IX International Olive Symposium

Sunday-Thursday, 10-14 September, 2023

Olive, an Ancient Crop for a Sustainable Future

Book of Abstracts

UCDAVIS | UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources

ISHS

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Selina Wang, Professor of Extension, University of California Davis
Reza Ehsani, Professor, University of California Merced

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Gabriela Vuletin Selak, Institute for Adriatic Crops and Karst Reclamation, Croatia
Wei Wang Zhejiang, University of Science and Technology, China
Isaac Zipori, Agricultural Research Organization, Volcani Center, Israel

Agenda

All symposium events will take place at AGR Room, The Alumni Center, UC Davis, 530 Alumni Lane, Davis, CA , USA

Sunday, 10 September

5:00-7:00 PM	**Registration and Opening Reception** *You may pick up registration materials throughout the event.*

Monday, 11 September

8:30 AM	Registration and coffee and refreshments

Welcome and Keynote

9:00	**Welcome by the Symposium Co-Chairs** *Giulia Marino, Dept. of Plant Sciences, University of California, Davis* *Selina Wang, Department of Food Science and Technology, University of California, Davis* *Reza Ehsani, School of Engineering, University of California, Merced*
9:10	**Welcome by International Society for Horticultural Science (ISHS)** *Ted DeJong, ISHS Executive Committee Chair and Dept. of Plant Sciences, University of California, Davis (Emeriti)*
9:20	*Keynote:* **History of the California Olive Oil Industry** *Dan Flynn, Founder, UC Davis Olive Center at the Robert Mondavi Institute for Wine and Food Science*
9:35	**Welcome by the UC Davis Olive Center: A model of academia and industry collaboration in the olive industry** *Javier Fernander Salvador, Executive Director, UC Davis Olive Center*
9:45	*Keynote:* **History and Current State of the California Table Olive Industry** *Louise Ferguson, Dept. of Plant Sciences, University of California, Davis*

Breeding & Genetics

Moderated by: Cristian Silvestri, Department of Agriculture and Forest Science, University of Tuscia

Time	Abstract #	Title	Presenter
10:00	74 YM	*Session Keynote:* Genetic engineering and genome editing in olive: Past achievements, advances, and prospects	*Cristian Silvestri, Department of Agriculture and Forest Science, University of Tuscia*
10:20	70 YM	System biology analysis discovers key cold-induced gene transcription regulators in olive tree	*Athanassios Molassiotis, Aristotle University of the Thessaloniki*
10:35	69	Whole genome re-sequencing of a Mediterranean Olea europaea collection provide new insights into olive biodiversity and domestication	*Christos Bazakos, Institute of Plant Breeding and Genetic Resources, Hellenic Agricultural Organization (ELGO) DIMITRA*

Time	Abstract #	Title	Presenter
10:50	98	RNA-Seq analyses reveal the possible molecular bases of resistance against leaf spot infection in olive and candidate genes underlying the resistance	*Annalisa Marchese, University of Palermo*
11:05	**Break**		
Breeding & Genetics: Biodiversity and Propagation *Moderated by: Tiziano Caruso, University of Palermo*			
11:35	96	*Session Keynote:* Exploring the genetic diversity of monumental olive trees from South-Western Sicily	*Tiziano Caruso, University of Palermo*
11:55	80 YM	Development of an efficient protoplast isolation and transfection protocol for olive	*Giuseppe Vaia, University of Tuscia*
12:10 PM	48 YM	Development of a deep proteomic pipeline for recalcitrant olive leaf tissue	*Ramona Abbattista, University of California, Davis*
12:25	115	New insights into olive micropropagation	*Cristian Silvestri, Department of Agriculture and Forest Science, University of Tuscia*
12:40	52	Deep insight into cultivated olive tree diversity, structure, and parentage relationships in Spain	*Francisco Jesús Gómez Gálvez, IFAPA Centro Alameda del Obispo*
12:55	**Lunch**		
Breeding & Genetics: Cultivars Evaluation *Moderated by: Pilar Rallo Morillo, University of Seville*			
2:30	85	*Session Keynote:* New promising table olive cultivars from the University of Sevilla breeding program	*Pilar Rallo Morillo, University of Seville*
2:50	11 YM	Three new cultivars of IFAPA olive breeding program resistant to Verticillium wilt	*Lorenzo León Moreno, IFAPA Centro Alameda del Obispo*
3:05	113 YM	The New Olive Cultivar Oliana®	*Franceso Maldera. University of Bari*
3:20	24 YM	Response of different olive cultivars to late frosts in the Marche region (Italy)	*Matteo Zucchini, Università Politecnica delle Marche*
3:35	201	Varietal Improvement: Todolivo's Breeding Program	*Angela Sanchez Jimenez, Todolivo, S.L.*
3:50	**Break**		
Poster Session 1 & 2 *Moderated by: Curt Pierce, University of California Cooperative Extension*			
4:10	50	Perspectives in olive propagation by *Azospirillum baldaniorum* SP245	*Livia Pappalettere, Scuola Superiore Sant'Anna, Pisa*
4:14	79	Micropropagation of Italian varieties with the aim to preserve genetic diversity in olive	*Cristian Silvestri, Dpt. of Agriculture and Forest Science, University of Tuscia*

Time	Abstract #	Title	Presenter
4:18	55	SSR markers in traceability of Croatian virgin olive oils	*Gabriela Vuletin Selak, Institute for Adriatic Crops and Karst Reclamation*
4:22	108	A Meta-analysis approach to identify putative candidate genes involved in susceptibility and resilience to *Xylella fastidiosa* in olive	*Annalisa Marchese, Department SAAF - University of Palermo*
4:26	58	Ancient Kaštela olive tree – proof of the long tradition of Croatian olive growing	*Mira Radunic, Institute for Adriatic Crops and Karst Reclamation Split*
4:30	93	First results of genome wide association study for the composition of fatty acid in olive oil	*Samanta Zelasco, Council for Agricultural Research and Economics (CREA)*
4:34	68	Genetic diversity and structure of Olive tree genetic resources from Catalonia (Northeastern Iberian Peninsula)	*Antònia Ninot, IRTA*
4:38	84	Ex situ Croatian olive germplasm collection – CroP_BioDiv	*Mira Radunic, Institute for Adriatic Crops and Karst Reclamation Split*
4:42	200	The Olive Grove in wide frame hedge	*Angela Sanchez Jimenez, Todolivo, S.L.*
4:46	114 YM	Evaluation of vegetative-productive characteristics of different olive cultivars grown, in rainfed conditions, in a high-density intensive orchard in central Italy	*Nicola Cinosi, University of Perugia, DSA3*
4:50	2	Scarification and germination of wild olive stones from Jabal Akhdar, Oman	*Thuraiya Al Jabri, University of Reading*
4:54	100	In vitro preliminary evaluation of the low vigour olive F2 'Koroneiki' progenies	*Annalisa Marchese, University of Palermo*
5:00 **6:00-8:00**	**California Olive Oils showcase and non-guided tasting** coordinated by the Olive Oil Commission of California and hosted by the UC Davis Olive Center **Strolling Dinner Reception**		
Tuesday, 12 September			
8:30 AM	Registration and coffee and refreshments		
Physiology *Moderated by: Daniela Farinelli, University of Perugia*			
9:00	22	*Session Keynote:* Tree-ring isotopic study reveals a different degree of tolerance to summer stress conditions in olive tree cultivars	*Daniela Farinelli, University of Perugia and Silvia Portarena, CNR - IRET*
9:20	20 YM	Could silicon ameliorate salt tolerance in *Olea europaea* L.?	*Carmen Fidalgo Illesca, Scuola Superiore Sant'Anna di Pisa*
9:35	39	Alternate bearing in olive - Mitigation with properly timed foliar-applied naphthaleneacetic acid or pruning	*Carol J. Lovatt, University of California, Riverside*

Time	Abstract #	Title	Presenter
9:50	110	Olive tree physiology and productivity in cold and dry coast area of Patagonia	*Nadia Arias, INBIOP (CONICET-UNPSJB)*
10:05	25	Anomaly detection in real-time continuous fruit-based monitoring of olive via extensimeter	*Arash Khosravi, Marche Polytechnic University*
10:20	**Break**		
Climate Change *Moderated by: Georgios Koubouris, Elgo-Dimitra, Institute for Olive Tree, Subtropical Crops and Viticulture*			
10:50	6	*Session Keynote:* Increasing olive tree resilience to climatic changes through the selection of tolerant genotypes and application of sustainable practices	*Georgios Koubouris, Elgo-Dimitra, Institute for Olive Tree, Subtropical Crops and Viticulture*
11:10	41	Agroecological approaches in olive farming, for combating land desertification and mitigating climate change in Messinia, Greece	*Vasileios Gkisakis, Hellenic Agricultural Organisation (ELGO) - DIMITRA*
11:25	45	High temperature environment reduces olive oil yield and quality	*Giora Ben-Ari, Agricultural Research Organization, Volcani Institute, Israel*
11:40	104	Exploring the response of olive genotypes to salinity and drought stresses	*Josip Tadic, Institute for Adriatic Crops and Karst Reclamation*
11:55	109	Experimental warming during autumn and winter decreased freezing resistance in *Olea europaea* plants	*Nadia Arias, INBIOP (CONICET-UNPSJB)*
12:10	Lunch		
Irrigation, Fertilization and Soil Management *Moderated by: Arnon Dag, Agricultural Research Organization, Volcani Institute, Israel*			
2:30	35	*Session Keynote:* Significance of proper nitrogen fertilization for olive productivity and oil quality	*Arnon Dag, Agricultural Research Organization, Volcani Institute, Israel*
2:50	21 YM	Caffeine uptake and degradation in olive tree (*Olea europaea* L.): a model for studying organic contaminants in irrigation water	*Elena Vichi, Scuola Superiore Sant'anna*
3:05	202	Evapotranspiration and water potential in two super-high density olive orchards in California	*Paula Guzman Delgado, University of California Davis*
3:20	106	Continuous deficit irrigation scheduling based on trunk growth rate frequencies approach	*Alfonso Moriana, University of Seville*
Crop Protection *Moderated by: Cindy Kron, University of California, Ag & Natural Resources*			
3:35	76	*Session Keynote:* Evaluation of new materials for control of Bactrocera oleae	*Cindy Kron, University of California, Ag & Natural Resources*
3:50	7	The etiology of Peacock's eye disease of olive in Israel	*David Ezra, ARO, The Volcani Institute, Rishon LeZion, Israel*

Time	Abstract #	Title	Presenter
4:05	34	Closing the loop: tandem between monitoring and modelling to predict Bactrocera oleae infestations	*Luca Rossini, Università degli Studi della Tuscia*
4:20	**Break**		
Poster Session 3, 4, & 5 *Moderated by: Paul Guzman Delgado, University of California, Davis*			
4:35	44	Root topography in high-density olive orchards	*Matteo Zucchini, Università Politecnica delle Marche*
4:39	56	Evaluating olive for cold hardiness in western Oregon	*Neil Bell, Oregon State University Extension Service*
4:43	71	Wood anatomical analyses in olive trees under different water stress	*Francesco Marra, University of Palermo*
4:47	87	Composition and biomechanical behavior of olive fruit cuticles	*Ana Morales-Sillero, University of Seville*
4:51	94	Assessment of minimum leaf conductance and photosynthetic gas exchange as a mean to determine drought tolerance in olive	*Samanta Zelasco, Council for Agricultural Research and Economics (CREA)*
4:55	29 YM	Vegetative and productive response of olive trees under anti-insect nets	*Matteo Zucchini, Università Politecnica delle Marche*
4:59	112	Pollen performance under heat temperatures in a promising olive clone (cv leccino)	*Susanna Bartolini, Scuola Superiore Sant'Anna, Pisa*
5:03	16	Proper agricultural practices related to water and soil for ensuring the sustainability of Mediterranean olive orchards	*Georgios Koubouris, Elgo-Dimitra, Institute for Olive Tree, Subtropical Crops and Viticulture*
5:07	19	Leaf content of N, P and K in twelve olive cultivars, as affected by the sampling period (summer vs. winter)	*Georgios Koubouris, Elgo-Dimitra, Institute for Olive Tree, Subtropical Crops and Viticulture*
5:11	49	Field trapping of the olive moth (Prays oleae Bern.) using olive fruit volatiles as attractants	*Mirella Zanetic, Institut za jadranske kulture*
5:15	53	Colletotrichum acutatum infection in Arbequina olive fruits under severe drought.	*Paula Conde-Innamorato, INIA*
5:19	4	Glassy-winged sharpshooter can acquire Xylella fastidiosa strain DeDonno from California ripe olive varieties	*Lindsey Burbank, USDA-ARS*
5:23	103	Vegetative growth is reduced by fruit load but is not affected by moderate water stress in summer	*Mercedes Arias Sibillotte, UDELAR*
Dinner is on your own. Enjoy downtown Davis restaurants. See the registration desk for a list of restaurants.			

6:30-7:30 PM
Taste of California - $30 fee to participate
To register and pay, visit https://registration.ucdavis.edu/Item/Details/1047

Contact: Adele Amico Roxas (adamicoroxas@ucdavis.edu)
Location: Robert Mondavi Institute for Wine and Food Science, Sensory Building, Silverado Vineyards Sensory Theater, 392 Old Davis Road, Davis CA 95616

This private tasting showcases a carefully selected variety of the best extra virgin olive oils produced in the state of California. This is an added opportunity for attendees of the Olive symposium to enjoy and learn about olive oil produced in the state. These oils are usually not available outside the United States, so this one-hour event at the Robert Mondavi Institute, Silverado Sensory Theater will be a unique opportunity for the attendees to enjoy the best of California!

Wednesday, 13 September

8:30 AM	Coffee and snacks

Planting Systems & Pruning

Moderated by: Richard Rosecrance, California State University, Chico

Time	Abstract #	Title	Presenter
9:00	46	*Session Keynote:* Optimizing Yield and Reducing Pruning Costs in "Manzanillo" Olive Orchards through Timing and Intensity of Mechanical Pruning	*Richard Rosecrance, California State University, Chico*
9:20	81	Pedestrian olive growing systems: A sustainable alternative to super-intensive olive growing systems using native Sicilian varieties	*Roberto Massenti, University of Palmero*
9:35	28	Long-term evaluation of the use of mechanical pruning in a super high density or hedge olive orchard	*António Bento Dias, Med/Universidade de Évora*
9:50	15	Continuous plant-based monitoring of olive orchards: A review	*Arash Khosravi, Marche Polytechnic University*
10:05	107	Response of "Manzanilla de Sevilla" in high density hedgerow olive orchards with "Chiquitita" as rootstock	*Alfonso Moriana, University of Seville*
10:20	**Break**		

Harvest

Moderated by: Ayelet Fishman, Technion-Israel Institute of Technology

10:50	83	*Session Keynote:* Developing Mechanical Harvesting and Postharvest Treatments for California and Israel's Table Olives (*Olea europaea* L.)	*Ayelet Fishman, Technion-Israel Institute of Technology*
11:10	27	Continuous olive harvesting in a high-density olive grove of portuguese '*Galega vulgar*' variety	*António Bento Dias, Med/Universidade de Évora*
11:25	40	Challenges and Opportunities in Mechanical Harvesting of Table Olives	*Reza Ehsani, UC Merced*
11:40	60	Effect of canopy management and shaking frequency on harvesting effectiveness in a Arbequina super-high-density orchard	*Sergio Tombesi, Universita' Cattolica del Sacro Cuore*

Time	Abstract #	Title	Presenter
11:55	102	Effect of Mechanical Harvesting on Harvesting Efficiency and Olive Oil Quality of Two Jordanian Olive Cultivars	*Salam Ayoub, National Agricultural Research Center (NARC) / Jordan*
12:10 PM	**Lunch**		
Olive Products and Marketing *Moderated by: Selina Wang, Dept. of Food Science and Technology, University of California, Davis*			
1:40	10	*Session Keynote:* Fruit phenolic composition of olive cultivars under Mediterranean and Subtropical climatic conditions	*Hande Yılmaz-Düzyaman, IFAPA Centro Alameda del Obispo*
2:00	86	Effects of pre-processing cooling treatments of harvested olives on oil volatile profile and quality parameters	*Mario Vendrell Calatayud, Scuola Superiore Sant'Anna*
2:15	67	The importance of standardization in the olive oil supply chain to produce a nutritional, safe, and high-quality product	*Alessia Sortino, ENR - The National Institution of Italy for Standardization Research and Promotion*
2:30	75	Accelerating the Technology Pathway to the New Palestinian Olive Oil Circular Bioeconomy	*Donald Humpal, DAI*
2:45	**Break**		
Poster Session 6 & 7 *Moderated by: Elizabeth Fichtner, University of California Cooperative Extension*			
3:30	73 YM	Urban 'olive-culture': evolution and distribution of the cultivar '*Ascolana tenera*' in the city of Ascoli Piceno, Italy	*Matteo Zucchini, Università Politecnica delle Marche*
3:34	63	Impact on olive pomace oil of the application of pulsed electric fields to the extraction of virgin olive oil on a pilot scale	*M Victoria Ruiz-Méndez, Instituto de la Grasa CSIC*
3:38	65	Evolution of phenolic compounds in two italian olive cultivars during drupe growth and ripening	*Claudio di Vaio, University of Naples Federico II*
3:42	3	Early exogenous application of methyl jasmonate modifies the phenolic profiles of the olive fruit and virgin olive oil	*Carlos Sanz, Spanish National Research Council (CSIC)*
3:46	66	Exploring sensorial variability and polyphenol content of an olive core collection	*Antònia Ninot, IRTA*
3:50	90	The influence of different thermal treatments on the antioxidant capacity and oxidative stability of virgin olive oil	*Maja Jukić Špika, Institute for Adriatic Crops*
3:54	91	Diversity Assessment of Virgin Olive Oils from Croatian Cultivated and Wild Olives by their Chemical Traits	*Maja Jukić Špika, Institute for Adriatic Crops*
3:58	99	Impact of olive genotype on olive oil oxidation during storage	*Mario Vendrell Calatayud, Scuola Superiore Sant'Anna*

