure kg 6,4 Zeolites kg 3	Frontiere 2.0 Liters 0,75	Frontiere 2.0 Liters 0,75

		B. subtilis kg 2,5	Evidence kg 2 Botrisine kg 3	Evidence kg 2 Botrisine kg 3
10	Pre-veraison or starting veraison	Sulphure kg 6,4 Zeolites kg 3 B. subtilis kg 2,5 -	Pur'Apres Liters 2	Pur'Apres Liters 2
11	Veraison	Sulphure kg 6,4 Zeolites kg 3	Pur'Apres Liters 2 Zeolites kg 3	Pur'Apres Liters 2 Zeolites kg 3
12	End of veraison	B. subtilis kg 2,5 Zeolites kg 3	B. subtilis kg 2,5 Zeolites kg 3	Frontiere 2.0 Liters 0,75 Evidence kg 2 B. subtilis kg 2,5 Zeolites kg 3
13	Ripening	B. subtilis kg 2,5 Zeolites kg 3	B. subtilis kg 2,5 Zeolites kg 3	B. subtilis kg 2,5 Zeolites kg 3
14	Before harvesting	B. subtilis kg 2,5	B. subtilis kg 2,5	B. subtilis kg 2,5

*** The number of treatments can vary according to the indications of the DSS (decision support system).**

Application of the protocol in the second year

For 2019 we follow the protocol (Table 1), designed for Sultanina table grape in corporation with our partners in Green Grapes project. The protocol applied by CUT was timely corrected following the DSS reports, the notification alerts sent by the ministry of agriculture and the field monitoring by the CUT staff. The final applied protocol for all three treatments is presented in table 2.

Table 2. Protocol used for table Grapes Sultanina for the year 2019

No Treatments	Date	CY1 strong reduction		CY2 50% reduction		CY3 Organic	
		PRODUCT	DOSE Kg/ha	PRODUCT	DOSE Kg/ha	PRODUCT	DOSE Kg/ha
1	04/04/2019	Kocide	1.5	Kocide	1.5	Kocide	1.5
		AQ10	0.04	AQ10	0.04	AQ10	0.04
2	17/4/2019	Sulfur	4	Sulfur	4	Sulfur	4
		Kocide	1.5	Kocide	1.5	Kocide	1.5
3	24/4/2019	Sulfur	4	Sulfur	4	Sulfur	4
		Kocide	1.5	Kocide	1.5	Kocide	1.5
4	3/5/2019	Pur'Avant	1,5	Kocide	1	Sulfur	2
		-	-	DINAMICO	2,5	Kocide	1.5
	13/5/2019	Pur'Avant	1,5	Pur'Avant	1,5	-	-
5	20/5/2019	Evidence	2	Evidence	2	Sulfur	2
		Oomisine	2	Oomisine	2	Kocide	1.5
		Frontiere	0,75	Frontiere	0,75	-	-
	31/5/2019	Botrisine	3	-	-	-	-
		Evidence	2	-	-	-	-
		Oomisine	2	-	-	-	-
		Frontiere	0,75	-	-	-	-
	7/6/2019	DINAMICO	2,5	DINAMICO	2,5	-	-
		BIO-D	2	BIO-D	2	-	-
6	14/6/2019	-	-	-	-	Kocide	0.8
		Dipel	0.5	-	-	Dipel	0.5
	19/6/2019	-		Kocide	0.5	-	-
		-		Pur'Après	2	-	-
7	21/6/2019	Dipel	0.5	Dipel	0.5	Dipel	0.5
	24/6/2019	Pur'Après	2	Pur'Après	2	-	-
8	12/7/2019	Dipel	1	Dipel	1	Dipel	0.5
		SERENADE	2.5	SERENADE	2.5	SERENADE	2.5
9	22/7/2018	Dipel	1	Dipel	1	Dipel	0.5
		SERENADE	2.5	SERENADE	2.5	SERENADE	2.5

The organic strategy was compared with the two strategies with the lowest environmental impact with the aim of reducing 50% of treatments with pesticides, and strong pesticide reduction after the second defense intervention. Due to high precipitation in 2019, cooper products were used early in phenological phase in order to prevent high infestations in the field. The use of copper in the organic management (CY3) was 8.3L of Kocide equivalent to 2.9kg/ha of Copper, which was higher than the previous year due to high precipitation but less than the 7 kg/ha per year following thus and complying with the EU legislation (Fig.3).

