ADVANCED VITICULTURE

2023/24

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Timetable:

Thursday morning (9:00-13.00h) Room 2.25 (Ferreira Lapa building)

Thursday Afternoon (14:00-17:00h) Sala 27 (main building)

Program and calendar (9/10/2023 to 22/12/2023)

Week	Date	Module	Lecturer
1	12/10	**Morning** **GENERAL INTRODUCTION** Introduction to Advanced Viticulture: Program, Calendar, Bibliography and Evaluation **VI- SUSTAINABLE VITICULTURE** - Introduction to Sustainable Viticulture - Types of Sustainable Viticulture – an overview. Organic and Biodynamic Viticulture, Regenerative Viticulture Practical reports: list of topics	Carlos Lopes (CL)
2	19/10	**I. VINEYARD MECHANIZATION** 1.1. Introduction 1.2. Mechanization of plantation 1.3. Mechanization of fertilization and soil management 1.4. Mechanization of canopy management 1.5. Vineyard spraying equipment. 1.6. Mechanical harvest 1.7. Mechanical pruning	Carlos Lopes (CL) + invited speakers

3	26/10	II. **YIELD ESTIMATION AND CONTROL** 2.1. Introduction 2.2. Yield components and the period in which they are determined. Factors affecting yield components 2.3. Yield variability and it's causes 2.4. Yield forecast 2.4.1. Advantages of Yield forecast 2.4.2. Main techniques for Yield forecasting 2.4.2.1. Aeropalynological forecast models; 2.4.2.2. Estimation of yield components; 2.4.2.3. Agrometeorological models; 2.4.2.4. Remote sensing; 2.4.2.5. Measuring trellis tension; 2.4.2.6. Image Analysis 2.5. Yield control by viticultural practices. 2.5.1. pruning level; 2.5.2. shoot thinning; 2.5.3. shoot tipping or hedging during flowering; 2.5.4. early leaf removal; 2.5.5. spraying growth regulators; 2.5.6. inflorescence thinning; 2.5.7. berry thinning; 2.5.8. cluster thinning.	CL + Invited speakers
	2/11	**Pedagogical break**	
4	9/11	**Free week for Practical Reports preparation**	
5	16/11	III. **IMPLICATIONS OF CLIMATE CHANGE FOR VITICULTURE AND WINE PRODUCTION** 3.1 Introduction 3.2 Climate Change & Viticulture – observed and estimated impacts 3.3 Adaptation measures 3.4 Workshop on Climate Change and Viticulture (invited speakers) - Thermal imaging as a tool to monitor the impact of climate change on viticulture (MCosta, ISA) - Coping with climate change: using grapevine selection methods to obtain tolerant genotypes - (Luisa Carvalho, ISA) -Climate changes and risk of berry sunburn (José Silvestre, INIAV); - Evaluation of climate change impacts on viticulture using new climate indices (R Egipto, INIAV) - Photovoltaic panels in the vineyard – a multipurpose adaptation measure (G. Victorino)	CL + invited speakers
7	23 Nov	**IV. PRECISION VITICULTURE** 4.1. Introduction 4.2. Technologies in Precision Viticulture	CL + invited speakers

		4.2.1. Geolocation 4.2.2. Geographical Information Systems; 4.2.3. Variable Rate Technology; 4.2.4. Remote Sensing 4.2.5 Proximal Sensing 4.2.6. Use of Robotics in viticulture. 4.3. Examples of Applications of PV – workshop with invited speakers	
8	27-29 Nov	**Study visit**	
9	30 Nov	**VI- WORKSHOP ON SUSTAINABLE VITICULTURE** - Importance of soil microbiome on Viticulture Sustainability (E. Santos, ISA) - Sustainable water use in viticulture and wine production (M Costa, ISA) - Metrics to calculate carbon footprint in viticulture and wine production (B. Caldeira, Consulai) - Wines of Alentejo Sustainability Plan (J. Barroso, CVRA); – Regenerative Viticulture (M. Cachão) - Low carbon Wine: a case study at Alentejo winegrowing region 14:00- 17:00 **Round Table on "Alternatives to Conventional Viticulture"**	CL + Invited speakers
10	7/12	**VI- SUSTAINABLE VITICULTURE (CONT.)** Presentation of the Practical Reports	*CL+ students*
11	14/12	**V WORKSHOP ON GRAPEVINE BIOTECHNOLOGY: MAIN APPLICATIONS IN VITICULTURE.** -Applications of biotechnology: what is currently being done. - Non-conventional approaches to solve recalcitrant grapevine and wine problems. - Grapevine genome organization: the role of bioinformatics. Grapevine epigenetics. -Using Molecular Biology tools to identify grapevine varieties and study Phylogeny - Grapevine: evolution under domestication -Acclimation and tolerance to abiotic stress of grapevine portuguese varieties. - Grapevine aquaporins: understanding the water, glycerol and atypical substrates transport in V.vinifera through	*Luisa Carvalho + invited speakers* Invited speakers