Time	Abstract #	Title	Presenter
4:02	51	Wild olive trees (*Olea oleaster*) in Croatia – Chemical and sensory characterization of their olive oils	*Mirella Zanetic, Institut za jadranske kulture*
4:06	111	Automated monitoring of table olive storage brines through an innovative sensorized smart system	*Rossella Manganiello, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Centro di ricerca Ingegneria e Trasformazioni agroalimentari*
4:10	30	Evaluation of the mechanical pruning effect on olive yield, in a high-density olive orchard of 'Galega cultivar'	*António Bento Dias, Med/Universidade de Évora*
4:14	101	Use of vegetation indexes to characterize within-canopy light conditions of pedestrian olive orchards	*Roberto Massenti, University of Palmero*
4:18	26	Olive Pruning Management with Mobile Laser Scanner	*Arash Khosravi, Marche Polytechnic University*
4:22	TBD	The effects of the ethephon and accede sprays on fruit detachment force, trunk shaking harvester efficiency and fruit value in Manzanillo table olive	*Emily Santos, Department of Plant Sciences University of California, Davis*
4:26	**Business Meeting and Young Minds (YM) Awards**		
5:22	**Break**		
6:00	**Closing Dinner** Robert Mondavi Institute (RMI) Sensory Building, 392 Old Davis Road, Davis, CA 95616 *2 block walk from the Alumni Center; behind the Sensory Building. Look for signage*		

Thursday, 14 September

Field Tour

6:30 AM	Coffee and load buses at the Alumni Center, 530 Alumni Lane, UC Davis
7:00	Depart – don't be late!
8:15	Stop #1: Agromillora Nursery
10:00	Depart Stop #1
11:00	Stop #2: Burreson's Mechanically Harvested Table Olive Orchard
12:00 PM	Depart Stop #2
12:15	Stop #3: California Olive Ranch, Artois
	Lunch followed by walking tours
3:00	Depart
5:00	Arrive at the Alumni Center, Cavis

Friday, 15 September

IX Olive Symposium Post-Tour
Departs at 8:30 AM from the UC Davis Alumni Center
Returns at 2:00 PM to the UC Davis Alumni Center

There is no fee to participate in this post-tour. Transportation in vans will be provided, but lunch is on your own. Register here: https://na.eventscloud.com/esurvey/olivetour

Stops will include:

- **Wolfskill Research Facility** (https://wolfskill.ucdavis.edu/). Wolfskill is 30 minutes from Davis in the town of Winters.
- **UC Davis Olive Center** (https://olivecenter.ucdavis.edu/) research trials with Director Javier Fernandez, and the olive germplasm collection in the USDA ARS National Clonal Germplasm Repository: (https://www.ars.usda.gov/pacific-west-area/davis-ca/natl-clonal-germplasm-rep-tree-fruit-nut-crops-grapes/) with Director Claire Heinitz and collection supervisor Jenny Smith.
- **Lunch:** Free time to get lunch in the multiple restaurants in the historical city of Winters.

Abstracts

In order of presentation with primary author listed.

Breeding & Genetics

#74 - YM: Genetic engineering and genome editing in olive: Past achievements, advances and prospects

Cristian Silvestri, Università degli Studi della Tuscia

Among the New Plant Breeding Techniques (NPBTs), the CRISPR/Cas9 system is re-shaping the plant biotechnology in agriculture, since they are faster, easier and cheaper and, moreover, are becoming part of the commonly used methodologies for obtaining new varieties. While considered to be one of the most economically important crops, not only for Mediterranean region, olive has not benefited enough from genetic engineering and genome editing technologies, even though classical breeding is prevented by difficulties related to high heterozygosity and long juvenile phase of the species. Olive breeding focused on different traits such as plant growth habit, juvenile period, oil quality, and several genes have been identified. Anyway, the difficulties related to de novo shoot regeneration and somatic embryogenesis hampered the use of the tissue culture mediated biotechnology in this species. In fact, the recalcitrance of olive tissues to the in vitro manipulation is the main bottleneck, due to the genotype dependence and the availability of very few protocols. In this presentation we described some achievements of olive genetic transformation and present approaches to overcome these difficulties. Finally, we discuss about genome editing applications, currently still unexplored in this species that, if edited without introducing foreign DNA into cells, may alleviate regulatory concerns related to genetically modified plants and could represent an opportunity to develop DNA-free genome editing plant materials.

#70 - YM: System biology analysis discovers key cold-induced gene transcription regulators in olive tree

Athanassios Molassiotis, Pomology lab, Faculty of Agriculture, Aristotle University of the Thessaloniki

Low temperature is a major factor influencing growth and development of olive (Olea europaea L.) tree in cold winter and spring. However, little is known about the molecular mechanisms enabling the olive tree to cope with cold stress conditions. The current study's main purpose is to investigate olive's (cv. "Chondrolia Chalkidikis") molecular response to cold exposure, through the combination of multi-omics and transcription factor functional analysis. In particular, one-year-old olive trees were transferred to a growth chamber to experience a gradual decrease in environmental temperature for 35 days, from 15 to -3 o C. In parallel, trees were kept under the same light/humidity conditions to 20 o C (control). Wide transcriptomic, proteomic and metabolomics analysis were performed in cold-stressed leaves exposed to 5, 0 and -3 o C, based on physiological and morphological stress indexes. Post-translational modifications of proteins were also in silico assessed, to further characterize protein homeostasis during cold stress. Combined analysis of the generated -omics data unraveled numerous molecular and biochemical pathways that were activated during cold exposure, but also highlighted key genes and proteins that orchestrate olive's response to low temperatures. Among them, two ethylene response transcription factors, namely ERF1 and ERF5, were remarkably differentiated and were further functionally analyzed to investigate their regulatory role during cold stress. Using this approach, we found that protoplasts overexpressing either ERF1 or ERF 5 increased their viability during cold exposure. Finally, promoter activation assays of in silico predicted ERF1/ERF5-target genes combined with DAP - seq (DNA affinity purification sequencing) data, uncovered novel cold-responsive genes and transcriptional pathways, providing n for the first time n a refined blueprint of the molecular mechanisms involved in the response of the olive tree to cold stress.

#69: Whole genome re-sequencing of a Mediterranean Olea europaea collection provide new insights into olive biodiversity and domestication

Christos Bazakos, ELGO-Dimitra, Institute Plant Breeding & Genetic Resource

Olive tree (Olea europaea L. var. europaea) is considered as one of the most important species of the Mediterranean region and its origin and domestication is found in ancient civilizations dating back six millennia. Wild olive tree (Olea europaea var. sylvestris), also known as oleaster, which came from Asia Minor and then expanded to Greece, is considered to be the ancestor of cultivated olive varieties. To gain a better understanding of the patterns of olive genome-wide variation in domesticated and wild genotypes, this study has developed the most complete genomic variation map and comprehensive catalogue/resource of molecular variation to date for 89 olive genotypes originating from the entire Mediterranean basin, revealing the genetic diversity of this commercially significant crop tree and explaining the divergence/similarity among different variants. Additionally, the monumental ancient tree "Throuba Naxos" was studied to characterize the potential origin or routes of olive domestication. Several candidate genes, known to be associated with key agronomic traits, including olive oil quality and fruit yield, were uncovered by selective sweep scan to be under selection pressure on all olive chromosomes. Furthermore, by conducting a genome-wide association study (GWAS), we identified genomic regions affected by breeding and genetic loci associated with phenotypic variation for agronomically important traits of relevance to olive breeding.

#98: RNA-Seq analyses reveal the possible molecular bases of resistance against leaf spot infection in olive and candidate genes underlying the resistance

Annalisa Marchese, Dipartimento Scienze Agrarie e Forestali, University of Palermo

The olive Peacock's eye infection caused by obligate fungal pathogen Spilocea oleagina is one of the major diseases of cultivated olive which can cause severe yield loss of about 20% or higher in susceptible cultivars. Until now, the genetic control of possible mechanism of resistance against it are quite limited and detailed molecular studies are needed. Therefore, we carried out a comparative transcriptomic analysis (RNA-seq) of a low susceptible cultivar Koroneiki and a high susceptible cultivar Nocellara del Belice, analyzing their leaves at two stages n "no sign of disease" and "evident sign of disease". Gene ontology (GO) and pathway enrichment analysis allowed the identification of many differentially expressed genes (DEGs) in both stages, however very few genes were in common among 'Koroneiki' and 'Nocellara del Belice'. In 'Koroneiki' it was remarkable the over-expression of many resistance gene analogs or pathogenesis-related (PR) genes (non-specific lipid-transfer genes (nsLTPs), LRR receptor-like serine/threonine-protein kinase genes, GDSL esterase lipase, defensin Ec-AMP-D2-like, Thaumatin-like proteins (TLPs), Mildew resistance Locus O (MLO) gene, glycine-rich protein (GRP), endochitinases, glucan endo-1,3-beta-glucosidases and proteinases), as well as genes involved in the production of secondary metabolites, cell wall biosynthesis, plant hormone signal transduction which are part of a typical defense reaction. It was also noteworthy, that transcription factors (TS), involved in Induced Systemic Resistance (ISR), resulted also uniquely expressed in 'Koroneiki', while 'Nocellara del Belice' lacked an effective defense response. Our results give valuable insights into transcriptional changes related to resistant and susceptible responses and allowed the identification of candidate genes and putative biomarkers for resistance which represent a valuable target to screen and select new resistant/less susceptible genotypes for breeding purposes.

Breeding & Genetics: Biodiversity and Propagation

#96: Exploring the genetic diversity of monumental olive trees from South-Western Sicily

Annalisa Marchese, Dept. Agricultural, Food and Forest Sciences, University of Palermo

Sicily has a remarkable rich olive germplasm of autochthonous cultivars and centennial genotypes, representing a genetic heritage of inestimable value, that could be potentially used to breed resistant

genotypes against emerging disease, such as Xylella fastidiosa , and hostile climatic conditions. In this study, centennial monumental olive trees, still productive, were identified on-farm from the Southern-Western part of the island, geolocated and characterized at both the morphological and molecular levels. The criterion of tree selection was based on their height, trunk size, and alleged age (more than 400-year-old). For the phenotypical characterization, the main traits of leaf, fruit, and endocarp, were measured. A set of 10 highly polymorphic Simple Sequence Repeat (SSR) markers were employed for the genetic characterization of vegetative samples from both the canopy and basal part of the tree by collecting the suckers to verify if trees were grafted. A Structure analysis was also conducted with seven SSRs to depict the structural patterns of the ancient olive germplasm gene pool by comparing their molecular profiles with those of olive cultivars present in published databases. Results evidenced that most of these trees resulted grafted at least one time, indicating that the vegetative propagation of selected varieties of local origin with superior traits started since ancient time. The diversity of the suckers was larger and in most of the cases they clustered together. Some of the centennial trees found showed a molecular profile identical to well-known local cultivars, therefore they can be considered " Patriarch " trees (" Mother plants ") of Sicilian cultivars, while others presented unique profiles. A significant level of still unexplored Sicilian olive genetic diversity was discovered potentially holding interesting biotic/abiotic resilience traits for breeding, which was well preserved thanks to the community of local growers. The Department SAAF-University of Palermo has started the vegetative propagation of these trees in an ex-situ collection for future characterization of biotic/abiotic stress resistance and agronomical performance as well as has undertaken initiatives to valorise these living monuments also by including their information and location in naturalistic itinerary guides.

#80 Development of an efficient protoplast isolation and transfection protocol for olive

Giuseppe Vaia, University of Tuscia

In a climate change scenario, new strategies are needed to increase the plant resilience; among the New Plant Breeding Techniques (NPBTs), the CRISPR/Cas9 system represents a useful tool for target gene editing, improving the health of the plants rapidly. The absence of a cell wall on the protoplasts makes them a versatile cell-based model system to study the functions of genes and proteins and could represent an opportunity to develop DNA-free genome editing, through transfection with RNPs, a pre-assembled complex of purified Cas9 protein and guide RNAs. In this work we described an optimized protocol for olive protoplast isolation, with a focus on the yield, viability and callus differentiation, starting from leaf and callus (obtained in different induction media), and released after an overnight incubation, studying three different cell-wall digestion enzymatic solutions. Isolated protoplasts were then transfected using PEG/Ca 2+ solution and with the plasmid pAVA393:GFP, and the transfection efficiency of the protoplasts have been evaluated after 24 h from the transfection event. The protoplasts, cultured in liquid medium for callus induction, showed the formation of microcolonies. Experiments for callus development and de novo shoot organogenesis and/or somatic embryogenesis are under investigation. Our results showed olive protoplasts can be a useful tool to be explored for DNA-free genome editing, using gRNA:Cas9 ribonucleoproteins (RNPs).

#48 – YM: Development of a deep proteomic pipeline for recalcitrant olive leaf tissue

Ramona Abbattista, Department of Plant Sciences, University of California, Davis

Proteomic analysis is a powerful tool to unravel the complexity of plant cellular processes that underpin the regulation of plant immunity. A major challenge is the improvement of the detectable fraction of the crop proteome that is still markedly lower compared to other omics, such as next generation sequencing technologies. This is due in part to the occurrence of large amounts of secondary compounds, which co-precipitate with proteins and severely interfere with the analysis. Olive leaf tissue is notoriously recalcitrant to common protein extraction methods due to high levels of interfering compounds, hence

hampering deep proteomic investigations. The interest in the chemical composition of olive leaves has increased with the scope to re-evaluate this agricultural waste byproduct as their extracts are enriched in diverse bioactive compounds. Many of these secondary metabolites are involved in the defence systems along with their biosynthesis enzymes, whose activity is usually cultivar- and stimuli-dependent. Despite olive leaf proteomics providing important insights into the defence pathways as well as health diagnostic biomarkers, it has received much less attention compared to oil, drupes, seed and pollen tissues. Our study aims to overcome these hurdles and expand the application of deep proteomic analyses to olive leaves. We developed a complete proteomic pipeline, from sample preparation to LC-HRMS and data analyses, allowing the first comparative proteomic study among three Italian olive cultivars, i.e., Leccino, Ogliarola and Coratina, known to exhibit different susceptibility to Xylella fastidiosa infections, and enabling the detection of 1.922 proteins. Olive proteomic research is expected to become an essential part of integrated omics approaches; thus, our study is a significant contribution, paving the way to unravel the molecular complexity underlying the genotype-dependent immune response to stress.

#115: New insights into olive micropropagation

Cristian Silvestri, Università degli Studi della Tuscia

The Italian olive sector is facing huge challenges to production and sustainability, because of the increasing national demand of EVOO, as well as the spread of novel pests and diseases, also correlated to the global climate changes scenario. The "Piano di Settore Olivicolo Oleario 2016", promoted by Italian Mipaaf, aimed to encourage the modernization of the sector, promotes the "restructuring, modernization and expansion of olive groves with new orchards by reforming, replanting, thickening, developing high-density intensive orchards". For the above, olive nursery is asked to respond with a significant quantitative increase in the production of high-quality plants to support the requirements of the new semi-intensive and intensive olive orchards. Moreover, the development of the Xylella emergency has made the search for complementary ex situ conservation strategies extremely timely and urgent. In this sense, this presentation focuses on the progresses of micropropagation (MP) including the technologies of encapsulation and synthetic seeds, in vitro slow growth storage (SGS) and cryopreservation (CP) techniques for improving mass production of high-quality plant materials (MP), as well as the medium- and long-term conservation of olive germplasm (SGS and CP), with the aim to understand "where we are" and "in what direction we are going", in order to promote the production and use of certified and high-quality plants and the ex situ conservation of olive biodiversity.