In every application using a mist sprayer, Yellow water sensitivity spray cards were used to monitor the correct and effective application of products on and into the vine canopy.

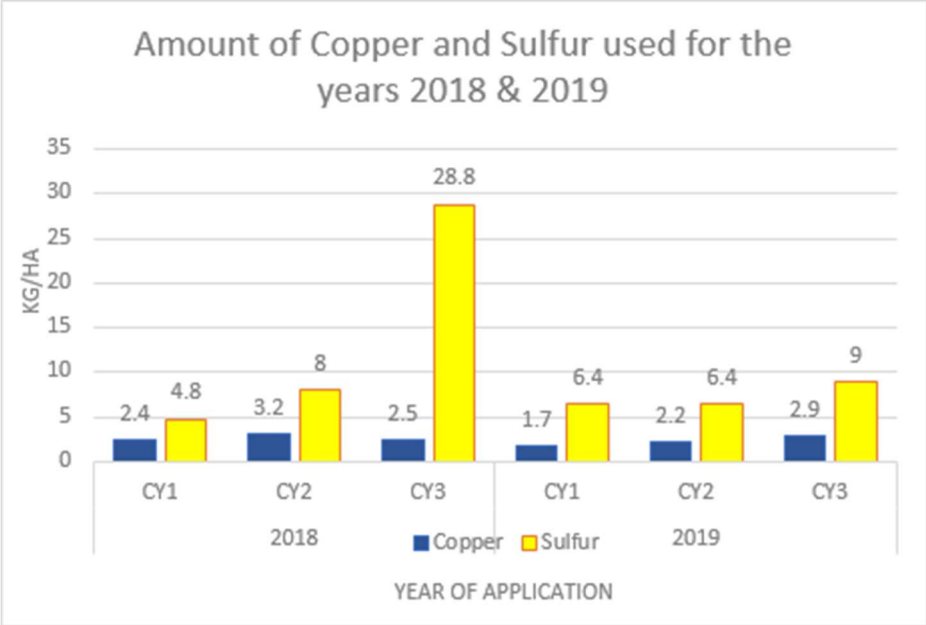


Fig.3. The amount of Copper and Sulfur used in the treatments for the years 2018 and 2019 (CY1 = strong reduction, CY2 ≈50% reduction, CY3 = Organic management.

Further to the applied protocol, the following management practises had been implemented in all three plots