		heterologous expression in a aqy-null Saccharomyces cerevisiae strain. – General Discussion	
12	21/12	**VI- SUSTAINABLE VITICULTURE (CONT.)** Discussion of the Practical Reports	CL

EVALUATION/ASSESSMENT

Evaluation by a **final examination (60%)** and a **written report (40%)** based on a literature review focused on a topic of Sustainable Viticulture.

The report should be formatted as a review paper and presented orally at the end of the semester. **The written report will be evaluated**.

Students should have **75% attendance** to be eligible to appear for the final exams.

GENERAL LITERATURE

Besides the slides of each lecture presentation, specific literature for each chapter will be uploaded to the webpage of the course at the FENIX platform.

Below are some examples of general bibliography (papers and books) that can be consulted:

Scientific and technical papers

Alibabaei K, Gaspar PD, Lima TM, Campos RM, Girão I, Monteiro J and Lopes CM (2022). A Review of the Challenges of Using Deep Learning Algorithms to Support Decision-Making in Agricultural Activities. Remote Sensing, 14, 638. https://doi.org/10.3390/rs14030638

Ashenfelter O and Storchmann K (2016). The Economics of Wine, weather and Climate change. Review of Environmental Economics and Policy, volume 10, Winter 2016, pp 25-46.

Bramley, R. G. V, & Hamilton, R. P. (2004). Understanding variability in winegrape production systems 2. Within vineyard variation in quality over several vintages. Australian Journal Of Grape And Wine Research, 10(1), 32–45.

Carvalho LC, Ramos MJN, Faísca-Silva D, van der Kellen D, Fernandes JC, Egipto R, Lopes CM and Amâncio S (2022). Developmental Regulation of Transcription in Touriga Nacional Berries under Deficit Irrigation. Plants, 11, 827. https://doi.org/ 10.3390/plants11060827

Chaves MM, Costa JM, Zarrouk O, Pinheiro C, Lopes CM and Pereira JS (2016). Controlling stomatal aperture in semi-arid regions - the dilemma of saving water or being cool? Plant Science, 251, 54–64. doi:10.1016/j.plantsci.2016.06.015

Chaves MM, Santos TP, SouzaCR, Ortuño MF, Rodrigues ML, Lopes CM, Maroco JP, Pereira JS, 2007. Deficit irrigation in grapevine improves water-use efficiency while controlling vigour and production quality. Ann Appl Biol., 150: 237- 252.

Chaves, MM;. Zarrouk, O.; Francisco, R.; Costa, JM; Santos, T.P.; Regalado, AP; Rodrigues, ML; Lopes, CM 2010. Grapevine under deficit irrigation: hints from physiological and molecular data. Annals of Botany 105: 661–676.

Clingeleffer, P., Dunn, G., Krstic, M., Martin, S. (2001). Crop Development, Crop Estimation and Crop Control to Secure Quality and Production of Major Wine Grape Varieties: A National Approach. Final report to Grape and Wine Research and Development Corporation, CSIRO Plant Industry, Austrália. pp. viii, 148, [17] http://hdl.handle.net/102.100.100/201731?index=1

Costa JM, Egipto R, Sánchez-Virosta A, Lopes CM, Chaves MM (2019). Canopy and soil thermal patterns to support water and heat stress management in vineyards.

Agricultural Water Management 216, 484-496. https://doi.org/10.1016/j.agwat.2018.06.001

Costa JM, Egipto R, Silvestre J, Lopes CM and Chaves MM (2018). Water and heat fluxes in Mediterranean vineyards: indicators and relevance for management. In: Water Scarcity and Sustainable Agriculture in Semiarid Environment. IF Garcia-Tejero, V.H Duran Zuazo (Eds), Elsevier, ISBN: 9780128131640, pp. 219-245. https://doi.org/10.1016/B978-0-12-813164-0.00010-7

Costa JM, Oliveira M, Egipto R, Cid F, Fragoso R, Lopes CM and Duarte E (2020). Water and wastewater management for sustainable viticulture and oenology in south Portugal – a review. Ciência e Técnica Vitivinícola, 35 (1), 1-15. https://doi.org/10.1051/ctv/2020350100

Costa JM, Vaz M, Escalona JM, Egipto R, Lopes CM, Medrano H, Chaves MM 2020. Water as a critical issue for viticulture in southern Europe: sustainability vs competitiveness. Ives Technical Reports. DOI: https://doi.org/10.20870/IVES-TR.2020.3182.

