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**S04: VITICULTURE AND WINEMAKING BETWEEN  
TRADITION AND INNOVATION**

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# **S04: VITICULTURE AND WINEMAKING BETWEEN TRADITION AND INNOVATION; BUCHAREST, EHC2024, MAY 13-16**

## **SESSION I: PLENARY SESSION**

### **ORAL PRESENTATIONS**

S04-O-I-1

#### **An outline of current state of Romanian viticulture and vitivinicultural products**

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The paper presents the main statistical parameters describing the Romanian viticulture and oenology in the present international context, analysing the evolution, tendencies, strengths, weaknesses, opportunities and threats. Planted surfaces of vineyard for wine and table grapes, production of table grapes, wine and grape juice, types of wines, consumption, imports and exports are considered and compared for the period of 2019-2022.

Surfaces covered in 2023 on various wine regions with the most cultivated autochthonous and international varieties are also presented. For the most known Romanian autochthonous variety, Feteasca neagra, evolution over the past 10 years is analysed.

**Keywords:** Romania, viticulture, wine production, wine consumption, import/export, Feteasca neagra, main grape varieties

S04-O-I-2

#### **Grapevine genetic resources for a sustainable viticulture**

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Plant material choice is a cornerstone in the wine system because it is a crucial driver of sustainability (especially economic and environmental). Grapevine germplasm is quite wide, mostly represented by *Vitis vinifera* varieties (about 13,600 registered in databases), followed by interspecific hybrids (about 8,300 registered in databases) and varieties of species other than *V. vinifera* (about 1,500 registered in databases). Conservation of the genetic resources is provided by databases, commercial vineyards,

in situ (on farm preservation) and ex situ (collections) conservation. The most grown variety in the world is Kyoho, a table grape interspecific hybrid grown in China, followed by Cabernet Sauvignon, Sultanina (Thompson Seedless) and Merlot (about 6,000 *V. vinifera* varieties are really grown). This large variability is important in terms of sustainability because the larger the grapevine diversity, the more resilient the grape/wine system, especially for the future generations. An outlook on the new disease-resistant/tolerant varieties is provided, as a tool to improve the environmental sustainability.

**Keywords:** germplasm, resilience, sustainability

S04-O-I-3

### **Prospects of non-thermal and thermal physical technologies - promising alternatives for winemaking optimization**

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The competitiveness of the wine market is constantly increasing as a result of growing consumer demand for innovative products. Thus, the wine industry focuses both on optimizing technological conditions, but also on food security and safety, while preserving the traditional character and typicality that make each wine special. Therefore, winemaking is gradually adopting physical technologies with non-thermal effects (ultrasound technology and cold plasma technology) and thermal effects (such as microwave treatment) to streamline and optimize winemaking technologies to reduce costs and increase sustainability. These methods could be economical and promising alternatives for increasing the nutritional value of the final product. Because the wines matured in contact with wood are among the most appreciated by consumers, but the production costs are high due to the use of large quantities of wood that becomes unusable in a short time, fast processes that produce minimal amounts of waste and with significantly positive influence on organoleptic qualities are necessary. In this study, the influences that these physical methods have on the organoleptic quality and some physico-chemical parameters of the wines are presented.

**Keywords:** ultrasounds, microwaves, cold plasma, wine-making

S04-O-I-4

### **Thousand-year history of northern viticulture in Ukraine: challenges and opportunities**

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Global and regional climate change has started to have a negative impact on the world's known winemaking regions. However, the experience of many countries around the world shows the prospect of growing grapes in unsuitable areas. In the south of Ukraine,

winemaking was developed from the 7th to the 3rd centuries BC, when the Greeks colonized the Black Sea region. First historical information about the cultivation of grapes in the north of Ukraine is in the chronicle of Nikon (1151). With the spread of Christianity in Kyivan Rus, vineyards were established at monasteries and princely palaces of Kyiv. Currently, there are only 160 wineries in Ukraine, 40 of which are craft wineries. The classic wine regions of Ukraine have long been the Crimea, the Black Sea region (includes Odesa, Mykolaiv, Kherson), Zaporizhzhia, and Zakarpattia. Since 2014, part of the southern vineyards has been temporarily occupied by the russians, some wineries have been mined, looted and damaged during the unprovoked invasion of our sovereign state. In recent years, winemaking has been actively moving to the western, central and northern regions, where historically it existed since hundreds of years ago. Modern Ukraine follows the path of the world's major wine-producing countries, prioritizing quality over quantity. Even now, during the war, Ukrainian winemakers take part in international competitions, and their wines get awards. As of 2020, the vineyard area north of the industrial cultivation zone in Ukraine is 1600 hectares. In recent years, the sum of active temperatures of 10 °C and above in Kyiv has been more than 3000 °C. In 2017–2021 at the Prof. V.L. Symyrenko Department of Horticulture of the National University of Life and Environmental Sciences of Ukraine, 50°23'02" N, 30°30'20" E, Kyiv studied 10 new Ukrainian-bred grape varieties – wine: 'Aromatnyi', 'Illichivskiy Rannii', 'Muskat Odeskyi', 'Shkoda', 'Yarylo', and table: 'Zahadka', 'Kardyshakh Tairovskiy', 'Kyshmysh Tairovskiy', 'Kometa', 'Persei', rootstock 'Riparia × Rupestris 101-14', irrigated plot, covered grape culture.

**Keywords:** *Vitis vinifera* L., grape, wine, cultivars, temperature, climate change

## **SESSION II: ENVIRONMENTALLY FRIENDLY VITICULTURE, SUSTAINABLE PRACTICES AND BIODIVERSITY**

### **ORAL PRESENTATIONS**

S04-O-II-1

**Effects of some treatments on rooting and shoot development in different *Vitis* species**

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Grafted or ungrafted young plants can be used for the plantation of both table and wine grape varieties. Generally, this choice is made according to the structure of the soil where the phylloxera pest will not thrive. In both cases, it is very important that both the cultivars and the rootstocks are rooted with sufficient efficiency. During the rooting phase, sometimes this efficiency may decrease significantly depending on the variety or species. In this study, grape cultivars belonging to different *Vitis* species and American

grapevine rootstocks were studied. The main purpose is to research the effects of some alternative preparations and their combinations on both rooting and shoot development instead of Indole butyric acid (IBA), which is widely used for rooting purposes in grapes. In the study, six *Vitis vinifera* cultivars, four Interspecies hybrids, two 4N cultivars (Kyoho and Heukboseok) and seven American rootstocks (Kober 5 BB, 140 R, 110 R, 99 R, Rupestris du Lot, 41 B and 1103 P) were used. The following parameters were evaluated in the rooted cuttings; callus status (0-3 scale), root development level (0-4 scale), number of roots (pcs), root length (cm), number of shoots (pcs), shoot length (cm), number of leaves on the shoot (pcs). The most appropriate application for each variety and rootstock was determined as a result of this study.

**Keywords:** Grapevine, cuttings, rootstocks, poliploidy, alternative preparations

S04-O-II-2

### **Field trials into the effects of 31 rootstock varieties on the generative and vegetative performance of Chardonnay**

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In a long-term experiment with Chardonnay the influences of 31 rootstock varieties on yield, cluster weight, must weight, titratable acidity in the must, pH-value of the must, pruning wood weight and occurrence of chlorosis were determined. The test site was a carbonate containing brown soil on flyschmarl with 18 to 25 % lime content and medium lime compatibility. On average over the 21 experimental years (2001 to 2021) 1103 P, G 26, Riparia Portalis, 725 P, Ganzin 1, Aripa and 779 P had a significant negative effect and 420 A, R 27, Binova, 41 B and SO4 had a significant positive effect on yield. Cluster weight was significantly reduced by 1103 P, 725 P, G 26 and 779 P and significantly increased by 420 A, Börner, R 27, Binova, Teleki 5C, 41 B, 3309 C and SO4. Ru 140, Ganzin 1, 41 B and EM 33 had a significant reducing effect on must weight. Acidity in the must was significantly reduced by Riparia Portalis, G 26, Grézot 1, Aripa, 101-14, R 7 and 3309 C and significantly increased by Börner, 125 AA, R 27, 1616 C, 99 Richter, EM 33, 779 P, Cosmo 2, Binova, 225 Ru A2, Ru 140 and 41 B. Pruning wood weight was significantly decreased by Aripa, Riparia Portalis, 3309 C, 101-14, G 26, 110 R, 1616 C, Ganzin 1, Börner, SO4, Cosmo 10 and Binova and significantly increased by R 7, 99 R, 725 P, 225 Ru A2, Fercal, 125 AA and Cosmo 2. Among these, Aripa and Riparia Portalis had the weakest growth by far. By the 25th year of growth between 6.7 % (SO4, R 7, 99 Richter, 1616 C) and 46.7 % (G 26) of the vines had failed, depending on the rootstock variety. Chlorosis did not occur or only occurred to a very small extent. Microvinification was performed on a highly limited scale on selected grafting combinations. In the sensory wine evaluation no significant differences could be determined.

**Keywords:** Chardonnay, rootstock varieties, yield, ripeness, pruning wood weight

S04-O-II-3

## **Analysis of stunting degeneration in grapevine**

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Stunting in grapevine is a far spread phenomenon in unselected grapevine material. The cultivar Neuburger is an autochthonous variety for full bodied white wines. Since a couple of years the interest of growers for this cultivar is decreasing due to the short internode phenomenon. Vines concerned by the degeneration loose their normal growing behavior by stunting and shortening of internodes. This decline occurs surprisingly and changes growth behavior also from former healthy looking vines. Maintenance of the variety would require to find genetic indications if a vine will be stable or carries the potential to easily switch to stunting.

Several genotypes of the cultivar were pooled to genotypes with and without symptoms and looked for the obviously differences. Several gibberellines were quantified by mass spectrometry. Only one of the GA substances showed a significant difference between healthy and stunted vines. Finally several genes from the GA metabolic pathway were analysed. We could find differences and mutations but none of them explains the phenomenon for the whole. Involving qPCR we tried to find relationship of RNA level of selected genes to short-internodal vines. Genes from different parts of gibberellin synthesis and the signaling pathway were selected. Two cytochrome P450 monooxygenase genes showed a tendency towards upregulation in one of two sample sets. In the case of gibberellin oxidases, one locus showed a significantly lower level of expression in the short-internodes variant. In the case of the genes involved in the signaling pathway, ambiguous results are found between the sample sets. Furthermore full transcriptome analysis by sequencing was done. Genes that showed significant differences between short-internodal and normal-growing vines as a result of the transcriptome analysis, were selected for further analysis. In some cases, significant differences in expression levels of RNA could be discovered.

For the possible contribution of epigenetic effects we sequenced the genome by nanopore technology. Some genes showed in symptom carrying vines a high degree of methylation. One of them is a Della protein. These changes could also be responsible for differences in RNA metabolism. Furthermore defined markers to get access to the genes with relevant mutations were applied. The findings allow the conclusion that the shorten internodes in Neuburger is based on several changes in the genome and not a single mutation.

As a practical approach for deliberating the stunting of selected vines gibberelline applications were performed to them. In some trials the intensity of stunting could be alleviated.

**Keywords:** grapevine, gibberellines, qPCR, RNA, sequencing, genetic marker

S04-O-II-4

## **A survey of global soil fertility in Piedmont (Italy) vineyards based on multiple physical, chemical and biological indexes**

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Understanding the complex interactions between soil, plant and microorganisms is essential to determine the impact of agricultural practices on soil fertility and crop resilience to various stresses. In the case of the vineyard, the reduced or missing supply of organic matter has contributed to a less resilient wine production with a negative impact on production potential and grape quality. On the other hand, winegrowers and technicians need innovative tools to assess the overall soil fertility level, also in light of the increasing use of microbial or organic biostimulants. To this end, a survey was conducted on 11 vineyards representing the various Barbera d'Asti production areas in one of Piedmont's most important winemaking territories (Italy). The soil near the vine roots was evaluated from a physical (texture and slaking index), chemical (macroelements and derived parameters) and biological (TeaBag Index and various indices derived from molecular analysis of the microbiome) point of view. The soils were characterised by medium basic pH, low organic matter content, low N and P content and medium to high K content. Despite the variability in texture, the slaking index and the soil aggregates breakdown curve defined 4 soil groups. The TeaBag Index, on the other hand, classified the vineyards into 3 groups, characterised by different capacities of organic matter decomposition. The various indices derived from the taxonomic analysis of the soil microbiome made it possible to differentiate the vineyards potential concerning soil quality, biodiversity, functionality, and resilience. The overall analysis of the data made it possible to identify a group of eight vineyards characterised by a similar degree of fertility, while the other three were found to diverge from this group and from each other. The result demonstrates the possibility of using simple methods applicable by winegrowers and technicians for an overall assessment of the vineyard's soil fertility status, suitable for developing a soil management strategy making the vineyard more resilient to abiotic and biotic stresses.

**Keywords:** Tea Bag Index, Slaking Index, soil microbiome, Barbera d'Asti

S04-O-II-5

**Effect of different plant growth regulators and salt strengths on somatic embryogenesis and plant regeneration in petiole cultures of *Vitis vinifera* L. cv. Thompson Seedless**

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Four different growth regulators such as TDZ (Thidiazuron), Zeatin, Picloram and IBA (Indole-3-butyric acid) were incorporated in  $\frac{1}{2}$  and  $\frac{3}{4}$  salt strength Murashige and Skoog's media (MS) individually and in a few combinations. *In vitro* studies on *Vitis vinifera* L. cv. "Thompson Seedless" petiole cultures revealed the efficiency of Zeatin for indirect somatic embryogenesis. Induction of embryogenic callus was achieved on  $\frac{1}{2}$  MS medium supplemented with individual Zeatin and in combination with IBA. Growth regulator free medium supplemented with coconut water favoured germination of somatic embryos and regeneration of plants.

**Keywords:** In Vitro regeneration, somatic embryogenesis, petiole segments, *Vitis vinifera* L

S04-O-II-6

**Yield components and leaf/fruit ratio effects on quality in Solaris**

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Since 2000, Denmark has emerged as a commercial wine-producing country, and with ongoing climate changes and the introduction of new early-ripening cultivars like 'Solaris', the potential for a growing wine industry is on the rise. However, viticulture in the cool Scandinavian climate is still relatively nascent, leaving many questions surrounding optimal cultural practices unanswered. A particularly debated aspect is the optimal fruit/leaf ratio, crucial for striking the right balance between grape quality and the economic potential yield. To address this, manipulations of the leaf/fruit ratio and cropping levels were implemented through early and late cluster thinning, and/or shoot thinning in the 'Solaris' cultivar across four vineyards. The effects on yield components were investigated based on fruiting shoots collected prior to the regular harvest, encompassing measurements of shoot length, weight, leaf number, and leaf area. Additionally, the clusters on the collected shoots underwent examination for weight, number of berries, and berry size, followed by juice extraction. Utilizing Fourier-transform infrared spectroscopy (FTIR), juice analysis provided data on sugars, acids, pH, and yeast available nitrogen. Results indicated that early cluster thinning and shoot thinning did not significantly impact yield components, with outcomes varying across locations. Late cluster thinning, however, exhibited an increase in sugar concentration and a decrease in acid levels in the juice across most locations. The treatments, coupled with

location differences, resulted in a substantial variation in the leaf/fruit ratio, ranging from a few cm<sup>2</sup>/g to over 70 cm<sup>2</sup>/g. This variation unveiled a clear leaf/fruit response affecting fruit quality, as expressed by glucose and fructose content. The findings underscored 'Solaris' as capable of producing high-quality berries in the cool Danish climate, with an optimal yield/quality balance, at a leaf/fruit ratio of 15-20 cm<sup>2</sup>/g.