#52: Deep insight into cultivated olive tree diversity, structure and parentage relationships in Spain

Angjelina Belaj, CIFA 'Alameda del Obispo', IFAPA

Prospecting surveys conducted several decades ago estimated that Spain accounted around 270 olive cultivars. However, recent works performed in different areas of the country, have revealed the presence of unknown varieties, thus highlighting the need to further recover and characterise the national cultivated germplasm. In this sense, the use of a set of 96 EST-SNP markers enabled the identification of a significant amount of new material with special relevance in olive growing areas with low cultivation pressure. As a result, the number of distinct genotypes documented in the World Olive Germplasm Bank of IFAPA, Cordoba (WOGBC-ESP046), ascended to 427. Likewise, around 54 and 21 new synonymies and homonymies cases were identified, respectively. This constitutes a rise of 68% in the representativeness of national cultivars, what allowed to deepen the diversification scenario and pedigree network. The wide genetic variability of Spanish germplasm was confirmed by structural analysis, and a new hot spot of diversity could be observed in the northern regions of La Rioja and Aragon. The pedigree analysis highlighted the influence of few founders/elite cultivars in the conformation of most olive germplasm, especially in Andalusia. It also showed the important role of autochthonous material in the north-east or the influence of foreign material in the north. The identification and the study of genetic relationships and pedigree analysis of Spanish olive germplasm,

together with their subsequent agronomic evaluation, will serve to broaden the genetic base of breeding programmes and to carry out a more efficient use of these genetic resources

Breeding & Genetics: Cultivars Evaluation

#85: New promising table olive cultivars from the University of Sevilla breeding program

Pilar Rallo, University of Sevilla, ETSIA

The olive breeding program at the University of Sevilla began in 2003 and is focused on the development of new cultivars with good quality for table olive processing an adapted to intensive and super intensive growing systems with mechanical harvesting. Along these years more than 3000 genotypes from different crossings have been evaluated. Between 2015 and 2019, 30 advance selections along with 13 traditional cultivars were established in different intensive and superintensive field trials. Here, we report the three new cultivars, to be soon registered, showing the best performance in intensive (7 x 5 m) irrigated olive orchards harvested by means of trunk shakers: US-06-1439, 06-1476 and 06- 1388. These genotypes show early bearing and high production with medium or large size and high pulp-to-pit ratio. Regarding adaptation to mechanical harvesting with trunk shakers, they all have high percentage of fruit removal and low bruising incidence. Mean traits in comparison to the two main Spanish table olive cultivars (Manzanilla de Sevilla and Hojiblanca) are summarized.

#11 - YM: Three new cultivars of IFAPA olive breeding program resistant to Verticillium wilt

Lorenzo Leon, IFAPA Centro "Alameda del Obispo"

Verticillium dahliae Kleb causes Verticillium wilt (VW) in olive (Olea europaea L.), which represents a phytosanitary limitation in many growing areas. As part of an integrated disease management strategy, the use of resistant cultivars is recommended, but only a limited number of traditional cultivars have showed high levels of resistance. Moreover, the agronomic performance of these resistant cultivars does not always fulfill the requirements of growers. The olive breeding program of IFAPA aims to select new olive genotypes showing both high levels of resistance to VW and interesting agronomic characteristics for olive oil production. New resistant genotypes obtained from crosses including cultivars of known resistance level were selected after screening for resistance to V. dahliae in growth chamber under controlled environmental conditions. These genotypes were re-evaluated in both microplot assay with artificially inoculated soil and under natural conditions in four different fields trials in Andalusia (Southern Spain). The comparison of the different experimental approaches allowed the identification of three genotypes consistently resistant to the disease. From the agronomic point of view, they also showed interesting traits related to high and early productivity and high oil content and produce extra virgin olive oils characterized by high levels of oleic acid percentage and phenol compounds, which provided high stability to the oils, together with new interesting flavor combinations. These genotypes will be soon released as new cultivars particularly recommended for areas under VW risk. Funding: this research was financially supported by IFAPA project AVA201900.27, partially funded by European Regional Development Fund (ERDF).

#113 - YM: The New Olive Cultivar Oliana®

Francesco Maldera, University of Bari

OLIANA®; is a commercially available olive cultivar developed through controlled crossing between cv. Arbequina and cv. Arbosana, belonging to the Agromillora olive breeding programme. It was evaluated in different growing areas over 15 years. The cultivar exhibits low vigor, compact growth habit, and early bearing, making it suitable for fully mechanized cultivation. Field trials conducted in multiple countries confirmed its agronomic potential and adaptability to super-intensive cultivation. OLIANA®; allows higher planting density even over 2,000 trees per hectare thanks to its very low vigor compared to the

parent cultivars. Among the other juvenility traits, a very high number of mixed buds could be found in OLIANA®;, also because of its vigour. It exhibits high productivity and higher and shorter shoots and has a ripening period between Arbequina and Arbosana. The fruit size is small, with a good pulp-to-pit ratio, and the oil content ranges from 12% to 20% on a fresh basis. OLIANA®; EVOOs are characterized by sweet, balanced, and harmonious flavour, with intense green fruity notes. The cultivar shows resistance to cold and moderate tolerance to olive leaf spot, while its sensitivity to root asphyxia is higher. Overall, the cv. OLIANA®; demonstrated exceptional adaptability to mechanization and high productivity, making it a promising choice for olive growers and offering significant potential for the olive oil industry.

#24 - YM: Response of different olive cultivars to late frosts in the Marche region (Italy)

Matteo Zucchini, Università Politecnica delle Marche

In Europe, the intensity and frequency of late-winter frost, as well as spring frost, is increasing, because of climate change. In olive (Olea europaea L.), frost damage can affect different tissues, from leaves to trunk, and in particular on inflorescences. A partial loss of inflorescences may not change the fruit set number, nevertheless, a too high loss of flowers would lead to a high loss of production. In central Italy, on the Adriatic coast, during the night of the 11 th of April 2022, for a few hours a temperature (°C) below zero was recorded. The low temperature damaged the inflorescences of olives with different degree, depending on cultivar and area. To evaluate the intensity of the damages, in three different orchards and in several cultivars, the number of viable and dead inflorescences was collected. From the data, the entity of the damage appears not to be correlated to the cultivar, in addition, each cultivar showed a different behaviour among different orchards. Arbequina showed 6% of dead inflorescences in the orchard of Maiolati Spontini, and 95% in the orchard of Agugliano. In Maiolati Spontini, only FS-17 showed a great loss of inflorescences. In the orchard of Fermo, Rosciola showed higher damages than other cultivars. This different response could be explained by small differences in temperature and humidity that are site-specific, and to the exact phenological stage of the flowers in that specific moment. These observations can provide insights in determining which are the most adaptable cultivars to the new climate that will settle in central Italy in the future. However, this goal seems very difficult to reach in only one cultivar, because of the different responses of the cultivars to different kinds of frosts (winter, late-winter, spring).

#201 - Varietal Improvement: Todolivo's Breeding Program

Angela Sanchez Jimenez, Todolivo, S.L.

Todolivo, a leading company in the execution and management of olive tree plantations and breeder of olive plants, has developed a successful genetic improvement program, through which it has naturally obtained, by cross-pollination, 72 new highly productive olive tree varieties from its first two phases of crosses. Of these, it has selected a group of 10 varieties which it intends to start marketing soon in the USA, five of which are already patented in this country; Todolivo I-15P, Todolivo I-6 P, Todolivo I-31 P, Todolivo I-42 P and Todolivo I-50 P and the remaining five are in the patent process; Todolivo I-20 P, Todolivo I-24 P, Todolivo I-30 P, Todolivo I-74 P and Todolivo I-100 P. Of these, Todolivo I-15 P is the first to be commercialized. All of them are very easy to handle, early varieties, with high productivity and high fat yield, which have a high tolerance to the most common diseases in olive groves and will allow growers to increase the productivity and profitability of their farms, as well as to produce extraordinary new EVOOs to differentiate their offer and expand the organoleptic range of existing oils on the market.

#50: Perspectives in olive propagation by Azospirillum baldaniorum SP245

Susanna Bartolini, Scuola Superiore Sant'Anna

The employment of alternative rooting agents to be used in the agamic propagation of olive plants (*Olea europaea* L.) is currently encouraged, mainly in the organic nursery sector. This issue has let to test the potential effectiveness of plant growth promoting rhizobacteria (PGPR), such as the free-living soil bacteria Azospirillum baldaniorum Sp245, in stimulating processes related to the formation of adventitious roots. This research had a twofold objective: I) to evaluate the efficacy of A. baldaniorum Sp245 in semi-hardwood olive cuttings of Santa Caterina and Leccino cultivars, known to be hard- and easy-to root, respectively; II) to develop a protocol for the early quantification of histological events associated to the adventitious root formation, ascertaining the efficacy of new rooting compounds. Comparative analyses were assessed with the indole-3-butyric acid (IBA), the most used synthetic auxin as root-promoting compound. Macroscopically morphological determinations and microscopically anatomical observations of the basal portion of cuttings were periodically assessed. The best results on rooting performances of Santa Caterina cultivar were obtained when cuttings were treated with the bacterial suspension. Indeed, an improvement of rooting ability, number of adventitious roots and mean root length was detected in comparison with IBA treatments. Histological analyses on Leccino cultivar showed that the main cellular changes, leading to the adventitious root formation, were significant without any statistical difference between A. baldaniorum Sp245 and IBA. These results appear to be innovative and promising. As alternative rooting agent, A. baldaniorum Sp245 could replace IBA in a context of organic nursery systems, and the development of protocols for early diagnosis of rooting aptitude could promote the propagation success. This latter aspect appears of a particular relevance mainly for olive genotypes, like Leccino, that show tolerance towards the bacterium Xylella fastidiosa subsp. pauca which should be considered for new olive orchards.

#79: Micropropagation of Italian varieties with the aim to preserve genetic diversity in olive

Michela Lupo, Università degli Studi della Tuscia

The use of a few cultivars for olive cultivation can lead to a loss of agrobiodiversity. Since in vitro techniques are valuable tools for micropropagation and conservation of plant biodiversity, an efficient micropropagation protocol for four Italian local varieties, 'Quartoletto, 'Maggianico', 'Montegibbio' and 'Montecalvo', was developed. Micropropagation, in fact, an important tool for clonal propagation and for the production of healthy genetic material that can sometimes guarantee better agronomic performance than plants derived from traditional propagation methods, while for olive, the application of this technique is very complex because adaptation to in vitro conditions is highly dependent on the genotype. In this study, the response of the four olive varieties to two different sterilisation protocols, proliferation and rooting have been studied. Shoot length and multiplication coefficient of the accessions, as well as rooting ability, showed clear differences, confirming the marked genotype-dependence of the olive. The application of the experimental protocols resulted in a high degree of success for all the genotypes tested, further expanding the application potential of the in vitro propagation technique for olive trees.

#55: SSR markers in traceability of Croatian virgin olive oils

Gabriela Vuletin Selak, Institute for Adriatic Crops

The availability of a traceability method for monovarietal and blend olive oils of Croatian autochthonous varieties would be useful for producers and consumers. The autochthonous olive germplasm of Croatia together with selected foreign cultivars were molecularly characterized to obtain molecular profiles specific for the cultivars included in this study. DNA from the monovarietal oils of the autochthonous varieties Buža, Drobnica, Istarska bjelica, Lastovka, Levantinka, Oblica and Piculja, the four international

varieties Coratina, Leccino, Pendolino and Koroneiki, and from their mixtures at 1:1 ratio, was isolated using the Olive Oil DNA Isolation Kit (Norgen Biotek Corp., Canada). The extraction yielded DNA of sufficient quantity and quality, suitable to perform the PCR amplifications at the 12 selected SSR loci. The expected alleles matching with those identified in leaves were obtained in some monovarietal oils together with additional alleles not corresponding to the used cultivars. Additional work is ongoing to improve the method for authentication of Croatian olive oils.

#108: A Meta-analysis approach to identify putative candidate genes involved in susceptibility and resilience to *Xylella fastidiosa* in olive

Annalisa Marchese, Dipartimento Scienze Agrarie e Forestali, L'Università degli Studi di Palermo

Xylella fastidiosa, a xylem-limited bacterium, infection causes devastating effects on olive groves in Italy (Apulia region) resulting in significant economic losses due to reduced olive productivity and increased plant mortality and it is much feared in all the Mediterranean countries, where the olive cultivations thrive. The impact of X. fastidiosa on olive groves extends beyond agricultural losses to encompass economic consequences for the European olive industry. Besides investigating the impact of X. fastidiosa on olive trees, this study aims to identify the adverse effects of X. fastidiosa on other fruit bearing trees also (*Vitis vinifera*, *Prunus dulcis*). The investigation employs RNA-Seq, a high-throughput sequencing technique, which plays a crucial role in understanding the molecular response of plants to Xylella fastidiosa infection by providing valuable insights into the complex interactions between the bacterium and the host plant at the transcriptomic level. Through the extensive literature survey, four papers investigating the infection of Xylella fastidiosa in two olive cultivars (the low susceptible 'Leccino' and the high susceptible 'Ogliarola salentina'), Prunus dulcis , Vitis vinifera and Medicago sativa were identified. A bioinformatics pipeline was developed for meta-analysis, enabling the identification of commonly shared genes and unique genes. Gene Ontology (GO) analysis was employed to unravel the biological significance and roles of the genes of interest, elucidating their potential involvement in specific biological pathways or molecular functions.

#58: Ancient Kaštela olive tree – proof of the long tradition of Croatian olive growing

Mira Radunic, Institute for Adriatic Crops, Centre of Excellence for, Biodiversity and Molecular Plant Breeding

Olive (*Olea europeae L.*) is the most widespread fruit species in the Mediterranean part of the Republic of Croatia and has a long tradition of cultivation. This is evidenced by the Old Olive Tree in Kaštela, a symbol of olive growing and olive culture. It is believed to date back to the 5th-6th century or even earlier. Morphological and molecular methods have proven its uniqueness, so it is considered autochthonous, i.e. the original tree of Kaštela. The trunk of the Old Kaštela olive tree consists of two parts. The circumference of the whole trunk is 10.75 m. The tree has medium vigour and open growth with a well-developed crown. The leaf has an elliptical-lanceolate shape, the fruit is oval, medium size (2.31 g), and the stone is elliptical, medium size (0.32 g), with rough surface. The oil content in the fruit amounts to 15.17 +- 1.53 %. The VOO obtained by centrifugal extraction had a mean oleic fatty acid content with average value of 71,3 +- 0,1, and had high palmitic fatty acid content (average 13.00 %). Medium content of linoleic fatty acid (average 10.55 +- 0.05 %) characterized oil of this Old Olive Tree in Kaštela. The phenolic compounds in the oils were analysed by liquid chromatography (LC) coupled to triple- quadrupole mass spectrometry (QQQ), with the highest content of 3,4- DHPEA-EA (monoaldehydic form of oleuropein- aglycone) with an average value of 129.91 +- 25.74 mg/kg. These olive trees are a protected natural monument that should be preserved for future generations.

#93: First results of genome wide association study for the composition of fatty acid in olive oil

Samanta Zelasco, Res.Centre for Olive,Fruit and Citrus crops, CREA

The cultivated olive tree is the oldest and most widespread tree crop in the Mediterranean basin. Most of the olive production is addressed to olive oil, which has remarkable qualitative properties, determined by its peculiar chemical composition. In particular, olive oils with a high content of oleic acid and a low content of linoleic acid are more advisable from a nutritional and technological point of view. Consequently, the development of novel varieties that produce oils with a high oleic/linoleic acid ratio is a priority in olive breeding programs. Understanding the basis of quantitative traits can help plant breeders improve yields, tolerance to (a)biotic stress, and qualitative traits.In recent years, association mapping (AM) methods have been developed to link individual genetic backgrounds (i.e. , genotypes) with specific traits (i.e. , phenotypes) based on linkage disequilibrium. In this work a panel of 142 varieties were genotyped using the Single Primer Enrichment Technology (SPET) and the fatty acid composition of olive oil was determined by nuclear magnetic resonance. Since variants calling was based on 'Leccino' genome assembly, this was maintained as reference through the analysis with respective gene models. The raw VCF file, including 4.532.192 variants, was subjected to filtering, resulting in 142 individuals with 479.208 nucleotide variants. Of these, 6949 are located in coding sequences of 1055 genes belonging to the oleic/linoleic pathways. Multidimensional scaling (MDS) was used to graphically show distances between individuals in a population using each individual's coordinates along the principal axes of a MDS graph. These coordinates were used as control variables (i.e., covariates) in genotype/phenotype association tests. LD pruning returned a set of high-quality variants (N=131.554) that were used as input by ADMIXTURE for the estimation of allele frequencies and classification of individuals into six ethnically similar groups (probably due to different ancestry). The resulting matrix (known as the Q matrix) was incorporated into models for GWAS. Five statistical models were used and 11 SNPs were found to be significantly associated with fatty acid composition. These first results can help to clarify the genetic basis explaining the variability of the fatty acid composition in olive and provide new molecular tools for assisted- markers breeding.

#68: Genetic diversity and structure of Olive tree genetic resources from Catalonia (North Eastern Iberian Peninsula)

Antònia Ninot, Institute of Agrifood Research and Technology

The most important olive cultivar in Catalonia (NE of Spain) is 'Arbequina' which is present in 4 out of 5 Protected Designations of Origin (PDO) existing in that region. Besides, there is a rich genetic heritage preserved by local farmers for centuries. Prospecting trials have permitted the collection of 129 olive accessions from different areas of the region that were further analysed by means of 9 SSRs. These markers made possible the identification of the accessions and helped to elucidate the genetic relationship among them and to test the putative existence of genetic structure. An UPGMA dendrogram based on the Dice similarity index was constructed to show the genetic relationships among genotypes. Genetic diversity parameters were calculated and genetic structure was assessed by using the Bayesian clustering method implemented in STRUCTURE v.2.3.4 software. SSR molecular markers distinguished 120 different profiles. Nine synonymies were found among the studied cultivars. Minimal allelic differences were identified among genotypes (up to four different alleles) in 25 accessions that probably belong to the same variety, being the total number of cultivars identified 104. In general, all the SSRs showed a high capacity for discrimination (PIC), with an average of 0.8408. The observed heterozygosity (Ho) was very high, with an average of 0.84, and the average of expected heterozygosity (He) was 0.86. From the test and SSR markers, showed a clear maximum for ΔK at K = 4, indicating that the Catalan germplasm could be grouped into 4 subpopulations according to a geographical pattern (from south to north), with admixture genotypes. Studying genetic differentiation at a fine geographic scale allows us to identify the current population's history. These results highlight the rich genetic diversity available in this area.