Costa JM, Vaz MM, Escalona J, Egipto R, Lopes CM and Chaves M (2016). Modern viticulture in southern Europe: vulnerabilities and strategies for adaptation to water scarcity. Agricultural Water Management, 164, 5–18. doi:10.1016/j.agwat.2015.08.021

Costa JM, Catarino S, Escalona J, and Comuzzo P (2022). Improving Sustainable Viticulture and Winemaking Practices, Academic Press, ISBN: 978-0-323-85150-3

García-Tejero IF, Costa JM, Egipto R, Durán-Zuazo VH, Lima RSN, Lopes CM and Chaves, MM (2016). Thermal data to monitor crop-water status in irrigated Mediterranean viticulture. Agricultural Water Management, 176, 80–90. http://dx.doi.org/10.1016/j.agwat.2016.05.008

Gerós, H. et al. 2015. Grapevine in a Changing Environment. A Molecular and Ecophysiological Perspective. Wiley & Sons Ltd. Gladstones, J. 2011. Wine, Terroir and Climate Change. Wakefield Press, Adelaide, South Austrália.

Iland, P. et al. 2011. The Grapevine: from the science to the practice of growing vines for wine. Patrick Iland Wine Promotions Pty, Austrália.

Jones, G. 2012. Climate Assessment for the Douro Wine Region: An Examination for the Past, Present and Future Conditions for Wine Production. ADVID, Régua, Portugal.

Lazcano C, Decock C and Wilson SG (2020). Defining and Managing for Healthy Vineyard Soils, Intersections With the Concept of Terroir. Front. Environ. Sci. 8:68. doi: 10.3389/fenvs.2020.00068

Lopes CM and Cadima J (2021). Grapevine bunch weight estimation using image-based features: comparing the predictive performance of number of visible berries and bunch area. OENO One, 55(4), 209-226. https://doi:10.20870/oenoone.2021.55.4.4741

Lopes CM, Costa JM, Egipto R, Zarrouk O and Chaves, MM (2018). Can Mediterranean terroirs withstand climate change? Case studies at the Alentejo Portuguese winegrowing region. E3S Web of Conferences, 50, 01004. DOI: https://doi.org/10.1051/e3sconf/20185001004

Lopes CM, Egipto R, Pedroso V, Pinto PA, Braga R, Neto M. 2017. Can berry composition be explained by climatic indices? Comparing classical with new indices in the Portuguese Dão region. Acta Horticulturae, 1157, 59-64, https://doi.org/10.17660/ActaHortic.2017.1157.10

Lopes CM, Egipto R, Zarrouk O, Chaves MM (2020). Carry-over effects on bud fertility makes early defoliation a risky crop-regulating practice in Mediterranean vineyards. Australian Journal of Grape and Wine Research, 26, 290–299. https://onlinelibrary.wiley.com/doi/abs/10.1111/ajgw.12437

Lopes, C.M., Santos, T., Monteiro, A.; Rodrigues, M.L, Costa, J.M. & Chaves, M.M. 2011. Combining cover cropping with deficit irrigation in a Mediterranean low vigor vineyard. Scientia Horticulturae, 129:603-612.

Meissner G, Athmann M., Fritz, J., Kauer R., Stoll M. and Schultz HR 2019. Conversion to organic and biodynamic viticultural practices: impact on soil, grapevine development and grape quality. OENO One 4, 639-659.

Mirás-Avalos JM, Araujo ES. Optimization of Vineyard Water Management: Challenges, Strategies, and Perspectives. Water. 2021; 13(6):746. https://doi.org/10.3390/w13060746

Monteiro, A.; Lopes, C.M. 2007. Influence of cover crop on water use and performance of vineyard in Mediterranean Portugal. Agri. Ecosyst. Environ., 121:336-342.

O.I.V. 2008. Guidelines for Sustainable Vitiviniculture: Production, processing and packaging of products. International Organisation of Vine and Wine, Resolution CST 1/2008, Paris, 2008.