**Keywords:** Canopy management, optimal yield, source and sink capacity

S04-O-II-7

### **The differences in the mineral content of selected grape cultivars in several vineyards in south-western Poland**

**Czaplicka, M.**, Gudarowska, E., Chohura, P., Rowinska, M., Parypa, K., Babelewski, P., Krezel, J., Uklanska-Pusz, C., Pilawka, T.

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Growing wine grapes in Poland is increasing year by year. More and more often, these vineyards are established in areas with soils of poor suitability for growing grapes. Polish vineyards are built on soils made of acidic rocks, where it is necessary to systematically monitor the soil pH and the mineral condition of the plants. This location of vineyards generates problems in cultivation and the occurrence of anomalies and deficiencies in plants and fruits. The aim of the work is to indicate the content of leaves in mineral elements and the mutual correlations between them, as well as to examine the place of cultivation for this content. Taking into account different varieties located in different vineyards, the different influence of these factors on the abundance of leaves and their mutual dependencies is clearly visible.

**Keywords:** mineral content, MG, Ca, P, K, leaf, grape, vineyard, PIWI

S04-O-II-8

### **Effects of zeolite application and irrigation on berry sunburn damage and vine performances in cv. Sangiovese (Vitis vinifera L.)**

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In the face of escalating climate change, the surge in heatwaves and prolonged droughts has become a pressing concern, significantly impacting grape maturation. Additionally, the combination of prolonged high-light intensities, high temperature, and UV radiation might result in a damage called berry sunburn. Recognizing the gravity of these emerging challenges, this study delves into the exploration of diverse mitigation strategies aimed at reducing berry sunburn incidence, preserving yield, and enhancing grape composition at harvest. Irrigation during berry ripening has recently been reconsidered as a way to cope with climate change. Similarly, foliar mineral treatments with mineral based compounds, such as zeolites, have aroused interest as a sustainable approach to cope with high temperature stress in vineyards. Thus, late irrigation and zeolite application were tested in 2021 and 2022 on 'Sangiovese' vines, cultivated near Bologna and trained to VSP spur-pruned cordon. Treatments were arranged in a strip-plot design and the

main factors were: cluster exposure/management (leaf removal of the basal leaves at veraison, leaf removal coupled with zeolite treatment, and no leaf removal) and irrigation (irrigation from berry softening to the end of August vs no irrigation). At harvest, the incidence and severity of berry necrosis and berry shrivel damages were recorded. Yield parameters were measured and grape composition analyzed, while frozen berries were used for anthocyanin analysis with HPLC. Both years were characterized by harsh summers (max Tair > 40°C). In this context, berries sheltered by foliage exhibited no signs of distress, while exposed clusters benefited significantly from both zeolite application and irrigation, effectively mitigating sunburn and the consequent decline in production. Irrigation however, resulted in a decrease in both berry soluble solids content and anthocyanins and therefore, a careful calibration of the management techniques to reduce the adverse impact of climate change on the berries will be needed.

**Keywords:** berry shrivel, climate change, cluster exposure, necrosis, water management

S04-O-II-9

### **Aroma precursors in Grillo grape (*Vitis vinifera* L.): exploit the impact of irrigation regimes**

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Water stress, applied through Regulated Deficit Irrigation (RDI), is a commonly employed practice to enhance the concentration of secondary metabolites in grapes. However, the impact of this practice on grape aromas has been poorly explored, and metabolic responses to water stress can vary significantly among different cultivars. In the context of warm climate conditions, such as in Sicily, the influence of irrigation strategy on the synthesis of aromatic precursors in the grapes of cv. Grillo (*Vitis vinifera* L.) was investigated in 2022 vintage. Two irrigation regimes were compared: 1) moderate water stress (MWS), maintaining Stem Water Potential ( $\Psi_{SWP}$ ) values > -1.4 MPa and < -1.1 MPa from veraison to harvest; 2) severe water stress (SWS), maintaining Stem Water Potential ( $\Psi_{SWP}$ ) values < -1.4 MPa and > -1.8 MPa from veraison to harvest. Berry sampling was performed at 5% of veraison, full veraison, and at harvest to evaluate the synthesis of aromatic precursors. For each treatment, from veraison to harvest, vegetative growth, bunch and berry weight, ripeness level (TSS, pH, titratable acidity), terpenic, norisoprenoids, benzenoids, and thiolic compounds precursors were assessed. At harvest, yield per vine was measured while wood weight was measured during pruning time in order to calculate the Ravaz index. Although SWS at full veraison showed higher concentrations for most of the aromatic compounds analyzed, the prolonged severe stress conditions triggered degradation processes, resulting in lower levels compared to MWS treatment at harvest. The imposed stress conditions had limited effects on primary metabolites and berry weight, indicating that the observed variations of aroma precursors were effectively dependent to the water stress conditions applied. These results suggest that regulated deficit irrigation applied from veraison to harvest

with different strategies may improve the aromatic profile of grapes, having a relevant impact in the context of climate change.

**Keywords:** Regulated deficit irrigation, grapevine, aromatic compounds, climate change

S04-O-II-10

### **RNAi-based approaches in grapevine plants for grey mould disease protection**

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Worldwide production of table and wine grapes is a leading sector, with an average of 77 million tons per year produced (FAOSTAT, 2020), and with continued growth in Europe in the area devoted to vine cultivation. During the growing season, most of the plant organs can be the host of several fungal and oomycete diseases, leading to important economic losses and causing detrimental effects on fruit quality. The increasingly scarce availability of fungicidal products banned for their negative impact on the environment, coupled with the emergence of resistance in the pathogen to these products, make crop defense increasingly challenging. In this perspective, the RNAi-conserved mechanism can induce target gene silencing, activated by the presence of double-stranded RNA molecules (dsRNAs). DsRNAs can be constitutively expressed in grapevine plants, through genetic engineering techniques provided that an efficient *in vitro* regeneration and transformation protocol is adapted and optimized to the genotype of interest. Although both somatic embryogenesis and organogenesis have been attempted in several grapevine cultivars and rootstocks, an innovative regeneration pathway starting from cotyledons and hypocotyls derived from somatic embryos has been fine-tuned. Only in Thompson Seedless, it was possible to isolate plant lines expressing the hairpin gene construct, specifically targeting the Dicer-like genes 1 and 2 of *Botrytis cinerea*. Further experiments of trans-grafting highlighted the potentiality to use these RNAi-based plant lines, source of active dsRNAs, as rootstocks useful to cultivate less susceptible non-modified elite cultivars as scion. The RNAi triggering molecules have also been topically applied as a spray treatment on leaves of grapevine plants growing in the greenhouse environment and on detached berries, providing an appreciable level of protection against *B. cinerea*, that can be extended if the long Bc-DCL1/2 dsRNAs are stabilized through encapsulation in specific nanocarriers.

**Keywords:** RNAi-based approaches, *Vitis vinifera*, gene silencing, *Botrytis cinerea*

S04-O-II-11

## **Development of new bioanalytical tools for assessing the grapes' infection with Botrytis cinerea**

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Electrochemical sensors based on screen-printed electrodes facilitate fast, sensitive and cost-effective measurements in situ being good alternatives to standard laboratory-based analytical methods for various parameters related to the quality of wine and grapes. This work presents the development of two electrochemical sensors for assessing the grapes' infection with *Botrytis cinerea*, namely a sensor for measuring laccase activity and a device to detect the fungal spores. A dual optical and electrochemical assay for laccase activity was developed by combining a paper membrane, containing all the necessary reagents and a screen-printed gold electrode. The change in the color of the membrane due to laccase activities of 3U/mL is detected in 10 minutes with the bare eyes, while quantitative analysis is enabled by analyzing the image taken with a smartphone. The electrochemical assay takes places simultaneously with the optical one and provides faster, quantitative results. An analysis kit for measuring laccase activity in the vineyard was developed which requires minimal user intervention, The kit was successfully applied to monitor the production of laccase in rose, white and red grape berries infected with *Botrytis cinerea*. However, high laccase activity is not specific to *Botrytis* fungi. The development of an electrochemical molecularly imprinted polymer (MIP) sensor for the specific detection of *Botrytis cinerea* spores was next investigated. Coupled electrochemical-Raman experiments were conducted to study the electropolymerisation of Tolidine Blue O in the presence and the absence of spores. In parallel, a protocol for washing the template microorganism and evaluate the specific binding was developed using Atomic Force Microscopy imaging and MIP obtained with *Micrococcus lysodeikticus*, a commercially available bacterium used as a model template. The preliminary results set the path towards sensitive and fast detection of the fungal spores of *Botrytis cinerea*.

**Keywords:** grapes, wine, sensor, laccase, *Botrytis cinerea*

S04-O-II-12

### **A first insight into the flora biodiversity of the Lebanese viticulture**

**Chalak, L.**<sup>1</sup>, Ghorra Chammoun<sup>2</sup>, Y. Chammoun spelled cu 1 L aici dar cu 2 de L în alt articol, cred ca e correct cu doi de L

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In viticulture, flora biodiversity could practically play an important role in compensating the negative impacts of vine monoculture and intensification of crop management. In this study, we assess for the first time the flora biodiversity bordering the vineyards in Western Bekaa, Lebanon. In spring 2023, a floristic survey was conducted in 13 vineyards situated between 840 and 1150 m a.s.l., in a sub-humid bioclimatic zone. For each vineyard, flora composition and richness were assessed along hedges, in four quadrates of 1 m<sup>2</sup> with an interval distance of 25 m. At least 240 species were identified. Asteraceae, Fabaceae and Poaceae were the most represented flora families. Among the most frequent species in the vineyards visited, wild species related mainly with oat, barley, *aegilops*, alfalfa, *astragalus* and clover were found. These species may provide a valuable potential in enhancing pollination ecosystem services and increasing soil fertility by symbiotic fixation. Thus, it is of significance to set the necessary approach for a sustainable management of flora biodiversity in the Lebanese vineyards.

**Keywords:** Floristic composition; richness; frequency; vineyards; West Bekaa; Lebanon

S04-O-II-13

### **Biodiversity in Grapevines: Unveiling the Potential of Ancient Sicilian Cultivars and Biotypes of Key Indigenous Varieties**

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The biodiversity of grapevines, crucial for viticulture, encompasses over 10,000 cultivars listed in the International Catalogue of Grapevine Varieties (VIVC). This diversity, categorized into biotypes and clones, gives rise to intra-varietal variations, ranging from minor morphological changes to macroscopic alterations, influencing adaptability and wine quality. Historical factors, such as the 19th-century Phylloxera epidemic in Europe, resulted in the dominance of a limited number of *Vitis vinifera* L. genotypes. However, renewed interest in ancient local cultivars and biotypes has emerged due to pressures linked to climate change. Intra-varietal diversity is now recognized for its potential to maintain grape quality under adverse climatic conditions. In 2023, the agronomic potential of ancient Sicilian varieties (Lucignola and Vitrarolo) and the biotypes of the main indigenous cultivars (Grillo, Catarratto, Nero d'Avola, Perricone, Frappato, Nocera) was assessed in four experimental vineyards located in different regions of Sicily (Western, Central, and Eastern). The study assessed the "genotype x environment" interactions, comparing biotypes regardless of the environment. The genotypes shared the same spacing, training system, and pruning method, under irrigation. Ten vines were

chosen randomly for each genotype, serving as biological replicates. Phenological stages, recorded independently for each vine, represented the percentage of buds at each stage. For each genotype, the progress of grape ripening, berry weight, vegetative growth, and water status were evaluated. At harvest, the yield per vine and the number of bunches were recorded, and their ratio was used to calculate the average bunch weight. During winter, the pruning wood weight was measured and the Ravaz index was calculated. Our results show that grape ripening depends on environmental conditions, and vines show different water status levels. Lesser-used grape genotypes may hold promise for adapting to climate change, serving as tools for preserving typical grape characteristics, but is needed further investigation.

**Keywords:** *Vitis vinifera* L., Biodiversity, grape quality, relic varieties

## **POSTER PRESENTATIONS**

S04-P-II-1

### **Farming practice influences non-essential metal and metalloid concentrations in grapevine in selected vineyards of the Cape Winelands, South Africa**

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The increasing contamination of soils and plants by non-essential metals and metalloids is extremely concerning. Conventional farming practices have facilitated the release of these elements from natural sources, and subsequent plant uptake, and bioaccumulation, increases the risk of adverse effects on plants, animals, and human health. Soils and grapevine (*Vitis vinifera*) leaves were sampled from selected organically and conventionally farmed vineyards, in the Cape Winelands, from four demarcated areas in each farm during winter and summer and analysed using inductively coupled plasma mass spectrometry (ICP-MS) techniques. The concentrations of aluminium (Al), antimony (Sb), barium (Ba), silicon (Si), vanadium (V), tin (Sn), and strontium (Sr) were determined, and analysed using a one-way ANOVA. Besides Sr and Sb levels in one organic farm (Farm D) and one conventional farm (Farm E), generally, Seasons had no significant (Degree of Freedom (DF) = 1, 6;  $P > 0.05$ ) effect on the concentrations of these elements in the soil. Remarkably, agricultural practices significantly (DF = 1, 22;  $P < 0.05$ ) affected leaf concentrations of five of the six heavy metals and one metalloid studied, with four metals (Sb, V, Al, and Sn) had higher concentrations in conventional than organic farms. However, Ba was significantly higher (DF = 1, 22;  $F = 10.74$ ;  $P < 0.01$ ) in organic farms ( $39.384 \pm 7.395$  mg/kg) than in conventional farms ( $20.332 \pm 2.623$  mg/kg). Generally, seasonal change did not significantly influence the level of most heavy metals in the vineyards' soil. This study demonstrated that organic farming could mitigate the uptake of heavy metals by grapevine plants.