#84: Ex situ Croatian olive germplasm collection – CroP_BioDiv

Mira Radunic, Institute for Adriatic Crops

Many different natural habitats contribute to high biological diversity in Croatia. The diversity of the olive tree is very high, with numerous cultivated and wild olive accessions. Within the project "Biodiversity and Molecular Plant Breeding", research expeditions were conducted throughout the olive growing area of Croatia. Nine wild olive populations and more than 40 indigenous accessions were located and samples were collected. Morphological characteristics of leaves, fruits and stones of all accessions were evaluated according to Baranco and Rallo (1984), and molecular profiles specific to genotypes were established using 12 SSR (Simple Sequence Repeats). Virgin olive oils from indigenous accessions and selected wild accessions were chemically profiled. Representative accessions were rooted, seedlings were grown and planted in an experimental olive orchard in 2020 - 2022 at the Institute for Adriatic Crops and Karst Reclamation Split. The collection of 125 wild olives and 40 indigenous accessions represent national olive gene pool as a base for future research.

#200: The Olive Grove in wide frame hedge

Angela Sanchez Jimenez, Todolivo, S.L.

The wide-framed hedgerow olive grove is a modern olive growing technique developed by the Spanish company Todolivo S. L. through the R+D+i that the company has been carrying out for 27 years. It represents a great change and advance in hedgerow olive growing, since it allows growers to produce, both in dry and irrigated conditions, a variety of high quality EVOOs in a more regular, sustainable and profitable way. It uses larger frames that require a lower density of trees per hectare, which reduces investment and management costs, pruning is simple, very economical, where the leaf mass is very well insolated as in the street, enabling, on the one hand, a good aeration, This allows, on the one hand, a good aeration, a correct physiological development and, on the other hand, a more homogeneous ripening of the fruit throughout the tree and higher fat yields, thus achieving a high productivity in the farm and a greater regularity in the harvests obtained, as well as the production of excellent EVOOs. Translated with www.DeepL.com/Translator (free version)

#114 - YM: Evaluation of vegetative-productive characteristics of different olive cultivars grown, in rainfed conditions, in a high-density intensive orchard in central Italy

Nicola Cinosi, Università di Perugia

In central Italy, in the years 2019-20, in a rainfed high-density intensive olive grove (trees at 5 x 2 m), an experiment was carried out to evaluate the agronomic behavior and the quality of the oil of the cultivars Arbequina, Arbosana, Koroneiki, Oliana and Sikitita. Oliana and Arbosana showed lower vegetative growth (stem diameter and height) than the other considered varieties. Sikitita showed the strongest growth. Arbequina, Arbosana and Sikitita showed the highest cumulative production. Arbosana and Oliana presented the highest values of production efficiency. At harvest, carried out at the end of the second decade of November, the cultivar Koroneiki showed the lowest values of resistance to detachment and weight of fruits. Sikitita presented the heaviest fruit and the lowest ratio of resistance to detachment / weight of fruits. Arbosana and Koroneiki showed the lowest levels of pigmentation of fruits. Oliana presented the lowest pulp consistency. Sikitita showed the highest pulp / stone ratio. Oliana showed the highest water content in the fruit. Koroneiki presented the lowest oil contents both when expressed on the basis of fresh weight and when expressed on the basis of dry weight, while Sikitita showed the highest values. The oils of all cultivars showed values of free acidity, number of peroxides and spectrophotometric constants that allow their classification as extra virgin. All cultivars showed oils with high oleic acid contents, with Koroneiki having the highest values. Koroneiki showed the highest phenolic contentl. Oliana showed the highest contents of aldehydes. Koroneiki presented the highest content of esters.

In conclusion, the results about the production potential of the examined varieties are interesting. Indeed, even though the grove was rainfed, in the fourth year after planting, they showed relatively high yields (up to about 47 q / ha with Arbequina). All cultivars presented interesting fruit characteristics. Indeed, a slow pigmentation and high oil contents (≥; 40% p.s.) were detected. These two parameters are important indicators for the quality and quantity of the oil. The results relating to the quality of oils are particularly good, because, for all cultivars, the fatty acid composition was optimal and the total phenolic content was higher than 300 mg / kg of oil, with Koroneiki and Sikitita having very high values (>; 800 mg / kg of oil). With regard to the contents of volatile substances, there are important differences between the cultivars, which can allow, through their appropriate combination at the time of designing the plant, a high potential for product diversification.

#2: Scarification and germination of wild olive stones from Jabal Akhdar, Oman

Thuraiya Al Jabri, School of Biological Sciences, University of Reading

Olea europaea subsp. cuspidata (Wall. & G.Don) Cif. (wild olive) is one of the key woody species in the mountain habitats of Oman. Wild olive trees are scattered, isolated, and at risk from several threats including climate change, urbanization, overgrazing, human activity, and the introduction of non-native species. One hundred and eighty-four trees from eight locations in three mountain ranges were assessed and tree damage scored by an index of four categories: 0-20%, 21-45%, 46%-64%, or ≥;65% of damage caused by grazing, dead branches, and human activity (cut or burnt branches). No regeneration of wild olive was detected in any of the three mountains (Dhofar, Western and Eastern Hajar mountains) during these field expeditions. There were significant differences of tree height among eight populations across Oman. Study of wild olive trees in the three mountain ranges of Oman showed damage predominantly ranging from 21-45% but with 29% of trees having >; 45%, and up to 65% damage. The Western Hajar mountains and Dhofar mountains had the worst condition index of wild olive trees. There was a negative correlation between tree damage and tree height and a positive correlation between tree damage and site slope, but no correlation between tree damage and altitude of the site. Urbanization, climate change and overgrazing has put wild olive populations at high risk. Immediate action to conserve the habitat of these mountains will play an essential role in maintaining this important species in the mountain's ecosystem habitat.

#100: In vitro preliminary evaluation of the low vigour olive F2 ‘Koroneiki’ progenies

Irene Granata, University of Palermo

Olive (*Olea europaea* L. subsp. europaea) is one of the most ancient, cultivated and economically important fruit crops in the Mediterranean areas, due to its many uses. Many of the cultivated genotypes show a high level of morphological and biological variation regarding agronomically important characteristics, as expressed through the high number of cultivar populations. One of the most suitable agronomic characters is the ‘low vigour’ to select compact genotypes for new intensive orchards. Among international olive germplasm, the Greek self-fertile cultivar ‘Koroneiki’ has close to the commercially ideal habit showing medium-low vigor and constant bearing, whilst maintaining commercially acceptable fruit yield and oil quality. The Department SAAF-University of Palermo has raised a F2 progeny, derived from the selfing of ‘Koroneiki’, obtaining a wide range of interesting genotypes showing low vigor and new architectural compact traits, including dwarf or “brachitic habit”. In plant breeding, in vitro culture represents an important tool to multiplicate large numbers of selected genotypes if compared to traditional propagation techniques. In this work, the preliminary results of in vitro shoots proliferation and rooting of F2 ‘Koroneiki’ genotypes, are presented. Single-node woody explants of dwarf, semi-dwarf and standard height genotypes were collected from the field, sterilized, and in vitro cultured. For branching of lateral buds, two types of culture media (OM and WPM), two types of cytokinin (Zeatin and Meta-Topolin), and three types of hormone concentrations (control, 2 and 1:1 mg/L) were evaluated. Rooting factors include two type of basalt salts (including vitamins) at half strength (OM and WPM), two types of auxins (IBA and NAA), and three levels of PGR concentration

(control, 1:1, 2:2 mg/L). Results showed great variability amongst the F2 progenies, and many clones were obtained. Interestingly, low vigor and dwarf traits are maintained in all in vitro stages. Results are useful for future selection and breeding programs.

Tuesday, 12 September: Oral Presentations

Physiology

#22: Tree-ring isotopic study reveals a different degree of tolerance to summer stress conditions in olive tree cultivars

Silvia Portarena a, Inst. Research on Terrestrial Ecosystems

Olive (*Olea europaea* L.) is a drought-tolerant tree species cultivated in Mediterranean-type environments. Although it is relatively tolerant to drought, prolonged hot and dry summer conditions can induce stress, leading to decreased yields. Due to global warming, a significant increase in frequency and severity of drought episodes is predicted in the Mediterranean Region. Hence, studies about the physiological bases of adaptation/tolerance of olive trees to stress are needed to better understand how various cultivars will cope with climate change. Adult olive trees of two high-quality cultivars (Moraiolo and Maurino) located in an orchard in Central Italy were investigated to observe possible differences in growth, fruit production, and tolerance to hot and droughty conditions. Studies were aimed at different physiological processes such as, stomatal sensitivity, photosynthetic capacity and intrinsic water-use efficiency. To study seasonal and interannual responses to climate variability, stable isotopes were investigated in tree rings to study carbon and water fluxes in the two olive cultivars over three growing seasons (2019 and 2022). The two cultivars differed in seasonal d 13 C trends during the three years. Tree ring δ 13 C values increased from early spring to summer and decreased from autumn to winter. The increasing trend in δ 13 C, from early spring to summer indicates a gradual decrease in photosynthetic isotopic discrimination. This would imply an increase in intrinsic water-use efficiency in response to increasing temperature and decreasing water availability. In this regard, cv. Maurino showed a more limited range of variation in comparison to cv. Moraiolo. This may be related to different stomatal sensitivity, leading to more limited stress tolerance in Maurino and different strategies of water relations with respect to Moraiolo. In all the years, Moraiolo reached significantly lower δ 13 C values in the winter and higher δ 13 C values in the summer, indicating a higher stomatal responsiveness and a higher phenotypic plasticity in response to changes in environmental conditions during the vegetative and reproductive season. Indeed, this cultivar has the potential to better tolerate thermal variations and drought conditions in response to Mediterranean climate change.

#20 - YM: Could silicon ameliorate salt tolerance in *Olea europaea* L.?

Ms. Carmen Fidalgo Illesca , Crop Science Research Center CSRC

High salt concentration in irrigation water can reduce productivity of olive tree. Olive is considered moderately tolerant to salinity, but tolerance mechanisms are cultivar and genotype dependent. Silicon (Si) is a metalloid that could alleviate salt stress in plants. The aim of this study is to evaluate the silicon priming effect on salt stress responses in salt-tolerant ('Frantoio') and salt-sensitive ('Leccino') cultivars. One-year old self-rooted plants of both cultivars were grown in growth chamber for 28 days and irrigated with 10 mgL -1 silicic acid Si (OH) 4 and then, for 51 days with 100 mM NaCl. Shoot elongation and physiological parameters were monitor during experiment. Data shown that silicon did not affect shoot elongation in both cultivars, and the subsequent salt stress did not impair shoot elongation either. Photosynthetic performancedecreasedin both cultivars in response to NaCl; however, in 'Frantoio' this effect was exacerbated by silicon pre-treatment. Ionomic profiling at whole plant level was conducted by atomic emission spectroscopy. After 28 days, there were no differences in silicon concentration, in both cultivars, between control and pre-treated plants. However, silicon had influence in ion uptake and mobilization in both cultivars. In pre-treated plants of 'Frantoio' a significant reduction of Mn (-23.1%) was observed at the root level and Zn (-65%), Fe (-44, 6%), Cu (-47.8%), K (-27%) in basal stem. Pre-

treated plants of 'Leccino' presented a significant decrease of 56.8% of Zn at the root level, an increase of Cu (+76.4%) in old leaves and Ca (+44.8%) in the apical stem. Metabolomic (UHPLC-MS/MS) analysis are in progress to understand if silicon affects the synthesis of the main osmolytes (e.g., proline and mannitol) and antioxidative molecules used to cope salt stress.

#39: Alternate bearing in olive; Mitigation with properly timed foliar-applied naphthaleneacetic acid or pruning

Carol J. Lovatt, Department of Botany and Plant Sciences, University of California, Riverside

Climate events causing floral bud abortion, poor pollination or abscission of reproductive structures result in alternate bearing (AB) in olive (Olea Europaea L.). Alternating low-yield OFF crops and high-yield ON crops have negative economic impacts on orchard management, harvesting, marketing, production of value-added products, and consumer prices, which destabilize the sustainability of olive commodity-based industries. In this research, AB severity for 'Manzanillo' olive, based on alternate bearing index (ABI), where 0 equals no AB and 1 is complete AB (crop one year, no crop the next), ranged from 0.35 to 0.94. Nonbearing shoots (NBS) on OFF-crop trees produced 20-fold more inflorescences the following spring than bearing shoots (BS) of ON-crop trees, whereas NBS on ON-crop trees produced 15-fold more inflorescences than BS. To increase flowering and yield following an ON-crop year, the number of NBS needs to be increased. Flower removal at full bloom (FB) with naphthaleneacetic acid (NAA) or fruit removal 28 days after full bloom (DAFB) by pruning were imposed on one side of commercial 'Manzanillo' olive trees and then the other side annually verses every other year (biennially). Over a 4-year period starting with an ON crop, for untreated ON-/OFF-crop control trees, ABI for total yield was 0.94 and ABI for yield of commercially valuable medium plus large (M+L) size fruit was 0.80. Foliar-applied NAA @ FB or pruning 28 DAFB to one side of the tree annually reduced the ABI for total yield to 0.75 and 0.72, respectively, and ABI for yield of M+L size fruit to 0.70 and 0.61, respectively. In contrast, foliar-applied NAA @ FB or pruning 28 DAFB to one side of the tree biennially reduced the ABI for total yield to 0.58 and 0.47, respectively, and ABI for yield of M+L size fruit to 0.46 and 0.37, respectively. There were no differences in 4-year cumulative total yields among treatments, whereas cumulative yields of M+L size fruit were 20% and 40% greater for trees treated with NAA or pruned biennially than trees treated annually for the same 3-year period (P < 0.01).

#110: Olive tree physiology and productivity in cold and dry coast area of Patagonia

Nadia Arias, INBIOP (CONICET-UNPSJB)

In the last years olive cultivars had expanded his distribution limits to higher latitudes where low temperatures and drought are the main factors that could limit olive productivity. In the coast area of Chubut province, located in the south-east of Patagonia, Argentina, olive tree cultivation has been proposed as a new economic alternative for the region. These new olive cultivars are considered the most southern olive crop around the world. The objective of the study was to evaluate the physiology and productivity of Olea europaea L. growing in the coast area of Patagonia. We determined water plant relations, leaf low temperature resistance, phenology and productivity of 6 olive cultivars (Arbequina, Picual, Manzanilla, Coratina, Frantoio and Barnea) growing in "La Providencia" farm located in Punta Ninfas area (42°52´28´´S, 64°46´40´O). We observed that all cultivars flowered (full flowered) between the end of November (their week) and the beginning of December (first week). For example, Barnea and Arbequina cultivars are at stage full flower boom (FF) the 21 th of November. We observed that during winter olive cultivars exhibited leaf cell damage (LT 50) at temperatures below -12°C, which highlights the importance of cold autumns in the region necessary to reach the maximum plant acclimation to low temperatures. Barnea exhibited 50% of leaf cell damage at higher temperatures (LT 50 -12,71 +- 0,56) while Frantoio exhibited lower cell damage at low temperatures (LT 50 -16,85 +- 0,38). In terms of oil quality, all the cultivars studied have oleic acid percent higher than 70%. The results show that all the studied cultivars growing in the coast are of

Patagonia had an optimal development. However, Barnea cultivar exhibited earlier flowering and was less resistant to low temperatures and could be more susceptible to the low and freezing temperatures present in Patagonia.

#25: Anomaly detection in real-time continuous fruit-based monitoring of olive via extensimeter

Arash Khosravi, Dipartimento di Scienze Agrarie, Universita' Politecnica delle Marche

In this study, we analyze the real-time measurements collected by extensimeter (fruit gauge) in olive orchards to identify their anomalies. The field data are collected by two different types of extensimeter (strain gauges and variable linear resistance transducer) with hourly temporal resolution and time span of 3.5 months in 2019, 3 months in 2020, and 2.5 months in 2021. To recognize the outliers in the sensor records, conventional statistical approaches including Hotelling's T-square, sliding window techniques such as Moving Average Absolute Deviation, Moving Median Absolute Deviation as well as two innovative methods, developed in this paper, including Moving Standard Absolute Deviation and integrated Moving Standard Absolute Deviation-T-square are implemented. The performance of the mentioned approaches are evaluated using the well-known statistical indices including Root Mean Square Error, Scatter Index, Bias, and Correlation Coefficient. To visually compare the models' performance, the results of different approaches are illustrated using Bland-Altman and Taylor diagrams. The results prove that the integrated model outperforms others in the recognition of outliers. It is useful for acquiring more robust data and identification of sensor malfunctionality or low accuracy during continuous monitoring.