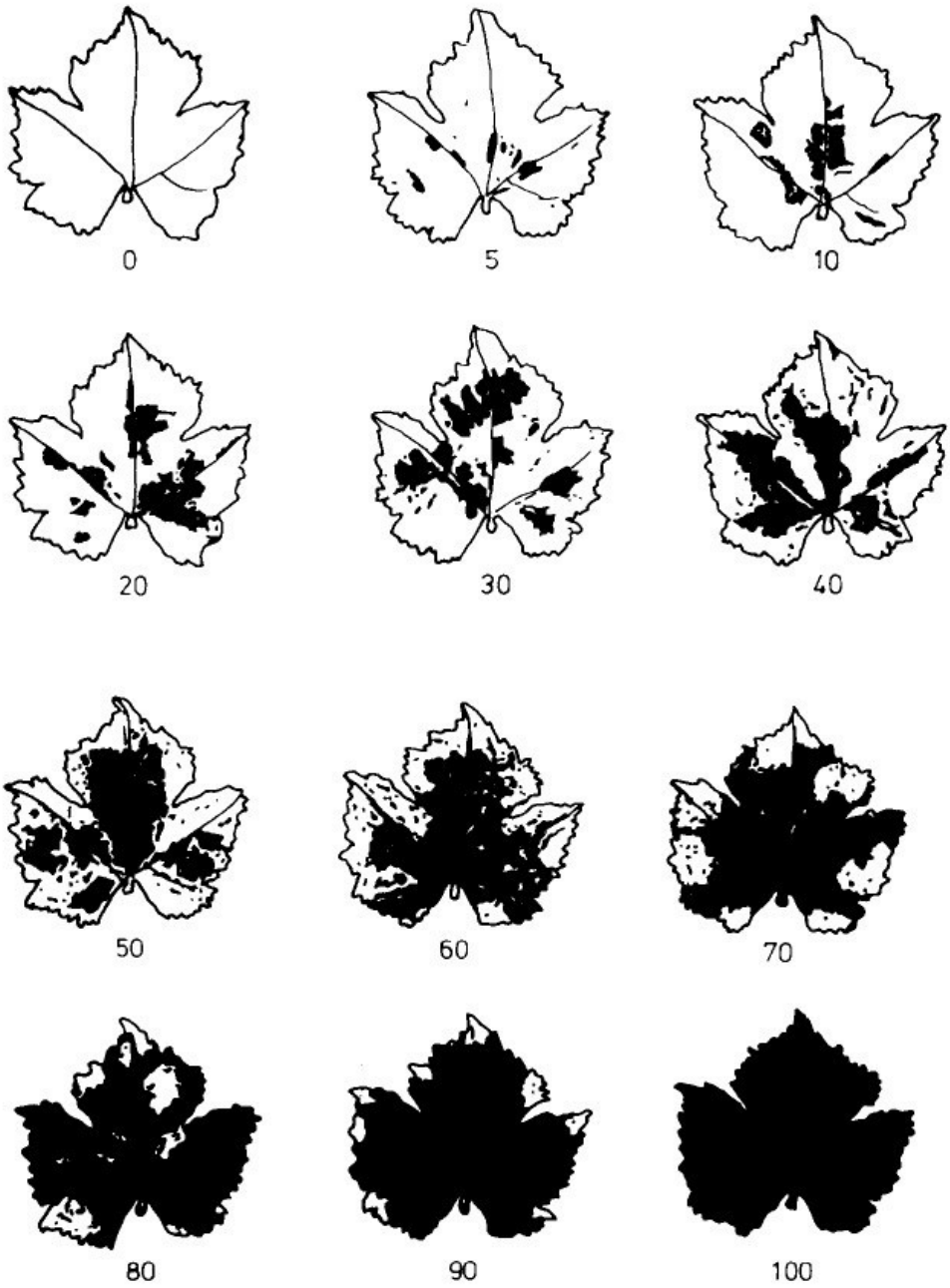
04/02/2019 Canopy management – Manual pruning
12/03/2019 Inter row management – Grass and pruning chopping
26/03/2019 Inter row management – Grass chopping
16/05/2019 Inter row soil management – Rotary ploughing
01/08/2019 Harvesting

Monitoring and analysis of the demonstration application

The Green Grapes protocol began in 2019 with the pruning of vine in early February. Every treatment or activity took place into the experimental plots, plant monitoring was contacted with emphasis on grapevine trunk diseases GTD (during pruning days) and the three major aerial diseases, Downy mildew (DM, *Plasmopara viticola*), Powdery mildew (PM, *Erysiphe necator*) and Botrytis (*Botrytis cinerea*). Downy mildew and Powdery mildew monitoring started with the appearance of the first leaves and continued until the end of August, where Botrytis monitoring started with Pre-veraison and/or starting veraison phase. Furthermore, field monitoring included the placement of white triangle sex pheromone traps for the capture and monitoring of *Lobesia botrana*.

The three treatments were divided into the 3 plots with 9 vines in each plot. A Total of 200 leaves were monitored for each treatment for the two aerial diseases, DM and PM. Also 200 Clusters were monitored for

Botrytis respectively. The severity and incidence of each disease was recorded following the EPPO / OEPP guidelines (EPPO Standards for the effective evaluation of plant protection products, Fig 4).