**Keywords:** Organic grapevine, conventional farming, heavy metal contamination, season, plant health

S04-P-II-2

**Study of affinity between rootstocks and graft on grape cultivars created at Research and Development Station for Viticulture and Winemaking Dragasani**

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The wine nursery in Dragasani was founded in 1896 after the attack of the phylloxera, being among the first units of producing wine planting material in the country alongside the one in Odobesti. For the production of wine-growing seedlings, a number of intensive methods have been developed, aimed at improving quality, increasing production and lowering the cost of production. The influence of the rootstock on the graft lies in the supply of plastic substances to the roots, in a higher or lower proportion that can develop or weaken the root system. This influence is stronger the more affinity there is. The multiplication of the vine is conditioned by a complex of pedoclimatic, technological and biological factors, which are closely related and act on the growth and development of the vine, especially on calluses. For the research carried out in 2023, the following varieties of rootstocks were studied: 'Kober 5BB', 'Craciunel 2', 'SO4-4', 'M70' together with the varieties of graft on grape cultivars created at the Research Development Station for Viticulture and Winemaking Dragasani: 'Crâmpoșie Selecționată', 'Tămâioasă Românească 104 Dg', 'Sauvignon 62 Dg', 'Novac', 'Negru de Drăgășani', 'Cabernet Sauvignon cl. 7', 'Victoria', 'Crâmpoșie Aromată'.

**Keywords:** cuttings of vines, leaching, fertilizers, production, soil nutrients

S04-P-II-4

**The effect of canopy topping height on the qualitative and quantitative characters in grapes of cv Mavrodafni (Vitis vinifera L.)**

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With the aim to strengthen the competitiveness of the sector, different cultivation techniques and practices were applied to the cultivation of Mavrodafni at a pilot scale. The application of new cultivation practices and procedures which are being evaluated in view of climate change could lead to an increase in the production of viticultural products as well as to a significant change of their qualitative characteristics, without exhausting the natural resources. At the same time, there is an opportunity to develop new products, making the cultivation of cv Mavrodafni particularly competitive. Initially, productive vineyards where cv Mavrodafni is being cultivated were identified. Two canopy management techniques were applied, namely topping of the main shoots at two different height levels: control vines underwent topping at 6 nodes above the grape (which is the usual viticultural technique) and vines which underwent topping at 10 nodes

above the grape. The two treatments were then evaluated on the qualitative and quantitative characters of the grapes. Regarding the effect of the two different canopy topping heights on the vines of cv Mavrodafni, the results showed that the vines with the lower topping height of the main shoots, recorded higher weight of grapes, while the vines that underwent the higher topping height of the main shoots, exhibited characters of the must of good quality (total soluble solids, pH, titratable acidity), which in combination with the high concentrations of individual sugars, suggest the production of grapes of better quality.

**Keywords:** topping, canopy management, grapevine, *Vitis vinifera* L.

S04-P-II-5

**The effect of rootstock on grape quality characters, phenolic and antioxidant potential of a biotype of cv Korinthiaki Staphis (*Vitis vinifera* L.)**

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The black Corinthian currant is one of the most important viticultural products of Greece with a significant contribution to the shaping of Greek society in the first 100 years of modern Greece. Grapevine cultivar Korinthiaki Staphis is cultivated in coastal parts of the Peloponnese and the Ionian Islands, where the soil and climate conditions are ideal for grapes of high quality. In the present study, the effect of three rootstocks (1103 Paulsen, Richter 110 and 41B) on the qualitative and quantitative characters of a biotype/potential clone of cv Korinthiaki Staphis was evaluated. On the vines that were grafted with each of the above rootstocks, during ripening, the following measurements took place: the average length, width and weight of grapes and berries, the average yield of each vine, the weight of 50 berries, the moisture percentage of the berries, as well as the weight percentages of skin and flesh. In addition, total soluble solids content (Brix), total acidity and pH were calculated. Quantitative determinations of various total phenolic components of skins and berries, as well as the antioxidant capacity, were also carried out with the use of spectrophotometry, and the content of the must in individual sugars, acids and individual anthocyanins was determined by HPLC. Differences were observed between the effect of the three rootstocks on both the qualitative and quantitative characters of the biotype. Vines grafted on rootstock 41B gave satisfactory production, but also balance in the desired quality characteristics. Rootstock 1103P appeared to delay harvest giving grapes with reduced total phenolics, anthocyanins and sugars, yet with increased antioxidant capacity. On the contrary, the grapes that came from the vines grafted on the rootstock R110 exhibited the highest concentration of total phenolics, anthocyanins and sugars, however they showed a deficient antioxidant capacity.

**Keywords:** rootstock, biotype, phenolics, antioxidant capacity, grapevine

S04-P-II-6

### **Research on the reduction of the water reserve in the soil and its influence on the production of grapes in the Murfatlar vineyard**

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The subject of climate change has been intensely debated in the last decade, with particular attention given to its influence on agricultural production. Changes in agricultural biotope parameters such as temperature and precipitation, rising CO<sub>2</sub> levels, and increased frequency of abnormal weather events are a worrying factor for declining harvests, food security, and increasing product prices. The Murfatlar vineyard, located on the Dobrogean plateau in southeastern Romania, is subject to such changes, with strong influences on the yield and quality of the grapes. In the Murfatlar viticultural center, during the period 2019-2023, a study was carried out on the main climatic parameters, where it was observed an increase in the thermal balance values, a reduction in the amount of precipitation and an uneven distribution of them in time and space. The current soil water reserve decreased from 92% in 2019 to 75% in 2023, reaching the lowest value of 61% in 2020. On average, there was a 24% decrease in water reserve relative to capacity field. This effect coincided with an increase in the average values of atmospheric temperatures from 18.3°C (normal) to 21.1°C and a 15% decrease in precipitation compared to the average recorded in the vegetative period. All these factors led to a reduction of grape production by up to 31% compared to the estimated amount, reaching an average of 3.98 t/ha in the period 2019-2023, compared to 5.68 t/ha, average estimated production of the same period, in the Murfatlar wine center. The increase in heliothermic resources, the uneven distribution of precipitation and the decrease of the soil water reserve led to a reduction in grape production, affecting the technological properties such as must yield and sugar content.

**Keywords:** climate changes, deficient precipitation, heliothermic resources, soil moisture, grape production

S04-P-II-7

### **Effect of water deficit on table grape berry quality**

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Vine irrigation is becoming an important practice for growing areas where drought is increasingly common with erratic rainfall and high temperatures during fruit ripening. Regulated deficit irrigation (RDI) has emerged as a potential strategy to enable crops to withstand mild water stress with minimal or no effects on yield and a potential positive impact on fruit quality. Three varieties of table grapes grown at NRDIBH Stefanesti were subjected to three water regimes: rainwater (no irrigation, NI), 100% ETC (FI) and 50% ETC (DI) during the growth period until fruit ripening (BBCH 71-89). At the time of harvesting, the following quality indicators were studied: Grape weight, malic acid (MA),

tartaric acid (TA), lactic acid (La), anthocyanin content (AC), total polyphenols (TP), color indices (DO 420+Do520+DO620). Under full irrigation and deficit irrigation at 50% of ETC, yield increased by 0.4 kg to 0.6 kg for all varieties versus the production recorded at NI. TA concentration increased under full irrigation (FI) (5.97%), while polyphenols and total antioxidants decreased significantly. The highest concentration of total polyphenols was found in the deficient irrigation DI (16 mg/100 g) and non-irrigated (NI) treatment (14 mg/100 g), compared to only 9 mg/100 g, as was evident in of full irrigation (FI). The results showed that the moderate water deficit during the ripening period increases the concentration of phenolic compounds, anthocyanins and does not affect the weight of the grape berries. Significant positive correlations were found between total polyphenols and color intensity (CI), with values ranging from 0.52 to 0.81 using the Pearson correlation. Deficit irrigation in certain stages of grapevine growth (DI) could be a controlled irrigation strategy that could improve grape berry quality without affecting plant growth parameters and fruit production.

**Keywords:** *Vitis vinifera*, irrigation, berry ripening, berry composition

S04-P-II-8

### **The influence of cover crops on soil water content in vineyards from central Transylvania**

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Grapevine (*Vitis vinifera*) is one of the main crops in Transylvania. In recent years, one of the problems of grape production is the pedological drought as a result of climate change. Cover cropping (CC) soil management has been recognized by some scientific studies as an effective practice to promote soil conservation and the health and sustainability of the vineyards (Keesstra et al., 2018). This study was carried out in 3 locations of the Târnavă vineyard and aimed to evaluate the real effect of CC on the water content of the soil in comparison with the conventional tillage of black field soil (CT). In this sense, the intervals between the grapevine rows were cultivated with *Trifolium Repens* (V1), *Phacelia Tanacetifolia* (V2), or left uncultivated but tillaged (V3). Soil water content was evaluated during the grapevine vegetation period of 2022 by monthly determination of the soil moisture at 3 depth intervals (0-20cm, 20-40cm, 40-60 cm). The results highlight significant differences depending on the location and time period, with higher values being recorded for location 1 and for September. In soil drought conditions, the water competition of the crops was more pronounced after flowering. From the point of view of the water competition of the main crop, the effect of the CC was statistically insignificant compared to the conventional management (CT). It is still difficult to clearly define whether the benefits of CC are greater than the disadvantages and additional research is needed for a better understanding of the CC effect on water resources. It could be useful to know when and how this viticultural practice can be adapted in the vineyards of central Transylvania.

**Keywords:** cover crops, vineyards, soil, water content

S04-P-II-9

### **The impact of soil maintenance systems and disease and pest control systems on the production capacity of vine ecosystems**

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The purpose of the research carried out in the Valea Călugărească wine center was to establish the influence of technological steps on the wine ecosystem functionality, within a vineyard with Chardonnay and Sauvignon varieties. The experimental process was developed based on two factors: the soil maintenance system (black field, partial mulching at intervals with straw and permanent wintering with grasses from the spontaneous flora) and the system for combating vine diseases and pests (chemical, biological and combined). In the case of grapevine downy mildew (*Plasmopara viticola*) and powdery mildew (*Uncinula necator*), the highest effectiveness was recorded, generally, after applying the combined treatment system, with fluctuations in the degree of attack between 2.44% and 2.94%, while in the case of gray mold attack (*Botrytis cinerea*) the highest effectiveness was observed in case of combined and chemical control. The biological treatment was not effective, exceeding the economic damage threshold of 5%. Regarding the soil maintenance systems, the permanent grassing system recorded an attack degree of 4.92% for grapevine downy mildew and 7.52% for powdery mildew. The systems for combating vine diseases and pests had a smaller impact on grape production, the registered differences being between 3.6-7.5%. The analysis of the production variations determined by soil maintenance systems indicates that, compared to the black field, the other two soil maintenance systems induced positive production differences ranging between +0.915 kg/vine in case of permanent grassing with species from the spontaneous flora and +1.072 kg/vine when mulching with straw was applied.

**Keywords:** vineyard, grass, treatment, production

S04-P-II-10

### **Selection of the most appropriate method to eliminate grape-vine Pinot gris virus and grapevine fleck virus using the analytical hierarchy process**

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This publication aimed to identify the most suitable method and parameters of Grapevine Pinot gris virus (GPGV) coinfecting with Grapevine fleck virus (GFkV) elimination in grapevine. Meristem culture, intensely regenerative apex culture, in vitro thermotherapy, in vitro chemotherapy and electrotherapy (through electrical stimulation in a uniform electric field and in a horizontal electrophoresis tank) were the methods used for virus elimination. Also, the Analytic Hierarchy Process (AHP) has been used to rank these virus elimination methods, based on virus removal rate and economic efficiency. Because in nature the viruses are often occur in mixed infection, the biological material

used in the GPGV elimination was represented by grapevines, *V. vinifera* L., Sangiovese and Negru mare genotypes, diagnosed with GPGV and GFkV viral complex. In this case, each virus of the viral complex constituted a very important assessment criterion because the regenerated plants must be free of both viruses. The results of the GPGV elimination analysed with AHP showed that in vitro chemotherapy was by far the most effective method, followed by meristem culture, apex culture, electrotherapy and, in vitro thermotherapy. The analysis was carried out using the SpiceLogic Analytic Hierarchy Process software.

**Keywords:** AHP; Vitis, GPGV; GFkV; meristem; apex; in vitro thermotherapy, in vitro chemotherapy; electro-therapy

S04-P-II-11

### **Recognizing barriers and exploring possibilities to reduce pesticide utilization in European viticulture**

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The current reliance on chemical pesticides for vineyard protection in European horticulture has raised concerns due to severe health and environmental consequences. European authorities, consumers, and society are urging a significant reduction in the use of chemical pesticides while ensuring the production of safe, high-quality, and affordable. To address this, there is a need for a change in direction towards preventive vineyard protection through agroecological practices to avoid pest outbreaks and infestations. The primary aim of this paper is to pinpoint the challenges encountered by end users (actors involved throughout the value chain) in the European vineyard production. This analysis takes into account the substantial decrease in pesticide usage and explores the requirements these end users must fulfill to overcome these obstacles. In order to discern the obstacles and requirements associated with the substantial decrease in pesticide usage, a multi-actor approach was employed. The authentic identification of barriers and needs directly involved actors along the value chain is crucial for steering research in the right and advantageous direction. Consequently, Concept-Knowledge workshops were utilized to assemble farmers, suppliers of agricultural inputs, advisors, specialists from agro-food industries, researchers, non-academic partners in a CA21134 Cost Action, and various other stakeholders. These groups exchanged insights on pesticide reduction, sharing their experiences and expectations regarding the adoption of zero-pesticide viticulture. The primary obstacles to reducing pesticide usage revolve around insufficient knowledge and information regarding alternative methods and techniques, their higher associated costs, and a lack of demonstrated effectiveness. The absence of a well-defined market and specific labeling further complicates the transition. Legislative challenges add to these barriers, with ambiguous laws, bureaucratic hurdles, and regulations that do not align with the needs of the value chain actors. As for the identified needs, they focus on advancing knowledge about plant immunity, understanding the role of microbiota, and promoting agroecological practices. There is also a need to enhance the use of varieties with high systemic resistance and provide guidance on the proper use of alternatives.