Climate Change

#6: Increasing olive tree resilience to climatic changes through the selection of tolerant genotypes and application of sustainable practices

Georgios Koubouris, Elgo-Dimitra, Institute for Olive Tree, Subtropical Crops and Viticulture

Extreme environmental conditions have challenged olive tree cultivation more frequently in recent decades. The intensity and duration of heat incidents and periods without rainfall increase, harming flowering and fruit yields. Even though olive grove management has advanced significantly, fruit yields still rely heavily on weather suitability. Almost every year, one major olive-producing country reports a drastic yield decrease due to climatic causes. In several projects, we aimed to evaluate an extensive germplasm collection for tolerance to abiotic stresses (water deficit, salinity, high temperature, low temperature, UV-B radiation) and phytopathological factors (olive fruit fly, verticillium). We also implemented multiyear field trials applying a magnitude of sustainable management practices for increasing the resilience of olive trees to climatic changes and enhancing their mitigation role through carbon sequestration.

#41: Agroecological approaches in olive farming, for combating land desertification and mitigating climate change in Messinia, Greece

Ioanna Michail, Mediterranean Agronomic Institute of Chania

Land desertification is becoming increasingly important for the Mediterranean basin, due to climate change and other increasing pressures on agricultural land. The olive sector plays a respective role, as intensive farming methods can deliver negative implications for the provision of several agroecosystem services, especially due to soil erosion and biodiversity loss. On the other hand, agroecological approaches, including olive farming practices such as reduced tillage/no-tillage and use of cover crops can mitigate soil degradation and enhance carbon sequestration. We installed an experiment in a hilly olive grove at Messinia, south Peloponnese, a main olive production area of Greece; Different soil treatments were set in 9 plots (3 plots/treatment) including the i) use of a cover crops mixture (Pisum sativum , Vicia faba , Hordium vulgare) ii) herbicide application and iii) natural vegetation (control). A

survey of soil physiochemical properties and surface run off-erosion is performed at plot level, coupled with monitoring of olive tree nutrient status, carbon sequestration, ground-dwelling arthropod diversity, yield, soil evapotranspiration and climatic conditions. Consequently, the findings of the in-situ experimentation are integrated in soil and water management models. The outcome of the above assessment is expected to provide robust decision support for effective management and policy solutions, for increased resilience and regeneration of degraded land.

#45: High temperature environment reduces olive oil yield and quality

Karen Wortman, Plant Sciences Institute, Hebrew University

Global warming is predicted to have a negative effect on plant growth due to the damaging effect of high temperatures. In order to address the effect of high temperature environments on olive oil yield and quality, we compared its effect on the fruit development of five olive cultivars placed in a region noted for its high summer temperatures, with trees of the same cultivars placed in a region of relatively mild summers. We found that the effects of a high temperature environment are genotype dependent and in general, high temperatures during fruit development affected three important traits: fruit weight, oil concentration and oil quality. None of the tested cultivars exhibited complete heat stress tolerance. These results suggest that different olive cultivars have developed a variety of mechanisms in dealing with high temperatures. Efficient pollination and fertilization depend on many factors, such as the duration of stigma receptivity and morphology, pollen grain sustainability, pollen tube development. We performed a long-term chronic heat stress as well as short-term acute heat stress. Pollen viability and pollen tube growth, negatively changed in these parameters when various olive varieties were exposed to elevated temperatures Elucidation of the mechanism of each of these responses may open the way to development of a variety of olives broadly adapted to conditions of high temperatures.

#104: Exploring the response of olive genotypes to salinity and drought stresses

Josip Tadic, Institute for Adriatic Crops

Abiotic stresses of increased salinity and long-term droughts are becoming widespread problems in modern orchards with dense structures where the evapotranspiration demand is high and low-quality water is used for irrigation in combination with water-soluble fertilizers. The aim of the research was to determine the impact of abiotic stresses of increased salinity and drought on four wild genotypes and three well-known olive cultivars, 'Oblica', 'Leccino' and 'Koroneiki', by monitoring the morphological, physiological, and biochemical changes caused by the stress. To induce abiotic stress from increased salinity, coarse sea salt was applied to achieve a treatment of 150 mM/L NaCl, while sugar alcohol mannitol was used to initiate a drought treatment. Analysis of samples and identification of alleles of 12 SSR loci confirmed the richness of the germplasm of Croatian autochthonous wild and cultivated olives. Leaf length and surface area proved to be significant morphometric indicators of stress levels. The cultivar 'Oblica' accumulated high concentrations of salt ions in its leaves. We assume that these ions are crucial in maintaining osmotic pressure in the cells, as other results did not indicate any severe signs of stress. However, genotypes that are susceptible to high salinity levels require a longer time to stabilize their Na + and Cl - levels compared to those that are resistant. According to results, modulation of SOD enzyme activity can serve as an indicator of abiotic stress caused by salinity and particularly drought. The wild olive genotypes LA 13 and PLJ 18 showed continuously satisfactory results in morphometric and biochemical analyses. These promising findings warrant further research on genotypic characterization, as they already represent valuable material for breeding programs.

#109: Experimental warming during autumn and winter decreased freezing resistance in Olea europaea plants

Nadia Soledad Arias, Ciudad Universitari

Global climate change is likely to increase mean average temperature, reduce precipitation and alters timings, frequency, and intensity of frost events. Warmer temperatures during the autumn and winter

will potentially increase growing season length and could expose plants to low and freezing temperatures, increasing their risk to suffer frost damage. The objective of this study was to determine leaf frost resistance and vegetative growth of Olea europaea exposed to experimental warming. A field experiment with two temperature levels was conducted using well-irrigated, potted olive trees (cvs. Arbequina, Picual) grown in open-top chambers for two periods of 60 days during the autumn or winter. The temperature levels were a near-ambient control (OTC 0) and a heated (OTC +) treatment (+4 °C). During autumn and winter, leaf cell membrane damage (LT 50) of cvs. Picual and Arbequina grown in heated treatments was higher (around 2°C) than control treatments. For example, cv. Arbequina plants grown inside OTC + during the autumn exhibited LT 50 values of -7.12 °C +- 0.67 and inside OTC 0 the values were -9°C +- 0.55. During the winter we found a negative and linear correlation between late-season shoot elongation (cm) and LT 50 (y= 0.756x-9.67, R 2 =0.90) . Olive plants that exhibited lower values of leaf LT 50 were those with less shoot elongation. The results showed that the exposure to warming temperatures decreased olive freezing resistance, suggesting that global climate change could limit olive crop acclimation to low temperatures and decrease survivability under freezing events.

#35: Significance of proper nitrogen fertilization for olive productivity and oil quality

Arnon Dag, Plant Sciences, Gilat Research Center, Agricultural Research Organization

Current trends of intensification of olive cultivation, including irrigation and fertigation have dictated a need to reconsider fertilization management practices. Nitrogen (N) is a major essential plant nutrient and the most applied mineral in fertilization programs in horticultural crops. We evaluated the effect of nitrogen fertilization level on olive tree physiology and olive oil quantity and quality in both controlled container and field experiments. Nitrogen fertilization levels affected fruit and leaf N. A significant negative correlation between fruit N and oil content was found. Furthermore, excess N fertilization reduced the fruit number per tree. With respect to oil quality, oil phenolic content decreased linearly as a function of increased leaf N, indicating protein-phenol competition in leaves. The overall saturation level of the fatty acids decreased with fruit N, and free fatty acids increased with the increased level of fruit N. Proper N fertilization is concluded to be fundamental to the successful management of intensively cultivated olive orchards. An annual level of ca. 150 kg N per hectare seems optimal for maintaining the highest long-term, high quality, oil yield.

#21 - YM: Caffeine uptake and degradation in olive tree (*Olea europaea* L.): a model for studying organic contaminants in irrigation water

Elena Vichi, School of Advanced Studies Sant'Anna Pisa

Wastewater irrigation can be considered a promising alternative to meet the growing demand for water in arid and semi-arid regions. However, in order to validate its use, it is necessary to verify whether the possible presence of organic contaminants may have negative effects on crops. The effects on olive fruit production and quality were analyzed in relation to treatment with water containing realistic concentrations of caffeine, an environmental contaminant frequently found in wastewater. Olive trees (Olea europaea L. cv. Leccino) were grown in pots (24x24 cm; 9.5 L) in a greenhouse (52 days) and daily water treatments were given to control plants and water containing caffeine (trimethyl -13 C) (0.014 mg L -1 , we chose to use caffeine trimethyl -13 C to discriminate our treatment from the plant's endogenous metabolite) for treated ones. Caffeine and polyphenol concentrations in the fruits were determined by UHPLC-ESI-MS/MS mass spectrometry (Sciex 5500 QTrap+), using an Information Dependent Acquisition (IDA) method. The results showed that plants treated with caffeine have a higher photosynthetic activity, with significant differences at early stages of veraison. A similar trend was also observed in the parameters of fluorescence and chlorophyll a + b content, suggesting a biostimulating activity of caffeine. The olive pigmentation index was higher (+8.78%) in caffeine treated plants compared to control plants, as well as the mesocarp oil content. Caffeine was detected at the root level (1.62 ng g -1 FW) while no caffeine was observed at leaves and fruit level. Analyses of polyphenols in

the fruits of caffeine treated plants showed significantly higher content of rutin (+35.03%), oleuropein (+249.3%), hydroxytyrosol (+59.9%), ligstroside (100.2%), chlorogenic acid (+42 %), vanillic acid (+49.7%), 4-cumaric acid (+47.7%) and piceid (77.6%). This work suggests a possible use of reclaimed water containing caffeine but further studies considering other pollutants frequently present in irrigation water are needed.

#202: Characterization of Evapotranspiration and water potential in different olive orchards in California

Paula Guzman-Delgado, Dept. of Plant Science, University of California Davis

The precision of irrigation management and research relies on our capability to correctly identify the upper limits of water use and water status of a crop under non-soil water limiting conditions. From a biometeorological perspective, this is often achieved by the adoption of proper crop coefficients (Kc), and from a physiological perspective, by the adoption of stem water potential (SWP) baselines. However, the high variability of the Kc and WP baselines available for olive impairs the applicability of these thresholds. In this study, we monitored orchard water use with the eddy covariance method and SWP with the pressure chamber for two consecutive years in two super-high density olive orchards in California, and compared the results with published values.

Interestingly, Kc seasonal trends differed from those commonly reported in literature. Kc increased from values of 0.4 to 0.5 in April and May to values of 0.5 to 0.7 in July and remained constant through the rest of the growing season. Kc values were similar in the two monitored years only in one site. SWP ranged between -1 and -1.8 MPa, and its difference with respect to the baseline varied through the season, being largest in July and August. The implications of these results for the use of these methods to improve irrigation management in olive are discussed.

#106: Continuous deficit irrigation scheduling bases on trunk growth rate frequencies approach

Marta Sánchez-Piñero, Dpto Agronomia, University of Seville

The accurate management of deficit irrigation scheduling needs continuous tool. Trunk diameter fluctuations curves were described long time ago but derived-indicators were not commonly used in olive trees. Trunk shrinks and swells in daily cycles and these curves provide different indicators. Trunk growth rate (TGR), the difference between two daily maximum, was suggested as water status measurement in olive trees but its great daily variability made difficult the irrigation scheduling. Recently, weekly frequencies of several TGR ranges were suggested as easy, sensitive approach to identify water stress conditions. Values between -0.1 to 0.3 mm day -1 (named as "Good") were considered the normal range in full irrigated conditions. On the contrary, the increase of the appearance of values more negative than -0.3 mm day -1 (named as "Severe") would indicate water stress conditions. In previous works, the decrease and increase, respectively, of the weekly frequency in each date was associated with different levels of water potential. Only in conditions of very severe water stress, "false positive" were reported with frequencies equal to full irrigated conditions. In this level of water stress, irrigation produced a very fast increase of TGR with values commonly greater than 0.3 mm day -1 (named as "Alert"). The aim of this work was to check this approach in a commercial orchard where a long period of no irrigation was performed. The experiment was performed in a mature, hedgerow olive orchard (cv Arbequina). Shaded water potential showed clearly a two different drought cycles along the experiment, the first moderate and the latter severe. TGR frequencies identified correctly the first but a "false positive" signal was observed in the second. However, estimation of maximum daily shrinkage (MDS), other indicator of daily trunk diameter fluctuations curve, provided information to identify accurately this period.

Crop Protection

#76: Evaluation of new materials for control of Bactrocera oleae

Cindy Kron, University of California Agriculture and Natural Resources

Olive fruit fly (OLFF), Bactrocera oleae Rossi, are found in Africa, Pakistan, India, Mediterranean Europe, Middle East, Mexico, and the United States where wild and cultivated olives are grown. B. oleae are considered the most important insect pests of olives due to their negative impacts on quality for table olives and olive oil produced from infested fruit. Three products are registered on olives in California for control of B. oleae : a deterrent, kaolin clay (Surround), an organic insecticide, spinosad (GF-120), and a conventional insecticide, fenpropathrin (Danitol 2.4EC) which are too few of products to allow for proper rotation of modes of action to prevent insecticide resistance from occurring. A field study was conducted to test the efficacy of organic: Burkholderia spp. strain A396 (Bountify) at 10.0 fl. oz/acre and 20.0 fl. oz/acre , Burkholderia spp. strain A396 (Venerate CG), spinetoram (Delegate 35WG) and conventional: spinosad (Entrust 2SC) insecticides against the conventional industry standard: (Danitol 2.4EC) and an untreated check. Treatments were replicated four times in a completely randomized block design and insecticides were applied three times throughout the olive growing season timed at pit hardening, OLFF population increase, and seven weeks later. The olive fruit fly tunneling and total infestation (tunneling and stings) data were analyzed using two-way ANOVA with mean separation using Fisher's Protected LSD (P < 0.05). The mean percent olive fruit fly tunneling was 23.3% in the untreated check which was significantly greater than all other treatments. In addition, Bountify at 20.0 fl. oz/acre had significantly lower tunneling damage than all other treatments and untreated check except Bountify at 10.0 fl. oz/acre. The mean percent olive fruit fly total infestation was 37.6% in the untreated check which was significantly greater than all other treatments.

#7: The etiology of Peacock's eye disease of olive in Israel

David Ezra, ARO, The Volcani Institute

Peacock's eye disease, caused by Venturia oleaginea , infects sensitive olive varieties in most production areas of the world. Infected leaves drop, the twigs dry out and the productivity of diseased trees may be drastically impaired in the following season. Chemical pesticides are commonly used for disease management. In recent years severe epidemics developed in Israel, even in groves that were sprayed 5 to 8 times. The reason for control failure is unknown. The long-term goal of our study was to develop a decision support system for implementation of effective, environmentally friendly control measures to prevent the development of peacock's eye disease and reduce the damage it causes in Israel. During the first year of the research, we studied the etiology (biology and epidemiology) of the pathogen in Israel. We monitored the development of the disease in four untreated olive groves of the variety "Souri" suffering from peacock's eye disease. Based on our findings we suggest that under the Mediterranean conditions prevailing in Israel, there are two main infection events during each growing season. The first occurs in late autumn-early winter (October-December). Disease symptoms resulting from this infection event become visible from January to February (1-4 months after infection), on leaves that emerged in the autumn. However, on leaves that emerged in the previous spring and summer, disease symptoms resulting from this same infection event, become visible from March to May (4-8 months after infection). The second infection event occurs in early spring (March-May). Disease symptoms on leaves that were infected in this event appear from December to January of the following season (8-12 months after infection). Since there is only one infection event in each growing season that results in

development of disease symptoms in the same season, we concluded that V. oleaginea completes a monocyclic disease cycle in Israel.

#34: Closing the loop: tandem between monitoring and modelling to predict Bactrocera oleae infestations

Luca Rossini, Università degli Studi della Tuscia

Bactrocera oleae is one of the key pests for olive cultivations. Every year, this species is responsible of several direct and indirect yield losses in many Countries worldwide on both table and oil olives. In the most infested areas, several control actions are required to maintain B. oleae populations under the damage threshold level, with subsequent lower level of economic and environmental sustainability of the orchards. Recently, it has been introduced a mathematical model that gave promising results in describing the stage population dynamics of this pest by connecting its biological parameters with environmental conditions. Even though the model was successfully validated with field data, a step forward is still needed to switch the model from purely descriptive to predictive. This work aims to lay the foundation of this transition, by applying the Kalman Filter estimation scheme to include monitoring data into the physiologically based model describing B. oleae life cycle. The resulting theoretical framework showed promising results. The model estimations are effectively improved by monitoring data, moreover, this scheme overcomes the dependence of the system on the initial conditions, information commonly unknown for wild populations developing in natural environments.

#44: Root topography in high-density olive orchards

Matteo Zucchini, Università Politecnica delle Marche

Root distribution and growth dynamics in high-density olive groves require more investigations to provide useful information to guide the vegetative growth during the early years after planting and to prevent physiological ageing in adult trees. The topography of the root was evaluated in 'Maurino' in two high-density olive orchards (1,250 trees ha-1) of 2 and 10 years, located respectively in Rome and Ancona (central Italy). Soil samples by drilling with a manual auger were taken at predetermined distances and depths on 8 trees in each olive grove. The soil samples were dried, weighed and the olive roots were separated using a sieve and then scanned. Images were processed with WinRHIZO software to obtain the total length, the mean root diameter and the Root Length Density (RLD). In the young olive grove, a tendency was observed to have larger diameter roots in the most superficial layers of soil and in the areas closest to the stem, while the RLD was greater in the first centimeters of soil along the row. Radical exploration also involved the inter-row without limitations due to the presence of the natural mulching. In the adult olive grove, the results were consistent with those of the young olive grove even though the root density was minimal at about one-meter distance between the trees along the row and the diameter of the roots was very small in the area of the inter-row subjected to compression by the passage of the machines. In conclusion, in the considered high-density orchards, the root system grew both along the row and in the inter-row. In adult trees, limitations to the root development may be due to autopathic phenomena between contiguous olive trees along the row or by portions of soil subject to excessive compaction due to the passage of machines in the inter-row.