BBCH:															
Survey date:								*Plasmopara viticola*							
Leaf	No disease	< 5 %	5-10 %	10-25 %	25-50 %	50-75 %	>75 %	Cluster	No disease	< 5 %	5-10 %	10-25 %	25-50 %	50-75 %	>75 %
1								1							
2								2							
3								3							
4								4							

Fig. 4. EPPO / OEPP guidelines (EPPO Standards for the effective evaluation of plant protection products).

Disease monitoring was performed on the following dates:

04/02/2019 GTD monitoring during pruning
05/02/2019 GTD monitoring during pruning
12/3/2019 BBCH 11-12 First leaf unfolded and spread away from shoot
31/5/2018 BBCH 71 Fruit set
4/7/2019 BBCH 81 - 85 Beginning of ripening
25/7/2019 BBCH 89 Berries ripe for harvest
28/8/2019 BBCH 89 one month after harvest

The foliar symptom survey was carried out counting the incidence and severity of active infections, i.e. leaves with sporulating lesions. This is because with the high temperatures rising in July the affected leaves fell down.

During harvesting 9 clusters from each treatment were collected for laboratory analysis. More specifically, one cluster from 3 vines from each plot per treatment was collected and used for:

1. Cluster weight
2. Measurement of the length and the width of each berry out of 25 berries
3. Pilling of the 25 berries and weight of the skin
4. Use of 75 berries per cluster for weight, total acidity, Sugar (Brix) and pH.
5. Smash of the 75 berries and use of the juice for Organic acid analysis (Tartaric, malic and citric acid) using HPLC, for total acidity using the titrable acidity method with sodium hydroxide, for the pH and for total soluble solids (Brix) using a refractometer.
6. Use all the 25 skin berries from and add in methanol. Liquit is centrifuged at 4000rpm for 10 min and filtered 0,45µm. Filtered liguid is stored in -80 ºC and will be injected in HPLC in order to estimate the level of total polyphenols with the 2020 samples.

Results and lessons learned

The monitoring of incidence and severity of plant diseases is shown in fig 5 - 8. Both PM and DM where present after the beginning of fruit set. Moreover, both diseases where more severe in 100% and 50% reduction after the beginning of fruit set. Despite the high incidence on the leaves no symptom on the berries was recorded. The incidence and severity was calculated as active lesions. Therefore, a final account of the damage caused can be done considering the highest value reached in the season.

Botrytis was not detected on clusters until the day of harvest.

No esca complex symptoms were recorded after harvest.

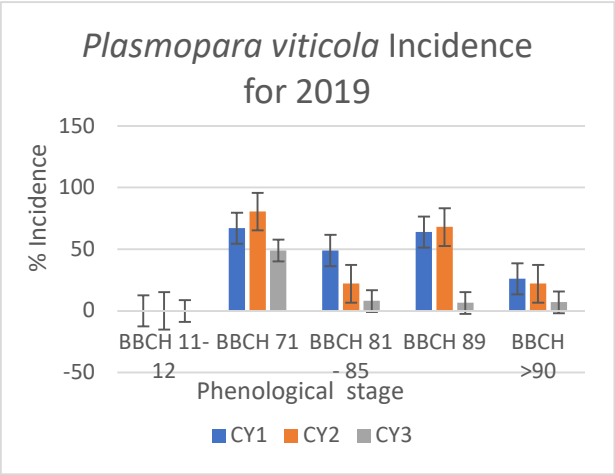


Fig. 5. Incidence of *Plasmopara viticola* symptoms on vine leaves for the 2nd year of application