**Keywords:** barriers, needs, viticulture, zero pesticides

S04-P-II-12

**Preliminary results of the effect of early topping on the canopy architecture of Carricante vine (*Vitis vinifera* L.)**

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Recently, a lot of studies report negative effects of climate change in viticulture, especially increase of temperature and radiative regimes, highlighting morpho-physiological modifications, acceleration of grape ripening with excessive sugar accumulation, low acidity and atypical flavors. These upheavals suggest a re-think of viticultural models and management strategies. The ripening under rising temperature can be controlled by changing canopy management techniques. This research focused on early shoots topping with the aim of evaluating how changes in canopy architecture can influence its functionality and grape qualitative-quantitative traits. The experiment was performed in the 2023 season in a vineyard on Etna mount (lat. 37°41'19.95"N; long. 15° 9'23.93"E; altitude 252 m a.s.l., eastern slope) on the white variety Carricante (*Vitis vinifera* L.); the vineyard is 12-years-old, cordon system trained, spur pruned. In the BBCH 73 stage (berries goat-sized, bunches begin to hang), all shoots on 50 vines were trimmed at the height of the node above the last bunch. On 9 index samples, the vines leaf area, physiological parameters, yield per vine and its traits were evaluated at commercial ripening. The topping performed removed 14% of the total leaf area and did not cause berry drop. The leaves from laterals of topped vines showed an increase in the transpiration rate during the hottest month (July) as consequence of an increase in VPD. In June, the leaf water potential of the lateral leaves from topped vines was more negative. Differences in bunch and berry weight were not found, while a significant reduction in the soluble solids (TSS) content was recorded for topped vines (21.6 vs. 23.1 °Brix) as well as an increase of polyphenols (+20% compared to control vines). The response of cv. Carricante, subjected to early shoot trimming and under extreme temperatures (almost 50°C at the end of July) was evaluated and will be discussed in terms of vine vigor and yield, grape composition and physiological behavior.

**Keywords:** Etna mount, topping, laterals, grape composition, polyphenols

## **SESSION III: SUSTAINABLE VITICULTURAL PRACTICES, MECHANIZATION AND AUTOMATION**

### **ORAL PRESENTATIONS**

S04-O-III-1

#### **Automated Detection of Botrytis Cinerea Infestation in Champagne Grape Crates Using RGB Imagery, Polarized Light, and Deep Learning**

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The Champagne region is renowned for its quality grapes, yet it faces challenges from unpredictable weather conditions that can lead to fungus infestations during harvest, notably Botrytis Cinerea. To ensure quality, grapes cannot leave the 50kg boxes once harvested until they are pressed. In this presentation, we showcase the design and validation of a sensing system utilizing RGB imagery, polarized light, and deep learning to automatically detect Botrytis Cinerea infestation in grape crates as they enter the press center. This system enables batch sorting by quality, facilitating the pressing of 12 tonnes of grapes of the same quality simultaneously. Operating in real-time, the system provides a quality score in under a second while forklifts are in motion. Its precision in detecting Botrytis infestation has been rigorously evaluated and found to be highly reliable, matching visual and chemical assessments. A human-in-the-loop approach allows for continuous improvement of the deep learning models. In case of underperformance, images can be isolated, re-annotated, and used for model retraining without interrupting operations. This iterative process ensures that the models continuously improve and are seamlessly integrated into the workflow.

**Keywords:** Post harvest quality, Deep Learning, Botrytis

S04-O-III-2

## **The ozone molecule at the service of the grapevine: from the nursery to the vineyard**

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The ozone molecule has proven its biocide properties over a wide range of microorganisms and applications. These biocide properties and the low remanence of the ozone molecule make it a promising candidate to substitute controversial plant protection products used in agriculture. The present study aims to review several applications of ozone in the gaseous state or in aqueous solution for its use in viticulture. From the nursery to the vineyard, different experimentations have been performed and have showed promising results: i) ozone gas application during 34h to 25 days on grafted grapevines in nursery has led to the reduction of fungal developments on the plants. ii) Ozonated water has also been tested in nursery. Irrigation with ozonated water have stimulated the roots growth in number and weight and have reduced the time needed for buds to break. Plants soaked in ozonated water have a similar recovery rate than the plant treated with fungicide treatment. iii) Another study investigated whether ozonated water could be used to control conidia dispersal of the esca-associated fungus *Phaeoacremonium aleophilum*. Fungal development after artificial inoculation was significantly reduced by 50% in planta with ozone treatment. iv) Finally, ozonated water can be interesting for the control of downy mildew in the vineyard. For all these applications, the ozone molecule has proved its usefulness to produce healthy grapevines and replace or reduce the use of conventional plant protection products.

**Keywords:** Grapevine, Ozone, Ozonated water, Antifungal activity

S04-O-III-3

## How to efficiently spray ozonated water to struggle against the downy mildew? When gas-liquid mass transfer meets agriculture

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Ozonated water (OW) has proved its biocide properties over a wide range of microorganisms and applications. These biocide properties and the low remanence in the environment of the ozone molecule makes it a promising candidate to substitute controversial phytosanitary products used in agriculture. Although experiments conducted in controlled conditions exhibited outstanding results for pest control, the early trials in real conditions where OW was applied by spraying have failed to control the pathogens. The present study explains that the process of spraying is a critical point to apply ozonated water since desorption phenomenon occurs: the dissolved ozone in the liquid phase diffuses extremely fast to the air phase, drastically reducing the ozone concentration applied to the plant. This low ozone dose applied is responsible for the low efficiency of treatments observed in real conditions. First, our work consisted to make a global characterization of the spray of ozonated water to experimentally assess the ozone desorption profile and to match with the mass transfer theories. By developing innovative techniques, a deep understanding of the ozone desorption has been acquired and solutions to reduce this desorption have emerged from the models developed. From the obtained knowledge, a homemade prototype have been created to reduce the ozone desorption during spraying. Thus, the second part of the work consisted to assess the efficiency of the prototype : downy mildew (*P.viticola*) inoculated leaves were sprayed with ozonated water, using or not the anti-desorption prototype. For all the trials made, visual observations of the symptoms were conducted, and the modalities treated with the prototype exhibited better efficiency of treatment, which validated the relevance of the prototype developed. Finally, this works highlights the necessity to be aware of applications techniques issues when using ozone and that agriculture complexity requires interdisciplinary approaches.

**Keywords:** Pest management, plasmopara viticola, pesticide alternative, vineyard applications, dissolved ozone

## **POSTER PRESENTATIONS**

S04-P-III-1

### **Multi-purpose small collaborative robot for smart viticulture: concept and design**

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In Japan, viticulture is manually performed to maintain product quality using limited land resources. Therefore, it is unique in the world. However, the labour shortage is a serious problem because of the decreasing farmer population, mainly due to ageing. To improve the current situation of viticulture in Japan and support workers, we designed a small collaborative robot powered by electric batteries (dimensions: 89 cm (L) × 64 cm (W) × 85 cm (H); weight: approximately 100 kg). The base unit of the robot can be moved by employing motors and following a worker at a predetermined speed and distance using a laser imaging detection and ranging (LIDAR) sensor. The base unit can also avoid obstacles by memorising the locations of objects detected with the LIDAR sensor. As the vineyard is typically sloping, we used crawlers instead of wheels in the base unit. The developed small collaborative robot can be used for multiple purposes because it includes the following attachments: 1) transporting attachment for harvested produce, spray tanks, and other materials (e.g., fertiliser), 2) spraying attachment for applying agrochemicals, 3) fertilising attachment for spreading fertiliser, 4) weeding attachment for mowing weeds, 5) pruning attachment for cutting the canopy of the grapevines, and 6) monitoring attachment for detecting abnormal situations (e.g., disease spread and nutrient deficiencies). We designed three components to effectively use these attachments: a) a trolley for improving the carrying capacity of the transporting and spraying attachments, b) a three-point linkage for providing a stable position to the fertilising and weeding attachments, and c) a position control for increasing the stability of the spraying, pruning, and monitoring attachments. Incorporating collaborative robots in viticulture can enhance efficiency and help workers in manual tasks by reducing physically demanding activities.

**Keywords:** attachment, collaborative robot, crawler, labour, LIDAR, motor, vineyard

## **Evaluation method for labourers' work status in a vineyard using Global Navigation Satellite Systems with Real-Time Kinematics**

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In viticulture, especially in Japan, labour management is crucial for efficient production and avoiding labour shortage. Thus, a method for determining the work status of labourers in a vineyard is required to improve the current situation. In this study, a labourer's working time was drawn on a grid map (hereafter referred to as the working-time map) to determine the current work status in an experimental vineyard. The moving speed of the labourer was also estimated. In this experiment, we focused on harvesting from among several works (harvesting, pruning, weeding, spraying, fertilising, and monitoring). Working time was estimated from the detention time of the labourer's position in each mesh recorded by using the Global Navigation Satellite Systems with Real-Time Kinematics (RTK-GNSS) receiver with a cycle of 1 Hz. Moving speed was estimated based on the differences in the latitude, longitude, and ellipsoid height between the labourer's two positions in the vineyard. Subsequently, the working-time map was successfully developed. In this map, the colour density in each grid varied based on the working time, directly showing the current work status. Based on the two positions recorded by using the RTK-GNSS receiver, the moving speed was estimated even when the terrain of the experimental vineyard was inclined. If the moving speeds can be determined by using the proposed method and the yield can be forecasted with a prediction model, the appropriate number of labourers required in the vineyard during harvesting can be established. These results showed that the RTK-GNSS receiver is practical for evaluating the current work status in the experimental vineyard. Note that our method can be used to understand the effects of introducing a new technology on labour productivity during not only harvesting but also other work activities in vineyards.

**Keywords:** grape cluster, harvesting, position, map, working time, viticulture, yield

## **SESSION IV: USE OF TRADITIONAL AND NEW GRAPE VARIETIES IN VINEYARDS**

### **ORAL PRESENTATIONS**

S04-O-IV-1

#### **Integration of RNAseq and WGCNA to study phenotypic plasticity in wine grape cultivars grown in Southern Italy**

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The phenotype of every organism is determined by the combination of its genotype (G), environment (E) and their interaction (GXE). Phenotypic plasticity is the ability of plants to express different phenotypes from the same base genotype depending on the growing environment. Studying plasticity in gene expression in natural systems is crucial for predicting and managing the effects of climate change on plant species. In this context, post-genomic era studies can provide a wide and unbiased view of plant physiology in different environmental conditions. Grapevine (*Vitis* spp., family Vitaceae) is characterized by a pronounced influence by the external conditions in terms of variability of the metabolic composition of the berries determining a broad phenotypic plasticity. In this work, we aimed to investigate the GXE interactions of two red grape varieties, the international Cabernet Sauvignon and the indigenous Aglianico, at berry commercial maturity, in three different environments of Southern Italy: Sicilia, Molise and Campania. We combined transcriptome analysis (RNAseq) with quality and environmental traits and correlated them using WGCNA. Firstly, PCA analysis indicated that both genotypes in Campania and Molise sites behaved similarly in terms of qualitative traits and transcriptomic response compared with the Sicilian site. Congruently, the highest number of differential expressed genes (DEGs) resulted in the comparisons involving the Sicilian site for both the varieties. WGCNA revealed highly co-expressed clusters of genes (modules). Interestingly one module of co-expressed genes, mostly enriched in ion transmembrane transport category, was found to be correlated with different climatic traits. Furthermore, the role of small non-coding RNAs in regulating plasticity-related traits was also deepened. Interestingly, most of the miRNA targets were detected in the samples whose comparisons have the highest number of DEGs, suggesting an involvement of epigenetic mechanism based on miRNA silencing in plant adaptation to the environment. These results can contribute to an advanced understanding on the relationship between genotype and environmental variables in wine grape also leading to the identification of the best performing genotype for each latitude.

**Keywords:** RNAseq, transcriptome, *Vitis vinifera* L., GxE interaction, grape, WGCNA

S04-O-IV-2

## **Utilizing Molecular Marker-Assisted Selection to Identify Seedless Grapevines from the Genetic Resources of Ganos Mountain Grapevines**

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The process of breeding perennial plants, such as grapevines, requires a significant amount of time and labor. Primarily, the characteristics of fruit, such as seedlessness, rely on traits that require a considerable period of time to be observed by traditional breeding methods. Breeders can utilize molecular methods to ascertain the presence of seedlessness traits within the genetic repertoire of plants. This study was conducted on genetic materials collected from Ganos Mountain in Thrace Region in Turkey. A total of 43 genotypes were assessed for seedlessness characteristics using molecular markers in the study. A total of three SSR markers were employed to screen for four bands that are indicative of seedlessness. It was found that 20 out of 43 genotypes exhibited homozygote or heterozygote patterns for those four bands. Out of the total, ten had one band, seven had a pair of bands, and three had all four bands. Nevertheless, a total of four bands were not present in 23 out of 43 genotypes. In order to conduct additional research on breeding programs for the development of novel seedless grapevine cultivars, a total of 20 genotypes with homozygous or heterozygous traits were chosen as genetic resources for the selection process.

**Keywords:** Seedlessness, Vitis, Genetic Resources, Marker Assisted Selection

S04-O-IV-3

### **Genetic profiling of a hidden grapevine germplasm of ancient terraces in Hadchit village, North Lebanon**

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Given the position of the Lebanese vineyards at the eastern Mediterranean and its long history of viticulture in various agroclimatic conditions, it is likely that this local germplasm holds a large substantial diversity. Nevertheless, it has not been adequately addressed yet. In this study, we shed light on the unnoticed Lebanese vineyards, by examining a group of 18 grapevine accessions from the Hadchit village (1400 m a.s.l.) in North Lebanon. Genetic analysis was performed with 22 nuclear and 3 chlorplastic microsatellite markers widely used in other studies. The average allelic diversity was 5.4 alleles per marker. Genetic profiling yielded 14 different genetic profiles and comparison to international grapevine databases revealed cases of synonymy, duplication, and misnaming, and also showed that more than half of the genetic profiles (8) had no correspondence. Simultaneously, information on traditional and present use, as well as the origin of genetic material was obtained through interviews with the local farmers. The studied accessions are of interest because of their long history, and diverse modes of utilization. The study highlights the interests of exploring the traditional grapevine germplasm preserved on farm and how it contributes to the genotypic richness held in Lebanon.

**Keywords:** ancient farmers vineyards, high altitude viticulture, SSR markers, on farm conservation, eastern Mediterranean

S04-O-IV-4

## **Precision Breeding and Genome Editing of Wine and Table Grape Cultivars for Improving Disease Resistance**

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Several fungal and bacterial pathogens affect grape production worldwide with adverse effects on fruit yield and quality. Conventional breeding for improving disease resistance has limited applications due to the heterozygous nature of the grapevine genome, incompatibility barriers among *Vitis* species and a long juvenile period. Precision breeding of grapevine enables the transfer of specific traits between sexually compatible species with minimum disruption of existing characteristics in commercial cultivars. Grapevine precision breeding has been possible due to the development of reliable plant regeneration and gene insertion protocols in combination with newly available information on the *Vitis* genome. Advances in precision breeding are currently being extended to optimize grapevine genome editing for improving disease resistance of elite wine and table grape cultivars. In the current study, the grapevine Mildew Locus O (MLO) genes were disrupted using CRISPR/Cas 9-mediated genome editing to study plant response to *Erysiphe necator* infection. Forty-seven edited plant lines were recovered on the basis of hygromycin resistance, acclimated under conditions of high humidity and transferred to a greenhouse. PCR and genome sequencing was carried out to confirm MLO editing in plant lines. Edited lines were screened along with controls for their response to infection by *Erysiphe necator*. Among the various plant lines studied, three exhibited a significant decrease in powdery mildew symptoms and infection severity compared to the controls. We are currently screening additional lines for powdery mildew resistance, while also generating edited plants from other *Vitis* cultivars. The use of CRISPR/Cas-9 mediated genome editing can provide durable disease resistance with the potential to improve the profitability and sustainability of the grape and wine industry.