Tuesday, 12 September: Poster Presentations

#56: Evaluating olive for cold hardiness in western Oregon

Neil Bell, Oregon State University Extension Service

Olive (Olea europaea) is a broadleaved evergreen tree widely grown in the Mediterranean region. Cultivation of olives spread to parts of the world with a similar climate and in North America this originally made California the center of olive production. Recently, there has been interest in cultivating olives in non-traditional growing regions, including western Oregon, where there are some small-scale growers. The fundamental challenge to growing olives in Oregon is winter cold injury to the woody

tissues of the tree. Originating as they do in a relatively mild climate, olives are not adapted to temperatures below approximately -9 o C and freezes of this severity do occur occasionally in western Oregon. Observational evidence shows that cultivars vary in their tolerance of cold, however, studies of the relative cold hardiness of olive cultivars in the literature are rare and involve few of the many cultivars. To determine relative cold hardiness of olive cultivars, a new replicated evaluation of 118 accessions was planted at the OSU North Willamette Research and Extension Center in Aurora, Oregon, USA in mid-July 2021. The site is full sun, slightly sloped and consists of silt loam soils. Temperature and other weather data are provided by a Bureau of Reclamation Agrimet weather station located adjacent to the evaluation. Minimum temperature in winter 2021-22 was -6 o C on January 1, 2022. Visual assessment of the evaluation in spring 2022 showed only minor leaf damage and occasional shoot tip dieback. The minimum temperature in winter 2022-23 was two consecutive nights of -6.5 o C in late December, the effects of which will be assessed in spring 2023. The first fruit were harvested from several cultivars in November 2022. The planting is expected to provide data not only on relative cold hardiness of cultivars, but also characteristics such as flowering, fruit set and fruit quality attributes.

#71: Wood anatomical analyses in olive trees under different water stress

Francesco Marra, University of Palermo

Multiple signals suggest an increasing frequency of extreme climate events in the future, especially drought, that can affect physiology, growth and survival of trees. Although olive (*Olea europaea* L.) is considered a high degree of drought tolerance species, severe water stress could negatively impact growth and development, even compromising its survival. Wood anatomical traits are mainly linked to hydraulic conductivity, growth and carbon use. These traits constitute indicators for determining the vulnerability of trees to water shortage. The effects of water stress on several major morphological and anatomical features of the xylem were investigated in an attempt to explain the origin of the differences in drought resistance between four olive cultivars (Biancolilla, Calatina, Nocellara del Belice and Koroneiki) with different vigor. Potted two years old trees were subjected to three irrigation treatments, T20, T50 and T100, that received 20, 50 and 100%, respectively, of crop evapotranspiration. Midday leaf water potential was measured during the growing period. The plants were dissected at the end of the growing season, micro-sections of the main stem were cut with a sliding microtome and then analyzed using an optical microscope. Among the wood anatomical features, the number of vessels (NV), total vessel area (TVA), mean vessel area (MVA) and consequently vessel density (VD) were measured. The difference between the anatomical features of the cultivars and water stress is discussed. We suggest that vessel anatomy profiles can provide useful information for further investigations on olive genotype drought tolerance.

#87: Composition and biomechanical behavior of olive fruit cuticles

Ana Morales-Sillero, Universidad de Sevilla, Dpto. Agronomía

The plant cuticle acts as a protective layer covering aerial parts of plants. Due to its location at the interface with the environment, it performs numerous roles such as preventing water loss, regulating gas exchange, protecting against UV light and mechanical damage, as well as participating in fruit postharvest. Fruit damage reduces the quality of the final products, which is key for table olives consumer's acceptance. In this work, anatomical and mechanical properties of the cuticles from two cultivars with different sensitivity to damage (‘Manzanilla de Sevilla’ and ‘Manzanilla Cacereña’) have been studied. Scanning electron microscopy showed small differences at the surface level after mechanical harvesting. This was accompanied by a decrease in the amount of waxes. On the other hand, 'Manzanilla de Sevilla', the most sensitive cultivar, displayed a significantly lower amount of cuticle, waxes and cuticle phenolics compared to 'Manzanilla Cacereña'. Biomechanical analysis of the 'Manzanilla de Sevilla' cuticle showed that intracuticular waxes significantly increased the elastic modulus and reduced cuticle elongation whereas epicuticular wax removal did not seem to affect the biomechanical performance of the cuticle.

#94: Assessment of minimum leaf conductance and photosynthetic gas exchange as a mean to determine drought tolerance in olive

Samanta Zelasco, Res.Centre for Olive,Fruit and Citrus crops, CREA

Understanding the physiological crops' responses to drought is a fundamental step in implementing breeding and varietal selection programs in order to respond effectively to climate change. Under water stress conditions, the stomata close thus minimizing water loss, with the cuticle layer becoming the dominant pathway for water vapor diffusion. Minimum leaf conductance or cuticular conductance (g min ; mmol m n2 s n1) is a measure of leaf water loss after maximum stomatal closure under drought stress. The extent of cuticular transpiration in relation to water reserves in the organs and the acquisition of water from the soil determines the suitability and survival of the plant in conditions of water stress, where lower values of g min indicate a better maintenance of hydration based on stored water (Kerstiens, 1996, Sack et al., 2003). In this sense, 30 olive cultivars were characterized in terms of minimum leaf conductance under conditions that are assumed to have induced maximum stomatal closure. Minimum leaf conductance was calculated using the gravimetric method of Sack and Scoffoni (2011). Intact, healthy leaves are detached from one-year-old branches, with the petiole then sealed in liquid paraffin. Once the leaves have been scanned to calculate the area, they were exposed at air under controlled conditions of light, temperature and relative humidity. During leaf drying, the stomata progressively close and the rate of water loss from the leaf decreases until it reaches a constant rate where the stomata are mostly closed. The cuticular transpiration rate was determined by regressing the change in leaf mass over time due to water loss in relation to the water vapor pressure difference between the inside and outside of the leaf, normalized for leaf area. Eventually, photosynthetic gas exchange was evaluated through the LI-6800 Portable Photosynthesis System (LI-COR Biosciences, Lincoln, USA) at the point of maximum stomatal closure. Statistically significant differences were found for both g min and LI-6800-derived values, thus resulting to be promising tools for the selection of drought stress tolerant varieties.

#29 - YM: Vegetative and productive response of olive trees under anti-insect nets

Matteo Zucchini, Universita' Politecnica delle Marche

The use of anti-insect net permits the management of insects pest without the use of pesticides. Also in Olive, the use of this tool can help to manage the Bractocera oleae fly. In addition to exclusion of the insect from the canopy, these nets can be useful against other abiotic phenomena, and provide shade. Although the shade can decrease the rate of photosynthesis, and therefore the growth of the vegetative and reproductive organs, it is possible that in summer the shade protects from excessive insolation leading to greater growth of these organs.

In this study we evaluated the response of the olive to shading that started in two different physiological phases. In July 2021 and 2022, the anti-insect nets (shading factor 15%) were installed before and after the pit hardening (with a gap about of 15 days). In 2021, the production of the trees didn't show differences in yield, but the tree coverage after the pit hardening showed biggest fruits than the control without net. The same treatments showed differences also in the new nodes emitted during the period of installation of the nets (from July to harvest time in November). In 2022 weren't recorded differences among the treatments, probably because of the low fruit load.

#112: Pollen performance under heat temperatures in a promising olive clone (cv leccino)

Susanna Bartolini, School of Advanced Studies Sant'Anna Pisa

During the progamic phase of olive trees, unsuitable weather conditions may produce aberrations on anthesis and pollination processes. In particular, the functionality of pollen grains, as well as being influenced by genetic factors, is affected by abiotic factors such as heat waves, a worrying condition due to the ongoing climate change. In a previous research work, in which floral quality parameters have

been analysed in several Leccino clones, notable performance of pollen grains has been observed for the clone L 1.4, also under sub-optimal microclimatic conditions at the canopy level. In particular, a lower sensitivity to partial shading conditions was found. Considering these interesting preliminary results, new experimental trials were planned in order to evaluate a possible pollen ability to face heat stress around anthesis. The study was conducted on potted olive trees that were subjected to the high temperature (HT) of 35°C (+- 0.5), according to daily cycles set up in growth chambers. The influence on-pollen viability and germination power by in vitro tests, and in vivo germination and pollen tube growth, as a result of active self-and cross-pollinations, was determined. Comparative assessments with control conditions such as the temperature of 24°C (+- 0.5) and weather regimes in open air were done. As regards the viability percentage and the germination power of pollen grains, assessed on agarized medium in vitro , values significantly changed when plants were submitted to HT cycles. Under these conditions, already after 24 and 48 hours, pollen viability and germination were reduced, 37.5% and 52.5%, respectively compared to controls. However, the growth of pollen tubes in vivo , both after self- and cross-pollination, did not hinder by HT, although a slowdown was detected. This result may suggest the Leccino clone L 1.4 as suitable for climatic areas stressed by high temperatures during the progamic phase.

#16: Proper agricultural practices related to water and soil for ensuring the sustainability of Mediterranean olive orchards

Nektarios Kourgialas, ELGO-DIMITRA, Institute for Olive Tree

Olive growing is one of the best adapted species to the Mediterranean climatic conditions. However, extreme climatic conditions can negatively affect fruit set and crop yield. Given that in many Mediterranean areas the frequency of extreme climate events has increased in recent years, the current study examines whether the application of Proper Agricultural Practices (PAPs), related to water and soil, can mitigate their effects on olive trees. In this work, 18 experimental olive groves (rainfed and irrigated) located in the island of Crete in Greece are studied. In this context, a set of 13 PAPs were applied for 3 consecutive years (2017, 2018, 2019). For the island of Crete, 2017 was an average year concerning climate conditions, 2018 was an extremely dry year, while 2019 was an extremely wet year. The main aim of this work was to investigate, whether the implementation of PAPs could have positive outcomes in the sustainability of Cretan olive orchards under different or even extreme climate conditions. Each of the studied parcels was divided into two parts, the control and the experimental (implementation of PAPs). Two indicators were used to evaluate the performance of PAPs, namely, Economic Water Productivity (EWP) and Yield (Y). EWP was found up to 2.20 times higher in the demonstration part of the orchards compared to the control, while Y was found up to 119% higher. The above results reveal that the application of the proposed PAPs can considerably support the adaptation of olive cultivation to extreme climate conditions.

Acknowledgments: With the contribution of the LIFE+ financial instrument of the European Union, for the project LIFE14 CCA/GR/00389 - AgroClimaWater

#19: Leaf content of N, P and K in twelve olive cultivars, as affected by the sampling period (summer vs. winter)

Ioanna Manolikaki, ELGO-DIMITRA, Institute for Olive Tree

Leaf analysis is a useful tool for diagnosing nutritional problems and organizing fertilizing schedules. In olive trees, the current trend, according to relevant publications, is to prefer summer sampling of leaves, as compared to the typical winter sampling that was applied for several decades in the past. However, for practical purposes, winter sampling is still widely applied by farmers in Greece. Moreover, in Greece, no significant data exist on comparing the nutritional status of different greek cultivars under the same growing conditions and all published work refers to experimentation with young olive trees. The purpose of the present work was to compare leaf nutrient analysis data for key macroelements (N, P and K), from 10 greek (Koroneiki, Mastoides, Kalamon, Amphissis, Megaritiki, Chondrolia Chalkidikis,

Gaidourelia, Valanolia, Lianolia Kerkyras, Koutsourelia), 1 Spanish (Picual) and 1 Italian (Frantoio) cultivars, at three different sampling periods (July 2019, January 2020 and July 2020). Experimentation took place in the irrigated part of the National Collection of olive cultivars (Chania, Crete, Grece), including 3 replications (blocks) for each cultivar. Genotype affected the nutrient content, with consistently low content being recorded for nitrogen in cv Koutsourelia, for phosphorus in cvs Kalamon and Valanolia and for potassium in cv Picual. Accordingly, consistently high content was recorded for nitrogen in cv Lianolia Kerkyras, for phosphorus in cvs Koroneiki and for potassium in cvs Lianolia Kerkyras, Koroneiki and Frantoio. Regarding the sampling period, although there were variations in absolute values, the general trends of low content in nitrogen and adequate content in potassium and phosphorus were depicted in all sampling periods.

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#72: Seasonal variation of macronutrients in an olive tree during flowering and fruit development stages under semi-arid climatic condition

Muhammad Azam, Institute of Horticultural Sciences, University of Agriculture Faisalabad

Pakistan have many favorable agro climatic regions for the cultivation of olive on a commercial scale but unfortunately no scientific study was carried out to standardize production technology in relation to nutritional level in the soil and leaves at various stages during the production year. Hence, the current study was conducted in Pothwar agro climatic conditions to find out appropriate stage of macronutrients (NPK) application in relation to soil and leaf nutritional status during 2017 and 2018. The data of soil and leaf analysis were collected at four different stages (i.e. at flowering, after fruit setting, at fruit enlargement and fruit maturity stages). The results against leaf and soil analysis were found significant regarding each variety, stage and year. The important observations regarding nitrogen level estimation were found that at the time of fruit set there was a decline in nitrogen level (1.562 % to 1.539) followed by a sharp decline trend from fruit set to fruit enlargement stage (1.47%). There was found non-significant interaction for total nitrogen level in between the years. It was also concluded that more soil and leaf nitrogen contents were found in those varieties which gave more yield per plant. The level of leaf phosphorous at different stage showed maximum value (0.108 %) at 1 st stage with the regular descending order up to 4 th stage with minimum value (0.07 %). However, relatively sharp decline in phosphorus contents was observed from 1 st stage to 2 nd stage. In the interaction of stages and years, it was noted that maximum phosphorus level was found in 1 st year in almost all the stages. As for as the potassium content in leaf and soil was concerned, the sharp decline was observed at last two stages which depicted that potassium depletion occurred with maximum range at fruit maturity to fruit ripening stage. Overall, the trend of NPK depletion showed that plants need phosphorus before fruit setting, nitrogen before as well as after fruit setting, and potash after pit hardening or at oil accumulation stages.

#49: Field trapping of the olive moth (Prays oleae Bern.) using olive fruit volatiles as attractants

Elda Vitanovic, Institute for Adriatic Crops

The olive moth (Prays oleae Bern.) is one of the most important olive pests, causing damage every year. It develops three generations whose caterpillars attack different plant organs (flowers, fruits 4-6 mm and leaves). For many years, the main measure to control the pest was the use of pesticides, whose intensive use had numerous negative consequences for the environment. Therefore, the EU has

committed to reduce pesticide consumption by 50% by 2030 and by 100% by 2050. For all these reasons, there is an urgent need to find new solutions for effective and environmentally friendly pest control. According to current knowledge, various insect species are attracted to the volatiles of the host plant. Since the interaction between olives and olive moth has not been studied yet, the aim of this study was to identify the volatiles of the olive, select those that could be responsible for the attraction of olive moth, and test them in olive groves. The plant material was collected from selected olive cultivars and the volatiles were identified using HS-SPME-GC-MS. About 70 different volatiles were identified. Among them, hexanal, E-2-hexanal, Z-2-hexen-1-ol, Z-3-hexen-1-ol and Z-2-hexen-1-ol acetate were selected and tested individually or in blends with delta traps to attract olive moth in selected olive groves. The results showed that they did not attract olive moths either singly or in blends. Based on these results, the same volatiles were tested with synthetic pheromones in delta traps in the same olive groves. Delta traps containing Z-3-hexen-1-ol or the blend of hexanal:Z-3-hexen-1-ol:Z-3-hexen-1-ol acetate (5%:14%:81%) with synthetic pheromone were significantly more attractive to olive moths than delta traps containing pheromone alone. This research was supported by project KK.01.1.1.04.0002 "New methods in olive pests controlling using plant volatiles", Split, Croatia, funded by the European Union and the Croatian Science Foundation under project DOK-2021-02-1355.