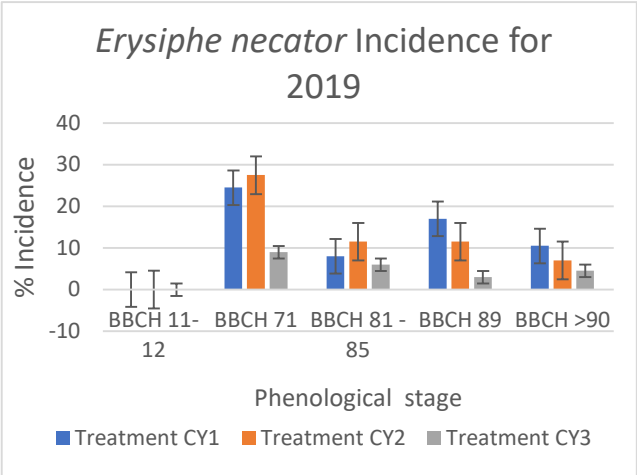


Fig.6. Incidence of *Erysiphe necator* symptoms on vine leaves for the 2nd year of application

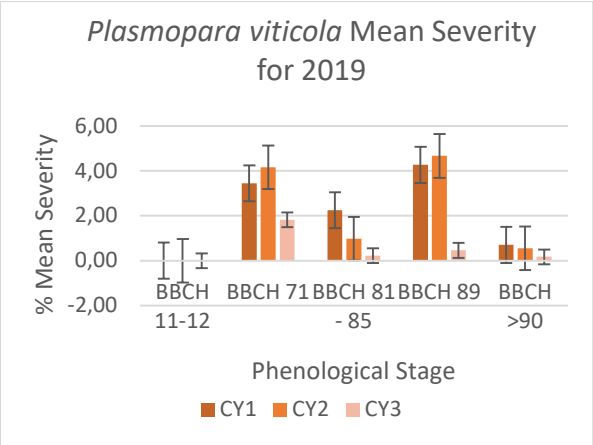


Fig. 7. Mean Severity of *Plasmopara viticola* symptoms on vine leaves for the 2nd year of application

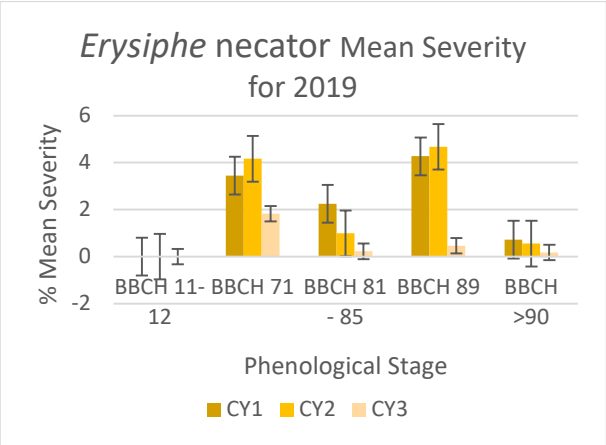


Fig.8. Mean Severity of *Erysiphe necator* symptoms on vine leaves for the 2nd year of application

Clusters quality and characteristics

Laboratory analysis has shown that for CY1 treatment, the average number for Cluster height, weight and width, as also for the weight of the 75 berries was longer than CY2 and CY3. There were no fluctuations between treatments for Total acidity, Brix%, pH, berry length, berry width and skin weight (Table 3). Total production was measured and the average for each treatment was:

Fig 9. Cluster of Sultanina grape analysed in the lab

CY1 Strong pesticide reduction 7,4 kg/plant (± 0,3), CY2 50% pesticide reduction 4,8 kg/plant (± 0,2) and CY3 Organic 3.2 kg/plant (± 0,03).

Table 3. SULTANINA GRAPE Laboratory analysis for the year 2019

	CLUSTER			75 weight	BRIX %	TA	pH	length	width	skin
PLOT	WEIGHT g	HEIGHT cm	WIDTH cm		%	g/l		mm	mm	mg
CY1	736.50	25.66	16.66	125.57	21.42	6.51	3.08	17.57	13.74	5.91
CY2	415.69	21.30	12.40	114.63	21.75	6.13	3.08	16.83	13.24	5.23
CY3	259.59	18.30	11.20	103.27	22.00	6.04	3.00	14.96	12.23	5.97

Fig.9. Laboratory analysis of the 2nd year for all three treatments

The results indicated a significant increase in cluster size and weight for the CY1 treatment compared to CY2 and CY3.