**Keywords:** *Vitis*, grapevine, powdery mildew

S04-O-IV-5

## The change to “Piwi” varieties in the Austrian viticulture

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Due to the former use today's traditional grapevine cultivars represent the genetic background of Mid Europe. Traditional cultivars were developed by improving their traits in numerous selection steps. Despite a huge number of autochthonous grapevines only a small number of traditional cultivars are still planted. Contrary to most other wine producing countries Austrian growers and customers quickly accepted new crossed varieties and therefore it is not amazing that the most frequently used vine for red wines is a variety introduced in the 60ies of the last century. Considering the small-scale wineries technical consulting is an essential necessity and growers are also grateful for hints concerning grapevine material. Currently, around 15% of the Austrian grapevine production is performed under organic conditions. Organic wineries are more interested in new developed varieties than conventional ones. Their need for varieties that are resistant against main diseases such as mildew and grape rot is urgent. The Piwi Varieties Donauriesling, Donauveltliner, Blütenmuskateller, Muscaris and Sauvignier gris are replanted instead of traditional varieties to reduce plant protection measures and save time and money.

Customers have become increasingly critical when it comes to plant protection by using chemicals. The acceptance of minimal residues of pesticides within grapes has declined dramatically. Some supermarkets do not accept wines with residues, even if the concentration is below legal limits.

Therefore, the growers have a narrow position between the high-quality demands of the market and the limited use of plant protection products. In this situation a high percentage of them are ready to use also new crossed varieties to improve the phytosanitary status of their production. Traditional cultivars offer highest wine quality but lack an essential resistance against mildew diseases. The idea of breeding new varieties for wine production is to combine these both essential traits. In the meantime, several generations of breeders have tried to deliver cultivars which carry both of them. It is still an on-going process and the breeding institutes create numerous genotypes hoping that one or even more will be accepted for high quality wines. Meanwhile too many new cultivars with some kind of mildew resistance have been offered to the growers. It seems essential that production will be directed to only few of them. Finally, most of them decide to wait as long as a single or few of them show the clear advantages for production. What is needed are cultivars with all-round qualities for the production process, wine quality at the same level as traditional varieties and improvements concerning disease sensitivity. On the other hand, several growers focused to the international markets are not very interested in new releases and for them only well-known varieties are relevant. In general, the wine market is conservative and it takes a long time until new cultivars become accepted. Steadily effort is necessary for selecting favourable genotypes bring them to the growers and convince the customers.

**Keywords:** grapevine, organic production, resistance breeding

S04-O-IV-6

### **PIWI varieties for La Rioja: innovation for improved sustainability**

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Control of fungal diseases is one of the most important challenges in viticulture due to the high amount of fungicides that winegrowers need to apply every season. Moreover, the economic relevance of grapevine makes improving sustainability an urgent need. *Erysiphe necator* and *Plasmopara viticola* are the most damaging fungal diseases in European viticulture. Several major genes have been identified in American and Asian germplasm and the breeding of resistant varieties (PIWI) is now a good alternative for a sustainable production. Introduction of new varieties is complicated by the winegrowers' resistance to adopt new germplasm. We have conducted a 2-year evaluation of agronomic (growth cycle, yield, nitrogen efficiency, berry size) and must parameters (total acidity, pH and probable alcoholic degree) of 9 resistant varieties in La Rioja. Microvinifications were conducted on five white varieties: Sauvignon Kretos, S. Nepis, S. Rytos, Soreli, Fleurtai and four red: Cabernet Volos, C. Eidos, Merlot Khourus and Julius in 2 different seasons with and without disease pressure. At the agronomic level, results showed significant differences between varieties with Sauvignon Nepis and Julius being very early maturing compared with controls (Tempranillo and Viura) and Soreli and Merlot Khourus as late maturing cvs in both years. Differences in production were also observed with mean yields ranging from 2kg/plant (Julius, S. Nepis) to 5kg/plant (Soreli) without disease pressure (2022) and lower yields in 2023. Regarding must parameters, significant differences were found among varieties in pH, total acidity and alcohol content. Sauvignon Nepis ( $6,6\pm 0,08$ g/L) and Merlot Khourus ( $4,6\pm 0,12$  g/L) wines showed the highest total acidity in both vintages. Wine total polyphenolic content was highest in C. Volos and Julius and values were higher than Tempranillo for all PIWI varieties. Results would be useful for paving the way for introducing new grape varieties with improved sustainability derived from Rioja germplasm.

**Keywords:** powdery mildew, genetic resistance, downy mildew

## **POSTER PRESENTATIONS**

S04-P-IV-1

### **Morphological and genetic differences of JX59 Muscat of Alexandria clone: the whitest Muscat in la Marina Alta, Spain**

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La Marina Alta, a region in the Alicante province of Spain, exhibits significant variability in the grapevine variety 'Muscat of Alexandria.' Within the selected clones in this region, CM59 stands out for its medium-sized berries, which are notably whiter than those of other Muscat clones in the area. CM59 also distinguishes itself through various agronomical traits, including differences in maturity and resistance to pests. Grown in different old vineyards, this clone demonstrates a favourable compatibility with various rootstocks and is particularly valued for table consumption. Despite its significance, there are limited references to this specific type of Muscat of Alexandria in available bibliographic resources, underscoring the importance of its characterisation. This study focuses on reporting ampelographic traits and general agronomic aspects of the CM59 clone. Additionally, by analysing nearly 40,000 Single Nucleotide Polymorphisms (SNPs) identified in a Genotyping-by-Sequencing (GBS) assay involving a small set of Muscat of Alexandria clones, approximately 2,600 SNPs were found to differ between CM59 and the other clones. In-depth analysis revealed those that could have a moderate impact (non-synonymous) or high impact, primarily involving start site loss or stop site gain. Noteworthy that among these later are genes associated with proteases controlling stomatal development, responses to abiotic and biotic stresses, expression regulation at pre- and post-translational levels, protein folding, transporters, grape pigmentation, apical development, regulation of flowering, growth, and signalling pathways. This comprehensive exploration of genetic variations provides valuable insights into the unique characteristics of the CM59 clone, contributing to our understanding of the genetic basis of its distinctive traits. This work was funded by Generalitat Valenciana (grant CIAICO/2021/118).

**Keywords:** ampelography, berry, resistances, SNPs, variability

S04-P-IV-2

## **Assessment of 'Frontenac' and 'King of the North' as Potential Genotypes for Late Harvest and Ice Wine Production in North Dakota**

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Late harvest wines and ice wines provide an opportunity for grapevine growers to achieve potentially higher returns for niche regionally distinct wines. In North Dakota, USA, a state where grapevine growers are challenged by extreme cold events, late harvest wines and ice wines give producers a scenario in which they may profit from the environmental obstacles which limit their regional viticulture. 'Frontenac' and 'King of the North', two commonly planted grapevines in the Upper Midwest and Northern Great Plains USA, were evaluated for their potential for late harvest and ice wines via monitoring yield components and fruit chemistry across three harvest dates (standard, late, and ice wine conditions). Both cultivars struggled with yield reduction as time proceeded. 'King of the North' rachises lacked structural integrity following freeze events, and it was omitted from evaluation in the second season. While 'Frontenac' rachis integrity was also compromised by freeze events it was evaluated across two consecutive growing seasons. 'Frontenac' must soluble solid content increased from 24.0 for standard harvest up to 27.3 for late harvest before reaching 35.5 Brix for the ice harvest during the 2017 season. In contrast, the must titratable acidity did not continue to fall with harvest date, after the initial shift from 17.3 (standard) to 13.3 g/L (late). Late harvest and ice wine harvest warrant further consideration for the state's grapevine growers; however, to ensure sustainable production practices, more cultivars must be examined with a focus on rachis lignification prior to frost and integrity after freeze events.

**Keywords:** cold hardy grapes, rachis integrity, titratable acidity, late-season wine

S04-P-IV-3

### **Investigating some characteristics of Red Sultan Autotetraploid grapes**

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Polyploidization in seedless grapes is an important technique to produce new cultivars in order to increase the quality and yield of grapes in the world. Seedless grapevines with increased ploidy can gain better quality than their original diploids in some characteristics. With the aim of creating an autotetraploid cultivar of seedless red grape in the Urmia region, an experiment was carried out for 9 years (2014-2022). In this study, which was carried out to obtain polyploid genotypes in vineyard conditions, the effects of two (9 g L<sup>-1</sup>, 11 g L<sup>-1</sup>) doses of colchicine were applied to the meristem regions in the bud burst stage of seedless grapevine cv. Red sultana, for two times (72 and 96 h) were investigated. The effects of mutagen were evaluated by following the treated buds. Mutant individuals were compared with the 'Red Sultana' (2x)cultivar by Karyotyping analysis. Stomatal characteristics, chloroplast numbers and karyotypes differed to varying degrees from their original diploids, and stomatal density decreased inversely with the increase in stomatal size in polyploid genotypes. To examine morphological changes, tetraploid shoots were rooted and planted in the vineyard. It was observed that the genotypes examined showed some differences in their morpho-physiological characteristics. In terms of autotetraploid performance, the result of colchicine concentration of 11gL<sup>-1</sup> /96 hours with 18.250 kg per vine was superior to other treatments. Quantitative characteristics of clusters in terms of width, light and cluster weight, berry length, width and weight, this treatment was superior. In the autotetraploid application, the highest TSS amount was obtained from the 9gL<sup>-1</sup>/72 hour (23 °B) application, while the lowest TSS amount was obtained from the 11gL<sup>-1</sup>/96 hour (18 °B) application, and the opposite result was obtained in terms of acidity. In terms of maturity index, the tetraploid genotype obtained from colchicine treatment for 72 hours of bud treatment with a concentration of 9gL<sup>-1</sup> was superior to others. In the cluster analysis, two groups including the control, tetraploid genotype 1, 2 and 3 were located in one group and tetraploid genotype 4 was located in the second group.

**Keywords:** Colchicine, Polyploidy, *Vitis vinifera* L., Quantitative characteristics, Cluster analyses

S04-P-IV-4

### **Local genetic resources for the reconstruction of the biodiversity of viticultural ecosystems in order to improve the quality of grapes**

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At a time when the reconstruction and strengthening of the biodiversity of viticultural ecosystems has become a priority objective, to substantially reduce the use of fungicides is to use disease-resistant varieties. Currently, we are observing a very important change due in large part to the need for ecological sustainability of vineyards. The aim of this study was to promote biodiversity to achieve a stable viticultural ecosystem and to increase the quality of grapes by using autochthonous disease-resistant cultivars. The study was carried out between 2017-2023 in the experimental plots of SCDVV Blaj, cultivated with seven autochthonous cultivars obtained by hybridization: Selena, Blasius, Rose Blaj, Rubin, Radames, Brumăriu, Astra. The present study focused on a combination of agroecological techniques applied /plot/cultivar: grassing between rows: natural/sown, total/partial, maintenance of vine rows by: chemical/mechanical weeding, agro-ecological practices: grass strips, flower strips, hedges, planting shrubs at the ends of each row, planting fruit trees, providing structural elements (piles of stones or wood), use of biopesticides and biological methods of pest control. The observed effects of biodiversity conservation practices differed between grape cultivars. The disease resistance of the Rubin, Radames, Brumăriu varieties led to an increase in the production of phytochemical compounds, having a positive effect on the quality of the grapes and the stability of the viticultural ecosystem. Biodiversity and immunity of the studied viticultural ecosystems has improved a lot in the last five years, as a result, although the application of chemical pesticides has been reduced to a minimum, grape harvests have stabilized in terms of quantity and quality. The benefits of biodiversity on grape quality depend on the grapevine cultivar.

**Keywords:** biodiversity; grapevine cultivars; viticultural ecosystem

S04-P-IV-5

### **Varietal selection of autochthonous grape varieties in Serbia**

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The autochthonous grape variety assortment in Serbia has been reduced to a few varieties. This paper presents results of varietal selection of autochthonous varieties Smederevka and Prokupac, which was conducted first time in Serbia with these varieties. Smederevka is a variety of combined characteristics (table grape and wine production). Prokupac is an old autochthonous variety that, in addition to wine production, has been used in breeding programs to create new varieties. So far, 4 clones of Smederevka and 12 clones of Prokupac variety have separated. The results of the study refer to mechanical composition of grapes and berries, as well as to qualitative parameters of grape juice (sugar content, total acidity and pH). For the Smederevka variety, clone SM3

(385.6 g) had the highest grape mass determined, while SM1 (207.75 g) had the lowest. Clone SM3 (18.2%) had the highest sugar content, followed by clones SM6 (17.6%), SM1 (17.4%) and SM5 (16.6%). The highest content of total acids was determined in the grape juice of the clones SM 1 (6.02 g/l) and SM 6 (5.95 g/l). Among the Prokupac clones, clone 41/1 had the largest cluster length, while the widest cluster was recorded for clone 43/4 (10.24 cm). Clone 41/3 had the highest percentage of cluster stem (5.3%), but the lowest percentage of berries in the cluster (94.7%). The berry weight of clone 40/8 was 2.78 g. Clone 43/2 was characterized by the highest accumulated sugar content (22.05%), while the highest total acid content was found in clone 40/5 (8.53 g/l). Separated clones enrich gene pool of autochthonous assortment. They have improved technological characteristics and oenological potential. Their expansion are suitable basis for production of wines with protected geographical origin from autochthonous varieties, which can be included in the list of new brands on the wine list of Serbia.

**Keywords:** varietal selection, autochthonous, grape, Smederevka. Prokupac

S04-P-IV-6

### **Intravarietal genetic diversity in grapevine (*Vitis vinifera* L.) cultivars of Lebanon as revealed by ampelographic descriptors and ISSR markers**

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Grapevine (*Vitis vinifera* L.) traditional cultivars of Lebanon have been subject to vegetative propagation for hundreds of years. They may have accumulated somatic mutations that have not yet been sufficiently explored. In this study, we investigate the intra-varietal diversity within four local cultivars: "Obeidi", "Merwah", "Aswad", and "Maryame". A total of 27 accessions growing in different agroclimatic areas of the country were collected and submitted to ampelographic and ISSR characterization. Ampelographic analysis indicated moderate variability for the quantitative traits of the bunch and of the berry while a limited variability was recorded for the qualitative traits. ISSR markers depicted variability among accessions reflecting more evidence in distinguishing divergent profiles within the four cultivars studied. These findings confirm the existence of an important clonal diversity for the Lebanese grapevine germplasm and recommend a strategic management towards conservation, propagation and vineyards establishment.