#53: Colletotrichum acutatum infection in Arbequina olive fruits under severe drought

Paula Conde-Innamorato, INIA Las Brujas, Sistema Vegetal Intensivo

Olive anthracnose caused by Colletotrichum spp. it is the most spread and economically significant olive fruit disease worldwide. The olive tree is a crop with high tolerance to water deficit. Water deficit length and intensity conditions olive productive and phytosanitary responses. Plants exposed to moderate drought stress activate basal defense responses allowing plants to react against pathogen infection. Particularly in olive fruits, moderate drought contributed to increase tolerance to Colletotrichum acutatum infection. However, is unknown the effect of severe drought on fruit parameters and disease progress. To unravel these effects, an experiment in six drainage lysimeters under controlled irrigation conditions (rain-out shelter) with Arbequina olive trees was established along two consecutive seasons. Two treatments were imposed: fully irrigated and non-irrigated from the end of pit hardening until harvest. At harvest olives were assessed for fruit quality and a subsample was inoculated with an isolate of C. acutatum to evaluate disease progress in vitro . Fruit yield (kg/tree) doubled and fresh fruit weight (g) tripled in the fully irrigated treatment compared to the non-irrigated one. Fruit moisture was significantly different among treatments, in non-irrigated was < 43% and in fully irrigated >; 64%. Also, oil yield content in dry bases showed lower values in non-irrigated treatment. Disease severity progress at 6 th day after inoculation was half in non-irrigated treatment compared with fully irrigated one. All comparison were significantly different with p < 0.01. We conclude that severe deficit irrigation reduces significantly olive yield, but fruits were more tolerant to anthracnose fruit rot. This highlights the importance of studying how abiotic stress, like drought, elicits defense mechanisms.

#4: Glassy-winged sharpshooter can acquire Xylella fastidiosa strain DeDonno from California ripe olive varieties

Lindsey Burbank, USDA-ARS

Xylella fastidiosa is a serious bacterial pathogen causing Olive Quick Decline Syndrome (OQDS) in Europe. The olive-pathogenic strains of X. fastidiosa (subsp. pauca) are not currently present in North America, but there is concern that these strains could have significant impacts on crops in California if introduced. X. fastidiosa is transmitted by several species of xylem-feeding insects with spittlebugs (Philaenus spumarius) implicated as the primary vectors in olive in Europe. Several insect species present in California, including the glassy-winged sharpshooter (Homalodisca vitripennis , GWSS) are known vectors of X. fastidiosa in grapevine, and would likely pose a risk of spreading introduced X. fastidiosa strains as well. This study evaluated the susceptibility of three California ripe olive varieties (Mission,

Manzanillo, and Sevillano) to olive-pathogenic X. fastidiosa strain DeDonno, as well as ability of GWSS to acquire this pathogen from infected olive plants. GWSS caged on X. fastidiosa -infected olive seedlings for 3 days tested positive by PCR for X. fastidiosa at a rate of 4.8%. This shows that GWSS can acquire X. fastidiosa from California ripe olive varieties and could potentially act as a vector of X. fastidiosa in this crop. Although overall acquisition rates were low, acquisition occurred as soon as 30 days post-inoculation of the plants in all three olive cultivars tested. This information will facilitate risk evaluation for spread of X. fastidiosa in olive in California should olive-pathogenic strains be introduced in this area in the future.

#103: Vegetative growth is reduced by fruit load but is not affected by moderate water stress in summer

Mercedes Arias Sibillotte, Universidad de la República de Uruguay

Olive trees have a high tendency towards alternate bearing. The harvest each year depends on the number of buds that were formed in the previous season and how many of them were induced to flower. Developing fruits are priority sinks competing with vegetative growth. On the other hand, irrigation improves vegetative growth. However, in the humid climate of Uruguay, with lower vapor-pressure deficit than in the Mediterranean basin, the development of vegetative growth in response to irrigation deficit is unknown. To understand the processes involved, an experiment was carried out for two seasons on adult olive trees of the Arbequina and Frantoio cultivars. Annual shoots were marked in spring, and the number of nodes and developing fruits were measured until harvest. The shoots were categorized as high- or low-load based on a critical value of 35 fruits/100 base nodes. After pit hardening, three irrigation regimes (rainfed, 50%, and 100% crop evapotranspiration) were applied until harvest. A negative effect of fruit load on vegetative growth was observed from the first recorded dates in spring. Fruit bearing shoots had between 29% and 63% fewer new nodes/100 base nodes than non-bearing shoots. Between 67% and 82% of the new nodes were formed before pit hardening in both cultivars and in both seasons, which explains why moderate water stress in summer did not reduce vegetative growth. Bud potential for the following year is defined in spring and is dependent on fruit load. These results reinforce the importance of spring as a critical moment to define irrigation strategies in relation to vegetative growth.

Wednesday, 13 September: Oral Presentations

#46: Optimizing Yield and Reducing Pruning Costs in "Manzanillo" Olive Orchards through Timing and Intensity of Mechanical Pruning

Richard Rosecrance, College of Agriculture, California State University, Chico

The present study investigated the optimal timing and intensity of mechanical pruning in "Manzanillo" olive orchards with the objective of promoting return bloom and reducing excessive vegetative growth. A randomized block design was employed, with 8 replicates, in a 10-year-old orchard to examine the effect of pruning timing in March, April, May, June, or an unpruned control, on fruit yields. Results revealed that pruning in March resulted in larger canopies and higher yields, compared to pruning in June. The diameter of the pruned branches also impacted regrowth, with smaller diameter branches promoting higher fruit production, while larger diameter branches induced more vegetative growth in the following year. Additionally, another study was conducted to evaluate the impact of topping at different tree heights (3.0 m, 4.0 m, and hand pruning only) on yield and pruning costs. The results indicated that topping at 3 meters resulted in smaller and more compact trees, reduced pruning costs, larger fruit, but lower yields compared to the other treatments. An optimal depth-to-alley width (d/a) ratio of 1 to 2 was found to be favorable for maximum production, but further research is needed to make definite conclusions. The findings of this study emphasize the significance of proper timing and intensity of mechanical pruning in enhancing yields and reducing pruning costs in "Manzanillo" olive orchards.

#81: Pedestrian olive growing systems: A sustainable alternative to super-intensive olive growing systems using native Sicilian varieties

Riccardo Lo Bianco, Università degli Studi di Palermo, Dipartimento SAAF

Recently, Italian and world olive growing has been struggling due to the onset of new pathogens, which threaten the entire olive industry. Enhancing biodiversity is an effective strategy for improving the sustainability of olive growing systems. The evaluation of native varieties, according to their biometric and fruit-bearing traits along with the assessment of final product quality, could contribute to the development and diffusion of new olive growing systems. This work is a long-term evaluation of growth, productivity, and olive oil quality of three Sicilian cultivars with different vigor/growth habits and grown in four different intensive pedestrian systems. Specifically, Abunara', 'Calatina', and 'Nocellara del Belice' olive trees were planted at 2 × 5 m and trained to central leader (CLx2), at 3 × 5 m and trained to free palmette (FPx3), at 4 × 5 m and trained to small globe vase (GVx4), and at 5 × 5 m and trained to poly-conic vase (PVx5). Growth, fruit yield, oil yield and quality were evaluated for eight years, from 2015 to 2022. The high-density planting systems (CLx2 and FPx3) showed slower growth (-16% trunk cross-sectional area and -15% canopy volume) than the low-density systems. They also had 26% higher yield per hectare despite a 27% lower yield per tree than low-density systems. 'Calatina' was the least vigorous (-25%) but most productive cultivar (+30%), especially at the highest densities with 125 t/ha cumulated over the eight years, 32% more than 'Abunara' and 53% more than 'Nocellara'. 'Abunara' and 'Nocellara' were relatively vigorous and suffered from the confined spaces of high-density systems. Overall, results show that local minor genotypes may respond better than widespread cultivars to the specific needs of pedestrian olive orchards. Also, different planting densities and training forms adapt to various types of mechanical harvesting and pruning and can eventually lead to the production of new olive oils of excellent quality. Finally, this work is a proof that the only effective solution to contrast sudden climate changes and associated diseases is to adopt planting systems that exploit biodiversity using available local genotypes.

#28: Long-term evaluation of the use of mechanical pruning in a super high density or hedge olive orchard

Antonio Fernando Bento Dias, Universidade de Évora

In super high density/hedge olive orchards (SHD) harvesting is performed using an over-the-row harvesting machine. For a good performance of this machine an adequate olive trees dimension is necessary. Although manual pruning is the current practice used, mechanical pruning can more easily adapt the canopy size to the harvesting machine. Between 2008 am 2017, a long-term trial to evaluate the use of mechanical pruning as an alternative to manual pruning in SHD olive orchards has carried out, in a commercial orchard of Arbequina cultivar. The trees were trained according to the central leader system. In this trial, in a randomised complete block design with three replications, four treatments (T1, T2, T3, T4) are being compared leading to 12 plots with 100 trees per plot. The treatments are: T1 - manual pruning using chain saws, each year; T2 - mechanical pruning, topping the canopy parallel to the ground followed by manual pruning complement in the two sides of the canopy; T3 - mechanical pruning, topping and hedging one side each year of the canopy. From 2008 until 2013, a manual pruning complement was done in the opposite side; T4 n mechanical pruning, topping and hedging two sides of canopy in even years; topping the canopy in odd years. Manual pruning complement in the two sides performed in 2010 and 2013.

In a sample of trees randomly selected, were collected data of the dimensions of the trees, before and after pruning. The time needed for pruning each plot and the yield obtained by plot, has also measured.

As expected mechanical pruning allow to obtain a higher pruning rate. There were significant differences in olive yield among years, but, in average, no significant differences between treatments were recorded. From 2014 to 2017, manual pruning (T1) show a higher yield than treatments T3 e T4.

#15: Continuous plant-based monitoring of olive orchards: A review

Arash Khosravi, Universita' Politecnica delle Marche

Precision agriculture (PA) is a farming management concept that emphasizes the application of technology to collecting high-resolution data (ranging from seasonal period up to minute intervals) for on-time agricultural practices with respect to the soil, plant and climate variables. Therefore, the repeated data collection (continuous monitoring) is beneficial in PA. Continuous monitoring could be performed on the soil, plant and environment, however, plants act as a connector between soil and environment and its physiological response reflects integration of soil, plant and environmental effect. Accordingly, continuous plant-based monitoring is widespread in olive orchards. Several sensor platforms have been used for monitoring of olive orchards and among them, ground-based (stationary) is the most suitable platform for continuous plant-based monitoring (up to minute intervals). Several fundamental information for precision olive orchards management including water stress, disease and pest status, fruit set and growth, fruit maturation, fruit size and yield load could be provided by continuous plant-based monitoring. This methodological review addressed current applications and challenges of continuous plant-based monitoring in olive orchards. Finally, we explain possible future development of it for providing wider services for agricultural practices.

#107: Response of "Manzanilla de Sevilla" in high density hedgerow olive orchards with "Chiquitita" as rootstock

Marta Sánchez-Piñero, Dpto Agronomía. ETSIA

High density hedgerow olive orchards have expanded rapidly in many olive growing areas from the end of the last century. Most of the current cultivars are not suitable for this system as they are too vigorous to be trained in hedgerow formation. 'Chiquitita' ('Sikitita') was a new cultivar obtained in a breeding program in Spain described as low vigor and specifically selected for these types of orchards. Recently, hedgerow table olive orchards have been also planted with successful results. Besides selecting new cultivars adapted, the use of rootstock which could reduce tree size would be very useful to expand the number of cultivars suitable for this growing system. For that reason, the aim of this work was to study the effect of 'Chiquitita' as rootstock on cv 'Manzanilla de Sevilla'. The experiment was performed in the experimental farm "La Hampa" (IRNAS-CSIC) in Coria del Rio (Seville, Spain). Trees of cv 'Manzanilla de Sevilla' were grafted on 'Chiquitita'. Grafted and non-grafted trees were planted on 2013 season in 7 blocks of 6 trees each (3 grafted and 3 non-grafted) in a 4x1.75 m distance. All trees were irrigated with a single, two drips per plant (8L h -1) system with a period of water stress from pit hardening until two weeks before harvest. The current work presents data of 2017 season. No significant differences were measured in vegetative growth, though grafted trees trended to lower shoot expansion from massive pit hardening. Number of inflorescence per shoot and fruit per inflorescence were almost equal between treatments. However, water relations, midday stem water potential and leaf conductance, were significantly different in some dates. Although yield and fruit size were not statistically different, grafted trees trended to lower values than non-grafted. Pulp-pit ratio were significantly lower in grafted trees because both components were smaller. Rootstock could induce a slightly decrease in fruit size.

Harvest

#83: Developing Mechanical Harvesting and Postharvest Treatments for California and Israel's Table Olives (Olea europaea L.)

Paz Ms. Shemesh, Dept. of Biotechnology and Food Engineering, Technion, Israel Institute of Technology

Table olives are among the oldest fermented fruit in the Mediterranean Basin, important in multiple countries' economies, including the US and Israel. However, despite the worldwide increase in demand for table olives as healthy functional food, the industry is declining due to high production costs, primarily the labor of manual harvesting. In Israel, growers mechanically harvest the 'Picual' and 'Souri'

table olive varieties, but the main variety, 'Manzanilla', is harvested manually due to its susceptibility to bruising damage. Once bruised, dark spots appear on the fruit immediately after harvesting due to a browning reaction promoted by polyphenol oxidase, resulting in loss of commercial value. Our main goal is to develop postharvest treatments for mechanically harvested 'Manzanilla' olives for table olive production, and to investigate other suitable cultivars less susceptible to bruising. A wide range of treatments was tested, mostly aimed at inhibiting the enzymatic activity post-harvest in the orchard. Immersion in ascorbic acid, phosphoric acid, sodium metabisulfite, citric acid, glutathione, and sodium hydroxide were investigated, with the most promising treatment being 1% NaOH. This treatment resulted in 8-10% defective fruit at the end of the fermentation, compared to 60% of the non-treated mechanically harvested control. Furthermore, 'Hojiblanca' variety was substantially more resistant to bruising than 'Manzanilla', and the non-treated mechanically harvested fruit were similar in appearance to the manually-picked olives. Tasting surveys are in progress to evaluate the consumer acceptance of the treated olives and the alternative cultivars.

#27: Continuous olive harvesting in a high density olive grove of portuguese 'Galega vulgar' variety

Antonio Fernando Bento Dias, Universidade de Évora, Largo dos Colegiais

In the last decade there was a considerable change in the Portuguese olive groves, with a reduction in the area of traditional groves and an increase of hedge olive groves, which exceeds 50 000ha. There is a tendency to maintain this increase because this system is based on the fully mechanised olive harvesting. It is predictable that the olive grove area with Portuguese varieties will tend to lose importance since the hedge groves use a restricted number of foreign varieties. In a project entitled "Mechanized pruning and continuous harvesting of olive groves of Portuguese varieties" , the performance of the side row continuous canopy shaking harvester (SRCCSH) prototype was evaluated. In a high density irrigated olive grove of Galega vulgar variety, planted with a 7m x 5m array, a trial to evaluate the performance of the side row continuous canopy shaking harvester (SRCCSH) prototype, was carried out The trial was organised in a randomised, complete block design, with five replications to compare the performance of the SRCCSH prototype with the harvesting solution used by the farmer. This work shows the olive harvesting efficiency, the harvest work rates and estimates the associated costs aiming to define the best alternative.

#40: Challenges and Opportunities in Mechanical Harvesting of Table Olives

Reza Ehsani, Department of Mechanical Engineering, University of California, Merced

An estimated 2.6 million metric tons of olives were produced globally in the 2020/21 crop year; a 10% decrease from 2019/2020. Due to the cost of traditional hand harvesting table olive production is declining. Mechanical harvesting could reduce harvesting time and cost and possibly reverse this decline. However, there are multiple challenges to developing economically and horticulturally effective mechanical harvesting. The structural changes of an olive trees' asymmetrical trunk and the energy-dampening quality of the trees pendulous fruit-bearing shoots sharply reduce the harvesting efficiency of traditional trunk shakers. Canopy contact shaking, currently used to harvest oil olives, applies the energy directly to the tree's fruit-bearing shoots. However, to achieve optimal canopy contact harvester efficiency both the orchard design and tree canopy need to be modified to produce the more closely spaced hedgerow and continuous fruiting wall that improve canopy contact harvester efficiency. Developing an efficient canopy harvesting system is dependent upon identifying what canopy sectors harvest poorly. Specifically, we are using acceleration data and harvested fruit yield to determine how effectively canopy shaking energy is being transmitted through the tree. Several past and current projects will be discussed.

#60: Effect of canopy management and shaking frequency on harvesting effectiveness in a Arbequina super-high density orchard

Sergio Tombesi, Università cattolica del Sacro Cuore

Harvesting in super high density (SHD) orchards is carried out by straddle harvesters usually derived from grape harvesters. Although new shaking box have been specifically designed for olive, the largest part of SHD olive orchards are harvested by grape harvesters with some modification to increase the contact between the shaking organs and the canopy. Since olive canopy has a significantly higher inertia than grapevine, canopy management and shaking frequency are fundamental parameters influencing harvesting effectiveness. In two consecutive years, on the same SHD 'Arbequina' orchard located in Central Italy(6 and 7 years old, respectively), Harvesting effectiveness and vibration transmission was measured on trees mechanically pruned and trees managed by selective pruning. In the first year two different frequencies were applied, 500 bpm and 350 bpm. Lowest tested frequency had poor vibration transmission and lower harvesting effectiveness than the highest one. Mechanically pruned trees had lower canopy volume and higher harvesting effectiveness because of the poor capability of modified grape harvester to collect fruits located in the apical part of the canopy. Overall a poor transmission of the vibration to the inner and basal part of the canopy was observed, indicating that the increase of canopy inertia caused by canopy aging can cause a significant decrease of harvesting effectiveness in that part of the canopy.