O.I.V. 2020. OIV guide for the implementation of principles of sustainable vitiviniculture. -International Organisation of Vine and Wine, Resolution OIV-VITI 641-2020, Paris, 2020

O.I.V. 2016. OIV general principles of sustainable vitiviniculture - environmental - social - economic and cultural aspects. Resolution OIV-CST 518-2016, Paris, 2016

Nogales A, Rottier E, Campos C, Victorino G, Costa JM, Coito JL, Pereira S, Viegas W and Lopes CM (2021). The effects of field inoculation of arbuscular mycorrhizal fungi through rye donor plants on grapevine performance and soil properties Agriculture, Ecosystems and Environment, 313, 1-13 https://doi.org/10.1016/j.agee.2021.107369

Nogales A, Santos E, Abreu MM, Diego A, Victorino G, Pereira HS, Lopes CM and Viegas W (2019). Mycorrhizal Inoculation Differentially Affects Grapevine's Performance in Copper Contaminated and Non-contaminated Soils. Frontiers in Plant Science, 9, 1-16. http://dx.doi.org/10.3389/fpls.2018.01906

Pedneault K., Provost C. 2016. Fungus resistant grape varieties as a suitable alternative for organic wine production: Benefits, limits, and challenges. Scientia Horticulturae, 208, 57-77

Profit, T. et al. 2006. Precision Viticulture. A new era in vineyard management and wine production. Winetitles, Ashford, South Australia. Seng, K. P., Ang, L. M., Schmidtke, L. M., &

Rogiers, S. Y. (2018). Computer vision and machine learning for viticulture technology. IEEE Access, 6, 67494–67510.

Victorino G and Lopes CM (2021). Grapevine yield components detection using image analysis: a case study with the white cultivar 'Encruzado'. Acta Horticulturae, 1314, 165-172. doi: 10.17660/ActaHortic.2021.1314.22

Victorino G, Braga R, Santos-Victor J and Lopes CM (2020). Yield components detection and image-based indicators for non-invasive grapevine yield prediction at different phenological phases. OENO One. 54(4), 833-848. https://doi.org/10.20870/oeno-one.2020.54.4.3616

Victorino G, Braga R, Santos-Victor J, and Lopes CM (2022). Overcoming the challenge of bunch occlusion by leaves for vineyard yield estimation using image analysis. OENO One. 56(1), 117-131. doi:10.20870/oeno-one.2022.56.1.4863

Victorino G, Braga RP, Santos-Victor J; Lopes CM (2022). Comparing a New Non-Invasive Vineyard Yield Estimation Approach Based on Image Analysis with Manual Sample-Based Methods. Agronomy 12, 1464. https://doi.org/10.3390/agronomy12061464

Victorino G, Poblete-Echeverría C and Lopes CM (2022). A multicultivar approach for grape bunch weight estimation using image analysis. Horticulturae, 8, 233. https://doi.org/10.3390/

Willer H, Lernoud J, (2019). Organic agriculture worldwide: current statistics. In: IFOAM Fa, editor editors. The World of Organic Agriculture Statistics and Emerging Trends 2014 Frick and Bonn.

Zarrouk O, Brunetti C, Egipto R, Pinheiro C, Genebra T, Gori A, Lopes CM, Tattini M and Chaves MM (2016). Grape ripening is regulated by deficit irrigation/elevated temperatures according to cluster position in the canopy. Frontiers in Plant Science, 7:1-18, http://dx.doi.org/10.3389/fpls.2016.01640

Zarrouk O, Costa JM, Francisco R, Lopes CM and Chaves MM (2015). Drought and water management in Mediterranean vineyards. In: Grapevine in a changing environment. A Molecular and Ecophysiological Approach. H Gerós, M Chaves, H. Medrano, S. Delrot (Eds).Wiley Books, UK, pp. 38-67. doi: 10.1002/9781118735985.ch3

Books

Costa J.M., Catarino S., Escalona J.M., Comuzzo P., (2022). Improving sustainable viticulture and winemaking practices. Academic Press, Elsevier. ISBN: 9780323851503.

Gerling C. (2015). Environmentally Sustainable Viticulture, Practices and Practicality. Apple Academic Press 2015, ISBN: 978-1-77188-112-8, CRS Press, 399 p.

Taylor S. (2017). The business of sustainable wine. How to build a brand equity in a 21st Century wine industry. Board and Bench, USA 264p.

Forbes, S. L., De Silva, T., & Gilinsky Jr. A (2020). Social Sustainability in the Global Wine Industry. Springer Books, Springer.