**Keywords:** *Vitis vinifera* L.; Autochthonous cultivars; ampelography; ISSR; clonal diversity

S04-P-IV-7

## **Variation, Correlations, and Observations of Applied Selection in Diverse Interspecific Cold-hardy Bunch Grapes**

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Grapevine breeding for cold-hardiness and fruit quality is critical to future success of grape growers in North Dakota, USA and other similar regions with brief growing seasons and severe cold. Across the North Dakota State University Grape Germplasm Enhancement Project's breeding plots, screening and selection were conducted simultaneously in mid-August, 2020 for 505 breeding lines. Vines were visually rated for yield traits, acclimation traits, and foliar fungal pathogens; berries were scored organoleptically for acidity, herbaceousness, and seed maturity while berry samples were collected and analyzed for berry mass and chemistry (soluble solid content [SSC], total acidity [TA], and pH). An overall mean TA of 23.3 g/L, pH of 2.95, and SSC of 18.3 °Brix were observed across all breeding lines. Culled lines (n=276) had averages of 25.0 g/L for TA, 2.91 for pH, and 17.6 °Brix. Lines advanced for further testing (n=17) had a mean TA of 18.6 g/L, a pH of 3.04, and a SSC of 19.9 °Brix. The performance of field based phenotypic selection was compared to varying thresholds of culling and advancement rates. Simultaneously, the cumulative breeding lines were assessed for correlations among critical traits to improve informed selection in applied grapevine breeding scenarios. As breeding programs continue to stretch the boundaries of traditional viticulture, employing diverse material to improve grapevine germplasm, rapid and accurate selection methodologies must be paired with traditional field selection of high performing vines to ensure grower focused deliverables for climate resilience and crop quality.

**Keywords:** Grape breeding, accession screening, selection criteria

S04-P-IV-8

### **Properties of the newly created table grapevine cultivar 'Kristina'**

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During the three-year tested period (2016-2018), the most important ampelographic and productive properties of the newly created table grapevine cultivar 'Kristina', which originated from the cross combination 'Muscat Hamburg' x 'Seedling 108', were studied. The cultivar was created at the Faculty of Agriculture, University of Belgrade. It was compared with the standard cultivar 'Muscat Hamburg' in terms of the studied properties. Regarding the ampelographic properties, the 'Kristina' cultivar represents a unique genotype and has a fully open tip of the young shoot, five lobes in the mature leaf, a hermaphrodite flower type, a loose bunch, a narrow ellipsoid berry shape, a blue-black color of the berry skin and a muscat flavor. Statistically significant differences in production traits between the 'Kristina' cultivar and the standard cultivar were found for ripening time, grape yield, bunch length, bunch width and sugar content in the must. On average, the 'Kristina' cultivar had a later ripening time (September 26) than the standard cultivar (September 18). The 'Kristina' cultivar had a grape yield of 2.19 kg/m<sup>2</sup>, a bunch weight of 328.0 g and a berry weight of 2.98 g, while the 'Muscat Hamburg' cultivar had a grape yield of 1.78 kg/m<sup>2</sup>, a bunch weight of 312.5 g and a berry weight of 3.61 g. The sugar and total acid content in the must of the 'Kristina' cultivar was 22.82%, i.e. 7.1 g/l respectively, while that of the 'Muscat Hamburg' cultivar was 17.2%, i.e. 6.3 g/l respectively. The 'Kristina' cultivar showed a very high resistance to the most important fungal diseases (*Plasmopara viticola*; *Uncinula necator*; *Botrytis cinerea*). Due to a number of positive properties, especially the beautiful and attractive appearance of bunches and berries, as well as disease resistance, 'Kristina' cultivar is expected to spread in production vineyards in Serbia.

**Keywords:** grapevine, ampelographic properties, yield, quality, resistance

## **SESSION V: IMPACT OF CLIMATE CHANGE ON VITI-VINICULTURAL AND WINE PRODUCTION**

### **ORAL PRESENTATIONS**

S04-O-V-1

#### **How soil and canopy management can mitigate climate change effects on Greco grapevine: the results of a transdisciplinary approach**

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Climate change has already caused significant warming and drought in most grape-growing areas of the world, particularly in the Mediterranean area where viticulture is suffering yield and grape quality reductions. Ongoing climate change is aggravating some critical issues in the production of the autochthonous grape variety Greco (*Vitis vinifera* L. subsp. *vinifera*), widely cultivated in southern Italy and used alone or blend in many quality label wines. Nowadays, there is a high risk for the economic sustainability of Greco cultivation due to reduced vine productivity, low selling price of grapes, and territory fragmentation. The application of adequate cultivation techniques, such as soil and canopy management, can help alleviating the increasing constraints to vineyard sustainability. In the framework of the Rural Development Programme 2014-2020, Campania Region funded the GREASE project to contribute to the main topic of improving grapevine productivity, resource use efficiency, and resilience through vineyards sustainable management. The general objective is to improve the production of Greco by optimizing vine canopy and soil management to achieve a good vegetative and reproductive balance that enhances grape and wine quality, improves farm profitability, and finally provides environmental sustainability. The project was carried out in a Greco experimental vineyard of Feudi di San Gregorio winery (Avellino, Campania region). The growth and the eco-physiological traits of vines were monitored in the main phenological phases by measuring morphological and eco-physiological parameters, fertility, and leaf anatomical traits. The meteorological data and soil water content were collected through weather stations and TDR sensors. Proximal sensing techniques were applied to monitor the whole vineyard performances. The production of each experimental plot was evaluated in terms of musts and wines characterization to assess

the treatments-induced changes in oenological traits. The results of three-years experimental trials are summarized.

**Keywords:** Soil-plant-atmosphere continuum, sustainability, eco-physiology, stress mitigation, grape quality

S04-O-V-2

**Climate change implications on vegetative phenophases of the main grape varieties grown at Bujoru viticulture and winemaking research facility**

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Since 1966, the World Meteorological Organization established the use of "climate change" concept that includes all forms of climate variability on time scales greater than 10 years, regardless of the cause. Bujoru viticulture and winemaking research facility, as well as the entire S-E geographical area of Romania, has been witnessing such phenomenon, since 2002. The most common phenomena documented was the manifestation of extreme drought. This phenomenon is amplified in recent years due to the lack precipitation during specific growing periods of the vines and high temperatures during vegetative phenophases. Because of the climatic factors an advance of phenophases with obvious repercussions on quality and quantity of grapes was observed in the main grape varieties grown at Bujoru viticulture and winemaking research facility. Climatic change mainly manifests its self by excessive drought mainly during the vegetative period but it can also extend in the following plant cycles. This leads to limited vegetative growth, fruiting and production yields below the biological potential of the varieties. If the current trend on climatic evolution is maintained, there is a possibility that in a short time there will be major changes in vine varieties zoning. Irrigation systems are now a must have for grapevine plantations and without these systems there is a low probability to order to obtain sustainable and qualitative productions yields.

**Keywords:** climate change, vegetative phenophases, drought

## **POSTER PRESENTATIONS**

S04-P-V-1

### **The evolution of the main climatic factors in the interval 2014-2023 and their influence on the grapes production obtained in the Murfatlar wine-growing center**

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Among the factors that influence the favorability of a vineyard, the climatic ones become more and more expressive, causing changes in the manifestation of the biological potential of the grapevine varieties. The study carried out in Murfatlar in the period 2014-2023 revealed changes in the thermal values consisting of increases in the average annual temperature by 2.1°C and in the vegetation period by 1.7°C compared to the multi-year average recorded in the period of reference, 1984-2013 interval. There is an increase in the annual frequency of days with maximums > 30.0°C, a decrease in the frequency of winter days (maximum of the day < 0.0°C), an increase in maximum temperatures both in winter and in those of summer. The amount of annual precipitation is reduced by 60.6 mm on average, and a change in their distribution is noted, especially during the growing season. The combined effect of climatic factors, expressed with the help of synthetic indicators calculated for the study period, describes a climate with sufficient heliothermal resources (the average value of the viticultural bioclimatic index - lbcv was 13.4) but with a water deficit (the average value of the hydrothermal coefficient - CH was 0.7 compared to 0.95 the previous average value). These climate changes have led to changes in the development of the phenophases, the current study presenting the evolution of 4 representative varieties for the vineyard, two for white wines - Feteasca regala and Columna and two for red wines, Feteasca neagra and Mamaia. An early ripening of the varieties is recorded, the harvest being carried out 5 to 7 days earlier for the white varieties, respectively for the red ones, simultaneously with an increase in the concentration of sugars in the must, reaching values of 230-240 g/l correlated with a decrease in total acidity.

**Keywords:** heliothermic resources, water deficit, synthetic climate indices, ripening varieties, grape quality

S04-P-V-2

### **Study on climate changes in the Odobești vineyard, Vrancea**

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Climate change already has a significant impact on agriculture, viticulture being one of the vulnerable branches considering the dependence on climatic conditions during the vine vegetation period, the main effects being reported on the evolution of the phenophases of the vine and the accumulation of sugars in the grapes. This paper aims to address a complex study on the climate changes recorded in the last 15 years in the wine-growing area of the Odobești vineyard, Vrancea, by analyzing the main annual and growing season climate indicators (air temperature, precipitation, insolation, air hygroscopicity) and synthetic climate indicators (Ihr, CH, Ibcv, IAOe). The climatic data analyzed in this study were recorded at the weather station of R.S.V.O. Odobești, in the period 2008-2023 and compared with the multiannual climate data (1946-2007 period). This study highlighted significant changes in climate factors in the Odobești wine ecosystem, and specific climate change phenomena (increase in annual and average values of the analyzed climate indicators, significant fluctuations in annual precipitation and during the growing season, drought and prolonged heat waves, etc.), with a direct impact on the vegetative and productive potential of the vine.

**Keywords:** climate change, climate indicators, grapevine, Odobești

S04-P-V-3

### **The behavior of some varieties and clones for red wines in the context of climate changes in the Valea Calugareasca viticultural center**

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The climate changes registered in the last 30 years have highlighted unfavorable trends in the evolution of climatic factors, respectively, the increase in the thermal regime, especially in the frequency of hot periods, and a decrease in the amounts of precipitation, which led to the emergence of the phenomenon of pedological drought. The long period of drought associated with a high thermal regime and a lower hygroscopicity of the air, installed during the period of intense growth of shoots and grapes, determined a reduction of the vegetative phenophases period, of shoot growth, and a slowdown of berry growth. All these factors had a negative impact on the qualitative potential for the red wine varieties, Negru aromat and Cabernet Sauvignon, and for the Fetească neagra 4 VI clone, by increasing the concentration of sugar in grapes by 17-20% and decreasing acidity by 20-30%.

**Keywords:** temperatures, rainfall, vegetative phenophases, sugar, acidity

S04-P-V-4

### **Assessing the Impact of Climate Change on Muscat of Alexandria Grapevines under Rain-Fed Conditions**

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The growth and characteristics of grapevines are influenced by numerous factors, including rootstocks, scions, vine training, climate conditions, field characteristics, and agricultural practices. Therefore, it is essential to identify the most suitable rootstock-scion combinations tailored to each unique condition. In this study, we assessed the growth and fruit set of two clones of Muscat of Alexandria grafted onto the rootstocks 41 B and 140 Ru. The experiment was conducted under a rain-fed regime in a field in La Marina Alta (Alicante, Spain), where this variety is representative. The aim was to understand the effects of a dry year with anomalously high temperatures on the growth and fruit set of the rootstock-scion combinations under study. The comparison of clones is also interesting as accumulated mutations and other changes may confer them with different abilities to acclimate to various environmental conditions. To achieve our goal, several parameters, including fertility, budburst and flowering time, development of buds (phenological stages), vigor, fruit set, and berry quality, were measured. Fruit set and fruit development were significantly affected in all rootstock-scion combinations, albeit to varying degrees, underscoring the importance of careful selection when choosing among them. Berry analysis results are consistent with previous observations of differing ripening times between clones. This work was funded by Generalitat Valenciana (grant CIAICO/2021/118) and contributes to the understanding of grapevine cultivation and adaptation.

**Keywords:** Phenology, clone, rootstock, fruit set, berry, dryness, temperature

S04-P-V-5

### **The behavior of the new variety for table grapes Adoris in the temperate continental climate conditions from northeastern Romania**

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The continuous growth of the global population, the current climate changes, along with the ever-changing demands of consumers, represent the main reasons for the obtaining of new grapevine varieties with superior quality characteristics and high ecological plasticity. The aim of the study was the agrobiological and technological evaluation of the new *Vitis vinifera* L. table grape variety Adoris, obtained at the Research Development

Station for Viticulture and Winemaking Iași, N-E of Romania, by controlled hybridization of Coarnă neagră × Muscat de Hamburg varieties, patented in 2023. The studies were carried out in the period 2017-2022, the variety showing high and constant grape yield (> 20 t/ha), a merchandise production of over 90%, and good biological resistance to drought and cryptogamic diseases, in the conditions of standard phytosanitary application scheme. Adoris variety is self-fertile, with a medium vegetation period, ripening the grapes in the second decade of September (IV-V maturation epochs). The grapes are medium-sized (310±30 g), with uniform, elliptical-shaped berries, with dark red-violet skin and intense pruinosity. Grape pulp and must are colorless, with a subtle muscat aroma. Accumulations of sugars are in average ≥200 g/L, the grapes maintaining a good acidity, over 5.1 g/L tartaric acid, the variety being recommended for planting in areas with a continental temperate climate, similar to the wine-growing area of origin.

**Keywords:** Agrobiological features, grapevine variety, technological features, temperate climate, *Vitis vinifera* L.

S04-P-V-6

**The effects of climate change on the intensity of attack of gray rot and black rot in the Cadarcă and Mustoasă de Măderat varieties from Miniș - Măderat vineyards**

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The microclimate present in the Miniș-Măderat geographical area brings Mediterranean influences, beneficial for the vine culture. Spring in this area is usually early and wet, while autumn is long, warm and dry, ensuring optimal conditions for the ripening of the grapes, typical of each variety. In recent years, due to climate changes characterized by prolonged drought (high temperatures in the first part of the growing season) and intense rains in the second part of June, favorable conditions for rot infection are created. The study of the intensity of the attack of black and gray rot was carried out on the autochthonous varieties at Cadarcă and Mustoasa de Măderat, vulnerable to these infections. In the studied period 2018-2023, the climate experienced deviations from the multiannual average values, the results obtained show that these two diseases are increasingly evident and more aggressive. Gray rot *Botryotinia fuckeliana* (sexual form) *Botrytis cinerea* (asexual form), through infections leads to profound changes in the composition of grapes and must, affecting the quality of the wines produced. Black rot *Guignardia bidwellii* being an epidemiological outbreak disease has a characteristic and rapid evolution. These findings are important for preventing infections of the two fungi.