The analytical characterization of the main organic acids of grapes (tartaric, malic and citric) revealed optimal levels of these compounds in each sample However, the organic acid most characterizing the product is tartaric acid and no differences were recorded among treatments. Furthermore, the amount of organic acids detected is considered low.

Table 4. Analytical characterization of the main organic acids of grapes (tartaric, malic and citric) for 2019

Treatment	Tartaric Acid (g/L)	Malic Acid (g/L)	Citric Acid
CY1 (100%)	4.72 ± 0.31	1.28 ± 0.05	76 ± 4.2
CY2 (50%)	4.81 ± 0.46	1.28 ± 0.05	71 ± 5.1
CY3 (Organic)	4.75 ± 0.35	1.30 ±0.04	72 ± 4.8

The analysis of residues on Sultanina table grapes for the 200 active ingredients for the year 2019 was below detection limit (ppm >0.01) for all three-treatment samples.

From the DSS, three different vineyard managements were compared and three related UPs were created in DSS vite.net. The organic management of the vineyard (CY3) was compared with a strategy that involved the use of 50% of plant protection products (CY2) and a strategy for which inputs were further reduced (CY1). The strategies did not differ so much in the number of cultivation operations (Table 5) as in the type and doses of active substances used, in particular in CY1 and CY2 resistance inducers were applied to reduce the number of plant protection products. Both CY2 and CY1 strategies made it possible to reduce the impacts on the health, air, water, soil and biodiversity sectors. In particular, the HTS indicator was reduced by 50 and 29% with the CY1 and CY2 strategy, respectively, while the DAI and TFI indicators by 30% with the CY1 strategy and 18% with CY2.

Table 5 - Number of cultivation operations and treatments for PUs of the Cyprus University of Technology.

	CY1 - STRONG PESTICIDE REDUCTION	**CY2 - 50% PESTICIDE REDUCTION**	**CY3 - ORGANIC AGRICULTURE**
Cultivation operations	6	6	6
Phytosanitary treatments	13	12	9
of which resistance inductors	6	4	0
Total	19	18	15

The Carbon Footprint was reduced by 65 and 35% respectively with the CY1 and CY2 strategy, as many reductions of 47 and 24% were obtained in the ETS indicator. Reductions of 70 and 30% for CY1 and CY2 respectively were recorded for the Water Foootprint indicator.

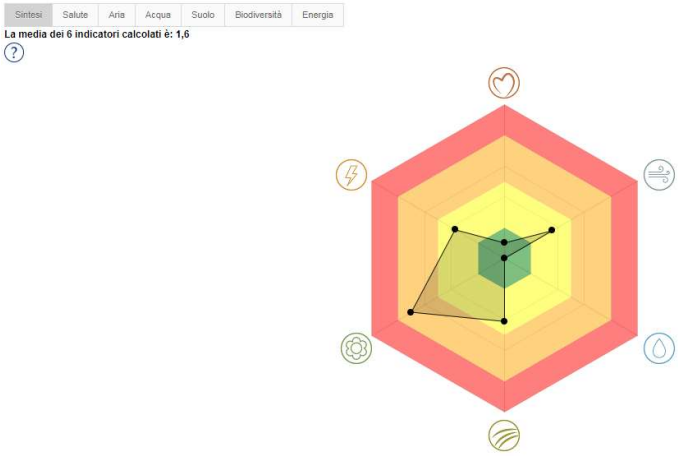
On the contrary, the values of the Fuel Use and Erosion indicators are higher for both design strategies than for biological management (CY3), due to a greater number of cultivation operations and treatments and a different soil texture (Table 6).