**Keywords:** *Botryotinia fuckeliana*, *Botrytis cinerea*, *Guignardia bidwellii*, Miniș Vineyard - Măderat, climate conditions.

S04-P-V-7

## Assessment of the plasticity level of two *Vitis vinifera* L. cultivars in three environments of central and southern Italy as an indicator of the impact of climate change

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Viticulture is affected by climate change. The level of plasticity, that represents an index of the genotype adaptability to different pedoclimatic conditions, is an indicator of the cultivar adaptation to the climate change, in particular to drought increase. Grapevine adaptation to drought generally involves morphological, physiological and productive modifications. This study explored the genotype x environment interaction of two black grape cultivars, Aglianico and Cabernet Sauvignon. The study was conducted in 2020 and 2021, in six commercial *Vitis vinifera* L. vineyards, located in three regions of central-southern Italy: Molise, Campania and Sicily. Bud fruitfulness, total leaf area/vine, midday water status, and fruit yield were measured. In Molise and Campania, the climate is characterized by cold winters and mild summers; the rainfall is fairly uniform throughout the year. Sicily is characterized by a prolonged drought period during the productive season. Both the potential and observed bud fertilities were generally lower in Aglianico. The vegetative parameters indicate a long period of water stress in Sicily. The leaf water potential of Aglianico was very negative during the dry season. In Molise and Campania, the stomatal conductance and the leaf water potential revealed that Cabernet Sauvignon can be classified as a near-isohydric cultivar, Aglianico as a near-anisohydric cultivar. The yield was in line with the bud load chosen during winter pruning. For the Aglianico cultivar the environmental conditions in Sicily were limiting; in Molise the environmental conditions favored an excess of vegetative growth and canopy density. On the contrary, Cabernet Sauvignon expressed its morphological stability mainly through its bud performance, shoot growth, leaf area, and total leaf area/vine. Cabernet Sauvignon, characterized by a high stomatal conductance, maintained a less negative leaf water potential, thus expressing its varietal characteristics, regardless of the environmental growing conditions mainly in Molise and Campania.

**Keywords:** terroir, physiology, Aglianico, Cabernet Sauvignon, total leaf area, water stress

## **SESSION VI: SUSTAINABLE OENOLOGICAL PRACTICES FOR WINE AND WINE SECTOR RELATED TOPICS**

### **ORAL PRESENTATIONS**

S04-O-VI-1

**Overview of oenological practices recently approved or under consideration for approval by the OIV**

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The International Wine and Vine Organization (OIV) is an intergovernmental technical and scientific organisation aiming to support the vitivinicultural sector by primarily setting internationally harmonised and accepted standards for the production of vitivinicultural products, among which standards of oenological practices are of an utmost importance. As the research continuously provides innovative solutions for an ever more dynamic and challenged wine industry, new oenological practices emerge, which, before being transposed into resolutions and recommended by the OIV, need to be evaluated by the expert groups within the organization. Thus, until approved by consensus of the OIV member states, the potential new standards (also named resolutions) remain unknown to the public, producers and many researchers. These standards can be proposed by any member state, only based on strong scientific facts. Sometimes the research and publications to back up the new procedures are scarce and not convincing enough to reach consensus, thus the process of approval takes time, awaiting new evidence to emerge. Therefore, timely informing the research community of the resolutions considered for approval can stir up the research in those particular areas. This presentation provides a review of the main resolutions of oenological practices recently approved or under consideration at the OIV and the scientific evidence behind them.

**Keywords:** OIV, oenological practices

S04-O-VI-2

### **Circular economy strategies for the processing and reintegration of wine by-products from the grape wine Cv. Lagrein into the food chain**

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The Lagrein grape variety is an autochthonous red cultivar grown in South Tyrol, Italy, known for its high content of antioxidants and polyphenolic compounds. For the integration of the Lagrein grape pomace into the food chain, the antioxidant profile of the pomace and its change during various processing steps has been characterized. The Antioxidant Capacity ( $> 80 \text{ mmol Fe}^{2+} 100 \text{ g}^{-1} \text{ DW}$ ), Total Polyphenol Content ( $> 4,000 \text{ mg GAE}_{\text{eq}} 100 \text{ g}^{-1} \text{ DW}$ ) and Total Anthocyanins ( $> 7 \text{ mg Cya-3-glu}_{\text{eq}} 100 \text{ g}^{-1} \text{ DW}$ ) of the grape pomace were nearly preserved throughout the drying and milling processes, resulting in a grape pomace flour rich in Antioxidant Capacity ( $> 65 \text{ mmol Fe}^{2+} 100 \text{ g}^{-1} \text{ DW}$ ), Total Polyphenol Content ( $> 3,600 \text{ mg GAE}_{\text{eq}} 100 \text{ g}^{-1} \text{ DW}$ ) and Total Anthocyanins ( $> 5 \text{ mg Cya-3-glu}_{\text{eq}} 100 \text{ g}^{-1} \text{ DW}$ ). The obtained flour, used as additional ingredient in baked goods, namely breadsticks, cookies and focaccia, revealed a substantial increase in the antioxidant profile of all the final products: +40% to 650% in the case of Antioxidant Capacity, +40% to +160% of Total Polyphenol Content, and +70% to +500% in the case of Total Anthocyanins. This research highlights the potential of Lagrein grape pomace for re-utilization in baked goods, in accordance with the circular economy principles for grape wine by-products and contributing to the sustainability of wine production.

**Keywords:** Wine Production, Grape Pomace, Autochthonous Cultivars, Sustainability, Baked Goods, Antioxidants, Polyphenols, Anthocyanins

S04-O-VI-3

### **Antimicrobial investigation of polyphenol action present in forest fruits and red wine extracts**

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Plant polyphenols are structurally diverse compounds that have been used for centuries due to their medicinal properties that include antimicrobial, antioxidant, anti-inflammatory and anti-carcinogenic properties. Existing evidence regarding the specific antibacterial capacity can recommend them as an alternative or complementary therapy in diseases with an infectious etiology [1]. Fruit extracts and red wine samples were subjected to a simple hydroalcoholic extraction process followed by concentration via rotoevaporation. pH, total polyphenol and anthocyanin content was monitored. Antimicrobial properties were tested by the disc-diffusimetric method on bacterial cultures of E.Coli, Klebsiella, S.Aureus. Maximum total polyphenol concentrations of 2.450 g/L with a minimum of 1.400 g/L for red wine samples and 2.332 g/L with a minimum of 1.089 g/L for fruit samples was obtained. Anthocyanin concentrations varied between 0.408-

0.182 g/L in red wines and 0.494-0.043 g/L for fruits. Fruit and wine extracts showed variable diameters of inhibition proportional to antimicrobial proprieties. The smallest diameters could be observed for Klebsiella cultures. A better efficacy was observed for S.Aureus and E.Coli cultures. Polyphenols can become an alternative to conventional antibiotic therapy, the results of the study confirming some literature references.

**Keywords:** Polyphenols, anthocyanins, bacterial cultures

S04-O-VI-4

### **Bioprotection as a tool to produce low-content sulfite wines. Case study - Cabernet sauvignon and Fetească neagră**

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Nowadays, there is an increasing concern about wine security and more winemakers choose bio-protection as an alternative to SO<sub>2</sub> in the winemaking process, to obtain a natural wine. This work aimed to evaluate the replacement of SO<sub>2</sub> with a PrimaFlora Bio VR in the first step of the winemaking. Two wines were produced in vintage 2021, in the Ceptura Wine-Growing Center, Dealu Mare Vineyard, Romania. Red wines of Cabernet sauvignon and Fetească neagră, a local variety, were obtained by two methods - treated with sulfur dioxide (25 mg/L) and treated with PrimaFlora (7 g/hL). The oenological parameters, antioxidant capacity, total phenolic, total flavonoids, and total anthocyanin contents were determined for each variant. The values obtained confirm positive aspects regarding the oenological parameters when it comes to wines treated without sulfur dioxide. The HPLC chromatographic profile of wine shows that Primaflora VR Bio favored the extraction and accumulation of several anthocyanins. Among them, malvidin-3-Glucoside represents approximately 50% for Cabernet sauvignon, and 66% for Feteasca neagra, respectively, of the total anthocyanins. Also, the content of total flavonoids for variants treated with Primaflora VB Bio was higher with 5 mg GAE/L (Cabernet sauvignon) and 22 mg GAE/L (Feteasca neagra) compared to the variants treated with

SO<sub>2</sub>, but the differences were insignificant. The antioxidant potential of wine was correlated with its total polyphenol content. The chemical analyses evidenced that the final concentrations of total phenols and flavonoids were not very different among the variants. Nevertheless, further studies could be useful to confirm the potential of PrimaFlora VB Bio as an alternative to sulfur dioxide, and a basic variant for organic wines with a low sulfite content.

**Keywords:** Bio protection, sulfur dioxide, red wine, Cabernet sauvignon, Feteasca neagra, anthocyanins, phenols, flavonoids

S04-O-VI-5

### **Wine tourism hotspot: a case study with a small Portuguese family-owned company**

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Wine tourism, often developed by small economic entities of a family dimension, has proven to be a catalyst for tourist activity and regional development. These entities can act as wine tourism hotspots – places that are well-known for offering a unique and enjoyable wine tourism experience, making them sought-after destinations for travelers interested in wine. This work aims to present a successful case study focused on the wine tourism activities of a family-owned company with 15 employees, a winery, and 67 hectares of vineyards, located in the Portuguese wine region of Bairrada. During the analyzed period, between May and August of 2023, 67 visit + lunch programs and 115 visit + wine tasting programs were conducted, with the second option being the most sought-after tourist product. Analyzing the countries of origin of tourists, it was possible to conclude that the most frequent visitors were Portuguese (30%), Brazilians (17%), and Americans (16%), followed by the Dutch (11%), Israelis (4%), Spaniards (3%), and Mexicans (2%), from a total of 20 nationalities. Through the SWOT analysis of the company's wine tourism activity, it was possible to identify as strong points the high reputation of this company in the wine industry and the recognition of the high quality of the wines, predisposing tourists to accept paying a higher price. The main weakness identified was the limited wine production, reducing its presence in the market and failing to meet demand. In conclusion, the case study deepened the understanding of the fundamental role that small family-owned wine companies play in a wine region because they can serve as focal points of attraction – hotspots - for a diverse range of tourists from different countries.

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**Keywords:** tourism, familiar company, wine-related activities, wine tourism hotspot.

## **Effect of an innovative continuous pressing system on the quality of white musts and wines**

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Minimizing air intake and mechanical stress on the white grapes during pressing allows to reduce the risk of oxidative spoilage and herbaceous aromas in the obtained wines. The innovative pressing system, here presented, allows a soft pressing of the grapes and the protection from air, with the advantage of working continuously. The press consists of a rotating cylindrical cage and a metallic cylinder that rotates in it. Grapes are pressed between the cage and the cylinder and the velocities of the two components are chosen so as there is no relative movement between them. The innovative press (IP) was compared to a conventional batch pneumatic press (PP). In a first assay, conducted on Trebbiano, Falanghina and Greco grapes, several parameters were compared, and the IP resulted to be advantageous in terms of higher total acidity, pH, total phenolics, absorbances at 280, 420 and 325 nm, with some differences among the cultivars. A second assay, conducted on Falanghina grapes, was aimed at evaluating the free and glycosidically bound volatile aroma compounds (VOCs) of musts and the sensory profile of wines obtained by IP and PP. In the IP must, a lower amount of C6 alcohols, responsible for herbaceous aromas, was found. As concerns the VOCs extracted from grapes, a common trend was not found. Floral terpenols (linalool,  $\alpha$ -terpineol, geraniol), were less abundant in the IP must, both in their free and in their bound form. On the contrary, benzyl alcohol, 2-phenylethyl alcohol, eugenol and  $\beta$ -damascenone in their bound forms were more concentrated in the PP must. Wine odor profiles showed that, among all the detected odors, Floral and Banana were more intense in the PP wine, while Honey was more intense in the IP wine.

**Keywords:** white winemaking, pressing, polyphenol indexes, aroma, sensory analysis

## **POSTER PRESENTATIONS**

S04-P-VI-1

### **Traceability of grape processing and the quality of wines obtained in the Codru wine-growing region of the Republic of Moldova**

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The authenticity and quality of the wines is in close correlation with the ecological and technological factors of growing grapes and their processing. By ensuring the traceability of grape cultivation and wine production, it contributes to the maintenance of the quality management system. In order to increase the competitiveness of wine products on the national and international markets, the Wine Register was created an IT system that helps to systematize data on vine areas and wineries, which contains detailed information about grape (areas, varieties) and wine (stocks of wines) producers in the Republic of Moldova. The article presents the results of the analysis of the ecological conditions and the quality of the wines obtained from the main producers of the Codru wine region. Through the organoleptic testing of the wine production of 2023 vintage year, the most competitive wine lots were evidenced.

**Keywords:** processing, wine, factors, quality, competitiveness

S04-P-VI-2

### **The quality of wines produced in south-western Poland – 2021**

**Czaplicka, M.**, Gudarowska, E., Chmielewska, J., Krezel, J., Parypa, K., Rowinska, M., Pilawka, T., Uklanska-Pusz, C., Babelowski, P., Mazurek, J., Chohura, P., Zubaidi, M., Nawirska-Olszanska, A.

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The development of wine production in Poland has been very dynamic in recent years. However, the real lack of winemaking traditions means that many winemakers make mistakes or draw on winemaking experiences from many traditional regions to obtain good wine. This affects the variety of wines available in this area. The aim of the study is to indicate the basic parameters of wines produced in this region, such as alcohol content, acidity, residual sugar content and organoleptic assessment. The study covered nearly 40 wines from the 2021 vintage, produced from both *Vitis vinifera* and PIWI varieties. These were both single-varietal wines and wines without a specific variety. The wines differed significantly in terms of alcohol content, acidity and residual sugar.