Table 6 - Values of individual indicators in PUs Cyprus

Fund	Unit of measure	Value		
		CY1 - STRONG PESTICIDE REDUCTION	CY2 - 50% PESTICIDE REDUCTION	CY3 - ORGANIC AGRICULTURE
Health				
Human Tox Score (HTS)	-	38.6	54.5	76.8
Dose Area Index (DAI)	-	7.1	8.8	10.8
Treatment Frequency Index (TFI)	-	11	13	16
Air				
Carbon Footprint (CF)	t CO2 eq / t of production	0,157	0,297	0.455
Carbon Sequestration	t of Carbon / ha	3.25	2,632	1,696
Soil				
EcologicalFootprint (EF)	global ha / t of production	0,179	0.247	0.382
Organic substance	%	3.36	3.21	3.53
SoilCoverage	days	72	72	72
Erosion	t land / ha	24.9	24.9	18.3
Soilcompaction	-	2.6	2.6	2.4
Biodiversity				
biodiversity	-	0	0	0
Eco Tox Score (ETS)	-	22.5	32.7	42.8
Power				
Fuel use	l fuel / ha	204.4	188.4	149.4
Renewablefuel	-	-	-	-
Waste	-	1.2	1.2	1.2
water				
Water Footprint	m3 water / t of production	507	1,211	1,729
Water supply	-	0	0	0
Water Use Technical Efficiency	-	0	0	0
acidification	SO2 eq t / t of production	0.001	0,002	0.003
eutrophication	PO4 eq t / t of production	0	0.001	0.001

Cyprus University of Tecnology: Protocol CY1 – 100% Strong Pesticide Reduction

Thanks to the information obtained from the compilation of the production units and from the Registration of Cultivation Operations (ROC) it was possible to create a sustainability profile of the production unit. 13 defense treatments were carried out, 6 of which with the use of resistance, and 6 cultivation operations.



The management implemented in CY1 has determined an overall good level of sustainability. The drastic reduction of plant protection products has influenced the health sector reporting a weighted average of 0.5, excellent sustainability due to the use of plant protection products with low risk for human health and with adequate doses. Excellent levels of sustainability also occurred in the water sector

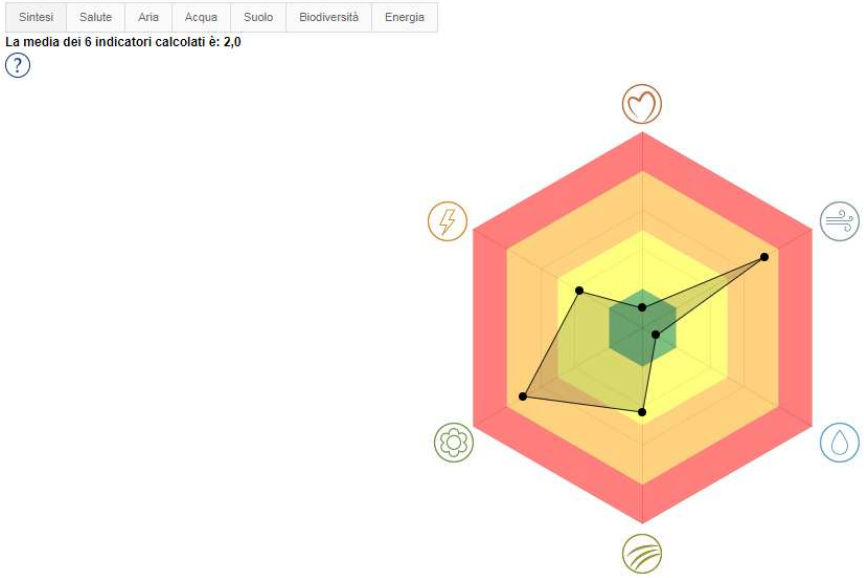
The air, energy and soil sectors reported average values, reaching higher values in the biodiversity sector.

Sustainability judgment:

Overall Score: 1.6 (0-5) - Excellent sustainability

Cyprus University of Tecnology: Protocol CY2 – 50% Pesticide Reduction

Thanks to the information obtained from the compilation of the production units and the Registration of Crop Operations (ROC) it was possible to create a sustainability profile of the production unit. A total of 12 defense treatments were performed, of which 4 with resistance inducers, and 6 cultivation operations.

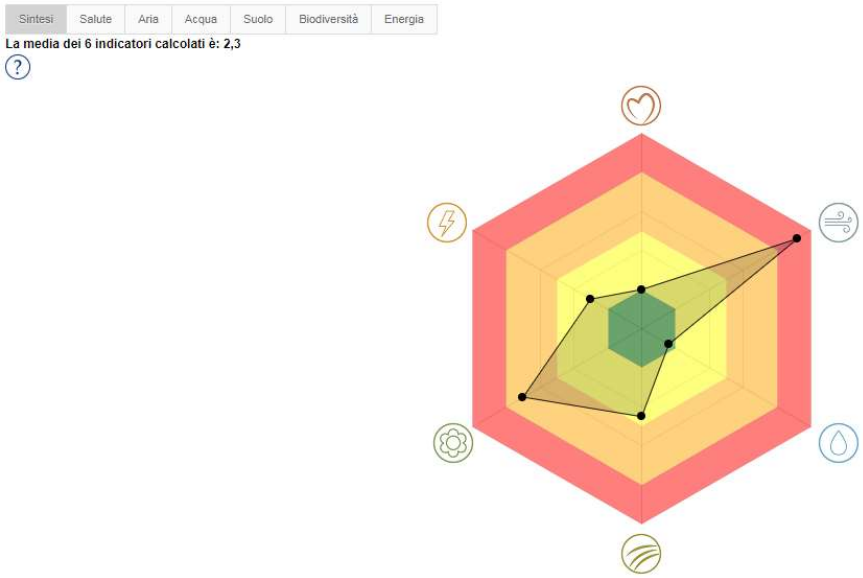


The management implemented in CY2 has determined an overall good level of sustainability. The 50% reduction in plant protection products affected the health sector, reporting a weighted average of 0.5, excellent sustainability due to the use of plant protection products with low risk for human health and with adequate doses. Excellent levels of sustainability occurred in the water sector. The energy and soil sectors reported average values, while higher less sustainable values were achieved in the air and biodiversity sectors.

Sustainability judgment:

Overall score: 2.0 (0-5) - good sustainability

Thanks to the information obtained from the compilation of the production units and the Registration of Crop Operations (ROC) it was possible to create a sustainability profile of the production unit. In UP CY3, 9 defense treatments and 6 cultivation operations were performed.



The management implemented in CY3 resulted in a fairly good level of sustainability overall. The health sector reported a weighted average of 1, good sustainability due to the use of plant protection products with low risk for human health and with adequate doses. Excellent levels of sustainability occurred in the water sector. The energy and soil sectors reported average values, while higher, less sustainable values were achieved in the biodiversity sector. Sustainability in the air sector was negative and very high, reaching a weighted average of 4.6.

Sustainability judgment:

Overall score: 2.3 (0-5) - good sustainability

Conclusions

The results obtained for 2019 suggests that the "Green Grapes" protocols used in organic Sultanina do not cause compromises in the quality of the productions. On the contrary, the further reduction of the pesticides used (CY1 and CY2 compared to CY3) can give the products an additional value on the market due to the growing attention of consumers towards issues related to the environmental sustainability of agriculture. The use of DSS is fundamental for the decision-making in the vineyard as the number of chemical application are reduced and treatments are applied only when necessary.

However, the increase in productivity and size of the berries maybe a positive result but also may have a negative outcome when taking into consideration the consumer's opinion. Organic consumers recognize organic Sultanina by the small size of the berries. The introduction of larger in size, berries may raises doubts regarding the status of grape cultivation (IPM or Organic). For this reason, further investigations should take place in order to examine the positive effects of biostimulants and defence inducers on table grapes and most importantly is the in depth education of consumers regarding this bio products.