**Keywords:** wine, polish wine, PIWI wine, quality, alcohol contain, sugar, acidity

S04-P-VI-3

### **Technological characteristic of Cabernet Sauvignon wines produced in an integrated system**

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Integrated Production implies reduced interventions on vine and wine making process, being favorable for the environmental protection and human health. At the Research and Development Institute for Viticulture and Enology, Valea Calugareasca, the effects of system have been studied on an experimental plot of Cabernet Sauvignon in comparison with a classical control plot and other three modules (MED) where different techniques were applied (soil maintenance and fertilization, vegetation structure, phytosanitary protection) representing intermediary steps for accomplishing the integrated production system. The chemical composition ratio reveals that total N, P and K supply is optimal for MED 1 "Soil maintenance and fertilization" and MED 4 "Integrated Production". As for MED 5 (Witness Control), it was noticeable that P<sub>2</sub>O<sub>5</sub> level exceeds the optimal domain, whereas that of K<sub>2</sub>O is lower. The fertility of the winter buds increased by a higher percentage than in case of MED 4, in MED 2 "Structure of the vegetation" the potential crop (buds retained at pruning) was attentively adjusted by considering both the requirements of the variety and the adequate airing of the canopy. With MED 4, the number of inflorescences was an average one, considered however as being optimal. The treatment application schedule according to the grapevine development stages and the infection strength gave the best results. Quite relevant for the quality of the grapes is the diminution of grey rot attack from 47% in case of MED 5, to 4,3% in case of MED 4, the results at veraison being mirrored also at harvesting. The physico-chemical composition of the wines produced presents several differences. The higher content in alcohol for the wines produced within MED 3 „Phytosanitary protection” and MED 4, the correlation with the higher level of the extract within MED 2 and MED 4 revealing the influence of the vegetation structure.

**Keywords:** systemic concept, integrated production, production system, maturation stage, conventional system, new concept

S04-P-VI-4

### **The quality of must for wine making of several grape cultivars, depending on the location of the vineyard and practice in viticulture**

**Czaplicka, M.,** Parypa, K., Gudarowska, E., Chohura, P., Rowinska, M., Babelewski, P., Krezel, J., Uklanska-Pusz, C., Mazurek, J., Pilawka, T.

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Viticulture in Poland is growing dynamically. Although production is still small and meets only 0.5% of domestic consumption needs, new vineyards are established every year. One of the significant problems in the development of beginner winemaking is the quality of the raw material for wine production. Winemakers usually complain about the need to harvest at a time dictated by the weather, and not by the full ripeness of the fruit. The study examined the relationship between the content of nutrients in leaves and soil and

the quality of fruit according to basic winemaking parameters. Both the location of the vineyard (or the winemaker's practices) and the content of selected elements had a significant impact on the quality of must. These data indicate that the brix level in fruit can be controlled by the application of microelements or other cultivation techniques, which in the future may contribute to improving the quality of wines produced in this region and in other, less developed wine areas.

**Keywords:** grape, viticulture, nutrients, most quality, fruit, soil, south-west Poland

S04-P-VI-5

### **Enzymatic reduction of glucose from grape must using glucose-oxidase as a strategy for the production of low-alcohol wine**

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Increasing temperatures as a result of climate change, the application of modern viticultural technologies, as well as the use of highly alcohol tolerant selected yeast strains, have gradually led to the production of wines with higher alcohol concentrations. On the contrary, consumers preference for wines with a lower ethanol content, which are generally perceived as healthier, has become increasingly evident in recent years. One of the most promising processes for obtaining wines with a lower alcohol concentration than the potential of the grapes at harvest is the enzymatic reduction of glucose from grape must using glucose-oxidase (GOX). The current studies aimed to evaluate the action of GOX, both in free form (produced by *Aspergillus niger*) and immobilized (Gluzyme Mono 10000 BG), in citrate buffer solutions (0.1 M), synthetic media (MMM) and grape must, with or without the addition of catalase (CAT). Tested in synthetic media, GOX catalyzed the transformation of over 50% of the glucose, the enzymatic reaction being strongly influenced by the pH of the solutions. The application of GOX in grape must (Muscat Ottonel; pH 4.00) for 24 hours at 20 °C, with intermittent aeration, led to a reduction in glucose content by up to 12.90% (24 g/L), in parallel with gluconic acid accumulation (< 4.00 g/L), being obtained wines with a lower alcohol concentration of up to 1.05% (v/v), but with higher values of volatile acidity and the browning index (DO420 nm) and lower non-reducing extract, which may adversely affect their sensory perception.

**Keywords:** ethanol, glucose oxidase, grape must, pH, enzymatic reaction.

S04-P-VI-6

### **Microbiological control in a winery: a case study with stainless-steel tanks for wine storage**

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Within a winery, the objective of microbiological monitoring is to uphold the wine quality. Therefore, the cleaning and monitoring of the winemaking and wine storage are crucial to ensure the microbiological and sensory quality of wine. This study aimed to demonstrate the importance of the microbiological control during the cleaning process of stainless-steel tanks utilized for wine storage. In the initial stage, samples were collected, after cleaning and sanitizing, from 17 stainless-steel tanks between January and March 2023. Molds and yeasts quantification was carried out using the Wallerstein Laboratory Nutrient (WLN) agar medium. Sampling points on each empty storage tank included the graduated scale, the wine-tasting tap, the tank's interior, and the main tap for wine release. Following analysis of the first results and corrective cleaning measures applied to all tanks, samples were once again collected, in the same conditions as in the initial stage, from 16 stainless-steel tanks between March and April 2023. Bioluminescence tests, employing all-in-one ATP sampling tests, were conducted at the same sampling points. The results obtained from the sanitized tanks showed that the graduated scale of the tanks was the sampling point where the highest loads of yeasts and moulds were detected, while the inside of the tank showed the lowest levels of contamination. In conclusion, the cleaning of stainless-steel tanks is a process requiring the use of more efficient disinfection and washing chemical agents. Additionally, it demands the disassembly of components (if technically feasible), especially at critical points more susceptible to microbiological contamination, such as the graduated scale. Funding: CERNAS is supported by Portuguese National Funds through the FCT - Foundation for Science and Technology, I.P., within the scope of the project Ref. UIDB/00681/2020. DOI: <https://doi.org/10.54499/UIDP/00681/2020>

**Keywords:** microbiology monitoring, wine tanks, cleaning process, wine quality.

S04-P-VI-7

### **The detection of aroma compounds in Georgian wines**

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The country of Georgia, recognized as the "cradle of viticulture," is home to more than 500 grape cultivars and boasts an 8000-year-old history of wine production. Georgian wines are distinguished by their unique aroma and organoleptic characteristics. The main goals of the presented research were to detect aroma profiles, especially terpene content in wines made from Georgian grape varieties – Cicka, Ojaleshi, Meskhuri Mtsvane, Saperavi, Rkatsiteli, Chkhaveri - and to assess their genomic bases. All wines used in the research were made by European wine-making technology. Aroma compounds were extracted using a liquid-liquid extraction method and analyzed using gas chromatography (GC). The results indicate the concentrations of six terpenoids in the aforementioned wines: Citronellol (-), Citronellol  $\beta$  (-), Linalool (-), Limonene S (-), Terpinen-4-ol (+), and Geraniol. By using specific bioinformatical tools (i.e. BLAST, Megante etc.) the TPS sequences of reference genomes of Pinot noir and Georgian grape varieties (Rkatsiteli, Saperavi, Chkhaveri, Meskhuri Mtsvane) were identified and on their bases three pairs of primers for amplification of mentioned genes were constructed for subsequent Next-generation sequencing and comparative genomic studies.

**Keywords:** Aroma, Georgian wines, Terpenes

S04-P-VI-8

### **Impact of autochthonous non-Saccharomyces yeasts on wine aroma complexity**

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Our understanding is limited regarding the effects of the indigenous non-Saccharomyces in sequential fermentation on the volatile compounds of autochthonous Maraština wine. Using targeted headspace solid phase microextraction (HS-SPME) coupled with gas chromatography-tandem mass spectrometry method (GC-MS), we aimed to clarify the impact of seven indigenous non-Saccharomyces yeasts on the wine aroma profile in sequential fermentation with *Saccharomyces cerevisiae*. The yeast isolates were selected from a collection of native yeasts established at the Institute for Adriatic Crops and Karst Reclamation (Split, Croatia) previously isolated from Maraština grapes. Fermentation trials were conducted in sterile laboratory flask with isolates of *Metschnikowia pulcherrima* K-6, *Metschnikowia chrysoperlae* K-11, *Metschnikowia sinensis/shanxiensis* P-7, *Lachancea thermotolerans* P-25, *Pichia kluyveri* Z-3, *Hanseniaspora uvarum* Z-7 and *Hanseniaspora guillermondii* N-29 in triplicate. Non-Saccharomyces yeasts were inoculated into sterile grape must. *S. cerevisiae* was inoculated in each trial when ethanol concentration reached 2-3 %vol. A control treatment included commercial strains *L. thermotolerans* and *M. pulcherrima*. A total of 55 volatile compounds were identified and semi-quantified including terpenic compounds, C13-

norisoprenoids, esters, alcohols, acids, volatile phenols, aldehydes and others. A total of 21 volatile compounds, mostly from the group of terpenic compounds and esters, were significantly different compared to the control. The highest concentration of ester compounds was detected in ferments obtained with *P. kluyveri*/*S. cerevisiae*. Volatile compounds such as  $\beta$ -damascenone, isopentyl acetate, phenylethyl acetate, and ethyl caprylate were present in concentrations higher than the perceptible odour threshold, directly influencing the wine aroma with sweet-fruity notes. The obtained results allow the selection of native yeasts for further research in selecting potential starter cultures in wine production because of their contribution to wine aroma and highlighting regional wine character.

**Keywords:** non-Saccharomyces, isolates, aroma, sequential fermentation, sterile grape must, Maraștina, white wine

S04-P-VI-9

### **Study of volatile compounds in white wines matured with oak chips**

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The maturation of wine constitutes an important stage in which various processes synergistically develop, generating changes in both organoleptic and compositional attributes of the wine. The current study aims to evaluate the influence of different maturation treatments (the addition of wood chips and the influence of ultrasound waves with a frequency of 35 kHz) on the aroma profile of Fetească regală and Sauvignon Blanc wines. For this study, volatile compounds were identified and quantified using a gas chromatography system (Agilent 7890A) coupled with a mass spectrometer detector (5975 C inert XL EI/CI MSD). The utilization of oak chips in the maturation procedures can positively influence the aromatic profile of wines and may be considered a favorable option for the production of wines with reduced maturation periods. Volatile compounds are extracted from oak wood based on factors such as the quantity of available compounds, the duration of contact between wine and oak wood, the degree of toasting and the specific type of oak wood employed. The results of such this experiment hold practical significance for winemakers, offering potential improvements in the use of wood incorporation as well as the extraction process, thereby contributing to the overall improvement of wine quality.

**Keywords:** ultrasound waves, wine maturation, oak chips, volatile compounds, gas chromatography

S04-P-VI-10

### **Analytical and sensorial comparison of white and orange wines**

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The aim of the study was to produce and compare white and orange wines between their sensory and analytical parameters. The following varieties were used: Pinot Gris, Gewurztraminer and Feteasca regala from the vintage 2018. The results of the chemical-physical analysis show that the wines that were fermented on the skins - orange wines - show a higher proportion of glycerol than the wines produced by the classic method, i.e. white wines. Glycerol content ranged from 7.10 to 9.47 g/l in white wines and 8.93-10.23 g/l in orange wines. Orange wines from Pinot Gris and Gewurztraminer varieties show higher values of lactic acid 0.28-0.63 g/l and lower values of malic acid 0.5-1.67 g/l due to partial malolactic fermentation, while white wines show values of lactic acid from 0.00 to 0.18 g/l. Malic acid in these samples ranged from 1.37 to 2.10 g/l. Among the other parameters (glucose, fructose, density, content of total acids and total sugars, tartaric acid, acetic acid and alcohol content), we did not detect statistically significant differences. As part of the sensory evaluation, Gewurztraminer 2018 orange won an average of 84.33 points at exhibition competitions, which is in the interval for obtaining a silver medal (84-88 points) at most exhibitions. Other samples were evaluated in the interval 81.66 – 83.5b. We did not find statistically significant differences between the point evaluation of white and orange wines. The measurement showed that orange wine binds free SO<sub>2</sub> faster than white wine. To maintain the content of free SO<sub>2</sub> at the level of 35mg/l, on average 2.5 times more SO<sub>2</sub> would be used to treat orange wine than white wine.

**Keywords:** white wine, orange wine, Pinot gris, Gewurztraminer, alcohol

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### **Increasing microalgae biomass feedstock by valorising wine gaseous and liquid residues**

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Global warming due to greenhouse gases (GHG) has become a serious worldwide concern. The new EU Green Deal aims to achieve GHG emissions reduction by at least 55% by 2030 and a climate neutral EU economy by 2050. The deal strongly encourages GHG reducing measures at local, national and European levels. The REDWine project will demonstrate the technical, economic and environmental feasibility of reducing by, at least, 31% of the CO<sub>2</sub> eq. emissions produced in the winery industry value chain by utilizing biogenic fermentation CO<sub>2</sub> for microalgae biomass production. REDWine concept will be realized through the establishment of an integrated Living Lab demonstrating the viability of the system at TRL 7. The Living Lab will be able to utilize 2 ton of fermentation off-gas/year (90% of total CO<sub>2</sub> produced in the fermenter) and 80 m<sup>3</sup> of liquid effluent (100% of the liquid effluent generated during fermenter washing) to produce 1 ton (dry weight) of Chlorella biomass/year. This biomass will be processed

under a downstream extraction process to obtain added-value extracts and applied in food, cosmetic and agricultural end-products and to generate a new EcoWine. REDWine will focus on the recovery of off-gas from a 20.000L fermenter of red wine production existing in Adegas Cooperativas de Palmela (ACP, located in Palmela, Portugal). REDWine's microalgae were tested in 2022 and 2023 with 4 purposes in vineyard: improve flowering stages, contribute to high temperature resistance, biofungicide against downy mildew and increasing in nitrogen content in ripening to help fermentation and improve aromatic compounds. It was also used in winemaking processes as a clarificant or anti-oxidant. So far, results were interesting on wine making process but need more trials and results to assess vineyard activity.

**Keywords:** CO2 sequestration, microalgae, vineyards, wine making

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**Are farm to fork strategy goals reasonable and achievable? state of the art of Península de Setúbal's winegrowers**

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The European Union's "farm to fork" strategy sets out several objectives to be achieved by farmers, who, among others, relate to increasing biodiversity, protecting soils and reducing the use of pesticides. The use of pesticides in 235 winegrowers in the Palmela region was evaluated between 2016 and 2023. To support some of the answers, a socio-economic survey was also carried out. The data analysed included the number of treatments, the dosages used, compliance with the pre-harvest interval, the reason why winegrowers performed phytosanitary treatment and how they chose a pesticide. In addition, residue analyses were carried out at the entrance of the grapes into the winery to assess whether the MRL was exceeded and whether were not authorised pesticides were used in the vine. For each year, it was found that, on average, farmers spray seven times, although the trend was to decrease and the most used pesticide belong to groups 3 (Triazol), according to the FRAC Codes. It was concluded that fear of diseases and pests and "empirical experience" sometimes go beyond knowledge and technology. In addition, the weak valorisation of grapes and discouragement with the implementation of some poorly reported strategies are factors that fuel the concern about the difficulty in achieving the goals.

**Keywords:** Pesticides, Farm to fork strategy, Sustainability, vineyard