#102: Effect of Mechanical Harvesting on Harvesting Efficiency and Olive Oil Quality of Two Jordanian Olive Cultivars

Salam Ayoub, Director Horticulture Research Directorate, National Agricultural Research Center NARC

This study was conducted in Ajloun area, Jordan on two local olive cultivars: 'Nabali Balaldi' and 'Nabali Mohassan' to evaluate the effect of harvesting method on harvesting efficiency and olive oil quality. Two harvesting methods were compared: hand harvesting and pneumatic comb machine harvester. The experiment consists of 4 replications, two trees for each treatment and 6 branches on each tree were labeled for recording number of harvested fruits and detached leaves. Results showed that mechanical harvesting using the battery operated machine (pneumatic comb machine) increased significantly harvesting productivity of the worker by 4-7 times compared with hand harvesting. Also the result showed that hand harvesting had higher percentage of harvested fruits for Nabali Baladi cultivar, but significantly lower percentage of detached leaves for both cultivars. Regarding the effect of harvesting method on fruit oil content and olive oil quality, results showed no significant differences between hand and machine harvesting on fruit oil content, olive oil acidity, peroxide value, K 232, K270, ΔK and fatty acid composition for both cultivars. Based on our results, we advise olive farmers in Jordan to use pneumatic comb machine as an alternative to manual harvesting, since it increases the worker efficiency (productivity) by 4-7 times compared to manual harvesting and without affecting negatively the oil content and the quality parameters of the olive oil produced.

Olive Products and Marketing

#10: Fruit phenolic composition of olive cultivars under Mediterranean and Subtropical climatic conditions

Hande Yilmaz-Düzyaman, IFAPA Centro

Extra virgin olive oil (EVOO) contains a myriad of minor compounds related to its healthy properties, including phenolic compounds. These compounds also determine the oxidative stability and organoleptic properties of EVOO, so they are components of primary importance for commercial quality. The phenolic composition of EVOO largely depends on the initial fruit phenolic composition, which subsequently undergoes a series of enzymatic transformations during malaxation in the olive oil mill. In the present work, fruit phenolic content and composition was evaluated over two seasons, in two

different harvest dates, in six cultivars ('Arbequina', 'Coratina', 'Hojiblanca', 'Koroneiki', 'Martina' and 'Picual'). This evaluation was performed under the contrasting conditions of the Mediterranean climate of Cordoba and of the subtropical climate of Tenerife with the aim of studying the influence of genetic and environmental factors on the phenolic composition of the fruits. In both climates, a marked decrease in the content of total and individual phenols was observed on the second harvest date respect to the earlier one. The total phenol content was significantly influenced by both factors: cultivar, with the highest values in 'Coratina', and location with the highest values in Tenerife, without significant interaction between them. Regarding phenolic composition, a higher genetic (cultivar) than environmental effect was observed for all groups of compounds. In particular, significant differences between cultivars were obtained for the percentage of individual compounds within each main group of phenolic compounds. In summary, the results obtained show a major effect of the genotype (cultivar) than the environment and the genotype x environment interaction on the phenolic content and composition in the fruit. These results allow to simplify the selection of genotypes of interest and indicates the possibilities of genetic improvement to obtain new cultivars with optimal phenolic content and composition. Funding: this research was financially supported by grant PID2020-115853RR funded by MCIN/AEI/ 10.13039/501100011033 and "ERDF A way of making Europe".

#38: Overall Olive Oil Content and Fatty Acid Profiles Affected Under Different Geographical Locations Among Four Olive Cultivars

Muhammad Azam, Institute of Horticultural Sciences, University of Agriculture Faisalabad

This investigation aims at demonstrating the prodigious consequences of high temperature on growth, yield, and quality of olive oil at three different geographical locations (BARI, IOF, HRS) among four olive cultivars (Coratina, Frantoio, Ottobratica and Leccino) during the year 2017 and 2018. The study has been carried out to investigate different parameters such as climatic conditions (rainfall and temperature), phenological attribute and yield traits (fruit set, fruit weight, yield, and oil content), and oil quality and fatty acid compositions (free fatty acid contents, peroxide, palmitic acid, palmitoleic acid, oleic acid, linoleic acid, and linolenic acid). The results indicated the positive correlation of yield with rainfall and negative with the temperature was observed among olive cultivars. The results showed higher rainfall (1189 mm) and temperature (37.51 °C) at location-1 and lower at location-3. Coratina and Frantoio depicted significantly higher fruit set and yield in warmer climatic regions (Location-1 and Location-2) while Leccino and Ottobratica showed better results in the cooler region. Higher oil content was observced in Frantoio and Coratina at location-1 and location-3 as compared to location-2. Overall, the lowest free fatty acid value was exhibited in Coratina and the highest in Ottobratica at all locations in both seasons. The contents of peroxide were observed higher in Leccino and lower in Coratina at all locations. The results showed no significant variation among fatty acid composition in cultivars and seasons, however, palmitic acid, palmitoleic acid and oleic acid contents were found higher at location-2, linoleic acid at location-3, and linolenic acid at location-2 in all four olive cultivars. Custer analysis was carried out to investigate the effect of environment among olive genotypes, which revealed 2 main groups and group-I contained two subgroups while group-II contained three subgroups. In PCA analysis, PC1 axis had Leccino-L3, Leccino-L1, Frantoio-L1, Ottobratica-L1, Coratina-L1, and Leccino-L3 and explained 91.99% of the total variation. Therefore, geographic location influence growth, yield and olive oil quality attributes.

#86: Effects of pre-processing cooling treatments of harvested olives on oil volatile profile and quality parameters

Mario Vendrell Calatayud, School of Advanced Studies Sant'Anna Pisa

Olive is an important crop with deep roots in Mediterranean culture and heritage. The quality of the fruit depends heavily on environmental conditions, and the current climate emergency is posing a threat to its production. The warmer temperatures during the later stages of development and harvest, in particular in specific cultivation areas, may lead to negative effects on aroma, fatty acid, and polyphenol

profiles of olive oil, resulting in reduced commercial life. To address this issue, we conducted trials based on pre-processing cooling of harvested olives in 2021 (cv Frantoio and Leccino) using hydrocooling technology. The study aimed to investigate the effects of the rapid (seconds , up to few minutes) cooling treatment on the quality and composition of freshly extracted olive oil samples and those stored for one year. All oil samples resulted to be extra-virgin, and analysis of volatile organic compounds (VOCs), fatty acids, and polyphenol content were performed. The results showed that the cooling treatment had a genotype-dependent effect on the volatile profile of the olives. In general, an increase in specific C6 aldehydes and alcohols, known to be related to herbal/green or fruity flavors, and a decrease of some off-flavor related aromas has been observed in both cultivars. However, in the Leccino cultivar, an increase of some volatiles related to off-flavors has been detected. Significant changes in the fatty acid profile were observed in Frantoio cultivar after the treatment, with a reduction of trans-oleic acid. Additionally, a significant increase of some flavones was observed. The treatment had limited effects on the oils analyzed after one year of storage, with no significant differences concerning the most important quality parameters between control and samples obtained from cooled olives. These findings suggest that pre-processing cooling can improve some positive related aroma compounds even though a marked effect of the genotype has been observed, that makes necessary performing additional and specific trials.

#67: The importance of standardization in the olive oil supply chain for the production of a nutritional, safe and high-quality product

Francesco Beltrame Quattrocchi, Università di Genova

Extra virgin olive oil is an essential component of the Mediterranean diet. All over the world, dietitians and nutritionists recommend using extra virgin olive during food preparation. Producers from different countries compete for improving the quality olive oil. In a globalized economy, the European Commission intends to address food and nutrition security with a series of research and innovation policies designed to "future-proof" food systems through a systemic approach called FOOD 2030 strategy. The aim of FOOD 2030 is to contribute to the transformation of European food systems into sustainable, resilient, diversified, competitive, inclusive, and efficient systems. The overarching goal is guaranteeing that everyone can live a healthy life. To ensure greater profitability, once a quality agricultural product has been harvested, it is necessary to enhance it by certifying its origin and disseminating the methods used to produce it. For these reasons it is essential to follow agronomic standards that can give the product a quality certification. The quality of an extra virgin olive oil is strongly dependent on compliance with certain standards such as the best storage conditions such as temperature, pressure, and packaging. The goal is to obtain a product with a high nutritional, functional and hedonistic value (panel test), constant over time (years) and space (territory). The objectives of this paper are: 1) to summarize the factors that determine the characteristics of an olive oil 2) to highlight how standardization can contribute to the quality of the olive oil supply chain 3) to discuss the importance of standardization, preparatory and crucial to the certification phase.

#75: Accelerating the Technology Pathway to the New Palestinian Olive Oil Circular Bioeconomy

Donald Humpal, Delevlopment Alternatives Incroporated

This paper discusses the current status of innovations to profitably turn olive biomass into products for domestic energy, agricultural compost, and industry. The West Bank and Gaza are steeped in the history and tradition of the healthy Mediterranean Diet rooted by the olive tree and the vital essence provided by quality olive oil. Its olive oil industry is driven by 275 small and medium oil mills that extract about 39,600 mt of olive oil from roughly 177,600 mt of olives, supporting from 80,000 to 100,000 household, along with many more distributors and marketers, wholesalers and retailers that provide an essential food and meal preparation ingredient. The sector's olive mills makes about a 5% contribution to national GDP, and up to 11% of Palestinian export value in good years. Over the past two decades, the national

olive oil industry has upgraded and modernized its olive oil mills and built supply chains to meet international traceability and transparency standards required by domestic, near neighbor, and international markets. Concurrently, Palestine's polytechnical universities have built cohorts of science, technology, engineering, and business graduates who have integrated SME supply chains as: employees and managers of olive groves and olive oil millers; as goods and service suppliers to the olive oil industry; as researchers and regulators; and as innovators creating new, higher value products from the ever-green olive tree and its byproducts. For example, The Jericho-based, woman-owned and -led Palolea turns olive leaves trimmed from tree trimming and olive harvests into leaf extracts of high-grade and very high oleuropein content for manufacturers and distributors of nutritional supplements, cosmetics and pharmaceutical, food and drink products. Palolea's advanced micronization and extraction of recycled olive leaves puts it close to the top of the economic value pyramid for by-products of olive oil production. This high value product position contrasts with many SME olive oil mills use and disposal of olive pumace (Bomak or Jift) and olive mill wastewater (Zibar) that are the high volume and high environmental impact byproducts of olive oil processing. Biomass component sorting pre-milling; pomace handling, densification and densified product differentiation; pomace composting; and olive mill wastewater treatments are increasing to derive new products. We describe the three-step approach being used to apply process and equipment re-engineering of oil industry processes and partnerships to help transform the environmental costs of olive oil mill byproducts into environment, financial, and employment benefits from a more circular bioeconomy.

Wednesday, 14 September: Poster Presentations

#73 - YM: Urban 'olive-culture': evolution and distribution of the cultivar '*Ascolana tenera*' in the city of Ascoli Piceno, Italy

Monica Pantaloni ,Universita' Politecnica delle Marche

The traditional olive tree landscape in the Mediterranean basin represents the cultural link of local identities to specific places. Thanks to the intrinsic value of the olive tree to combine ornamental, environmental and social multifunctional dimensions, the conservation of local germplasm heritage has always been important in the evolution of European cities. Considering the olive tree landscape as a part of the green infrastructures within the city, defining new strategies to stimulate new forms of local economic development through the enhancement of these elements within the urban and peri-urban context could be essential to provide a wide range of ecosystem services. The study's objective was to describe a method for the recognition and qualitative characterization of olive trees in Ascoli Piceno, a historic city in Central Italy with a compact nucleus of the medieval and late nineteenth-century matrix. Through indirect and direct on-site surveys supported by geospatial technologies for the collection and management of territorial data, a first 'state of the art' has been outlined concerning the distribution, cultivar identification and characteristics of the trees at the city scale, with particular attention to 'Ascolana tenera', the oldest and most representative cultivar of the area. The results showed a different distribution of cultivars based on the different environmental matrices of the urban footprint. Since the highest presence of 'Ascolana tenera' was found in the consolidated historical fabric of the city up to 1954, this could be a valid method to investigate the potential 'neglected ecotypes' of this cultivar starting from the genetic and phenotypic characterization of the ancient olive trees 'hidden' by the progressive urbanization of rural areas, and their multiplication in the commercial orchards. If supported by all local stakeholders, this' top-down' study can represent a starting point for the design of 'bottom-up' actions based on 'citizen science' technologies for testing collaborative research methodologies and innovative teaching in support of urban sustainability.

#63: Impact on olive pomace oil of the application of pulsed electric fields to the extraction of virgin olive oil on a pilot scale

M Victoria Ruiz-Méndez, Instituto de la Grasa CSIC

Pomace oil is the main by-product of olive oil production and is currently undergoing major development thanks to the technological advances introduced by olive mills in recent years. Among the systems that have been tested to improve the extraction and quality of olive oil, the application of pulsed electric fields (PEF) is gaining importance due to its ease of implementation in olive mills. PEF treatments favour a more efficient rupture of the fruit membranes, which in turn facilitates the extraction of the oil and some of its main minor components. Extraction trials have been carried out at pilot and industrial scale to evaluate the effect of PEF technology on oil extraction yield and on the organoleptic and functional quality of EVOO (1). These trials concluded that, under optimal conditions, PEF technology could significantly improve oil yield by up to 25% and enhance the incorporation of phenolic and volatile compounds in virgin olive oils. In this work, olive pomace oils from two cultivars, Arbequina and Manzanilla, obtained in a pilot plant with and without the application of PEF technology have been evaluated. Apart from cultivar differences, the results showed that PEF technology produced olive pomace oils without differences in fatty acid composition, waxes, squalene or triterpenic compounds. There was a significant reduction of aliphatic alcohols and, to a lesser extent, of total saturated aliphatic aliphatic hydrocarbons. However, a higher total sterol content was found in both cultivars, which increases their nutritional value, as there is a small loss of sterols during the refining process. In conclusion, the results suggest that a better quality of olive pomace oil can be obtained when PEF is applied. Further research is needed to draw firm conclusions. Navarro et al. (2022). Food, 11(14), 2022.

#65: Evolution of phenolic compounds in two italian olive cultivars during drupe growth and ripening

Claudio Di Vaio, Università degli Studi di Napoli Federico II

The olive tree (Olea europaea L.) is one of the most representative and characteristic crops of the Mediterranean basin. In Italy, the cultivation of the olive tree has been practiced for thousands of years and, thanks to the orographic and bioclimatic heterogeneity of the territory, it has led to the differentiation of a rich genetic heritage which includes over 500 different varieties, adapted to different agro-ecosystems. Table olives and above all extra virgin olive oil represent fundamental elements of the Mediterranean diet, being universally recognized as beneficial foods for human health, thanks to presence of phenolic molecules, characterized by a strong antioxidant activity. The genetic variability of the varieties is one of the factors that most influence the concentration of polyphenols in the drupes and oil and, at the same time, a high polyphenol content is considered a positive attribute of the individual cultivars. This study aimed to evaluate the change in the vegetative and productive behavior of plants belonging to two cultivars of olive with different commercial uses (Leccino and Nocellara del Belice), evaluating the change in the physical parameters of the drupes during the development and maturation and the variation of phenolic compounds present in the drupes and leaves of the two cultivars, by HPLC analysis. At harvest, the drupes of cv. "Nocellara del Belice" showed a greater weight of about 44.31% compared to the cv. "Leccino" and the Jae n index of drupes showed a higher and earlier trend in the cv. "Leccino", reporting values of 3.4 compared to 0.8 of cv. the "Nocellara del Belice". As regards the polyphenolic profile, oleuropein was the most stable phenolic molecule for the drupes of both cultivars, as well as the most abundant at the time of harvest, with values of about 30 mg/100g FW; at harvest the verbascoside content in the "Leccino" cv., was greater than about 143.33 % compared to "Nocellara del Belice".

#3: Early exogenous application of methyl jasmonate modifies the phenolic profiles of the olive fruit and virgin olive oil

Pilar Luaces, Instituto de la Grasa - CSIC

Virgin olive oil (VOO) owes its proven health-promoting properties mainly to its phenolic compounds. Most of them derives from the phenolic glycosides present in the olive fruit, which are modified during the industrial oil extraction process to finally give rise to the typical phenolic profile of VOO. They are mainly derivatives of the alcohols with a phenylethane structure (phenylethanoids) tyrosol (Ty) and hydroxytyrosol (HTy), coming from the hydroxylated aromatic amino acids tyrosine and 3,4-dihydroxyphenylalanine, respectively. The rest of the main VOO phenolics are phenylpropanoids, their metabolic origin being the non-hydroxylated aromatic amino acid phenylalanine. Due to its health-promoting properties, there is a growing interest in increasing the functionality of VOO. In this regard, it is widely known that the phytohormone methyl jasmonate (MJ) causes an increase in the synthesis of phenolic compounds in different plant species. In this work, the effect of the exogenous application of MJ on the phenolic composition of the olive fruits and in the resulting oils has been studied. To do this, the most suitable moment to perform the MJ treatment has been identified first by finding out the moment of fruit development in which the main phenolic compounds are synthesized more actively. Then, the content of phenolic compounds has been studied throughout the process of fruit development and ripening and in the resulting oils. It was found that the MJ application provoked a significant increase in the ratio of phenylethanoid/phenylpropanoid compounds in the olive fruit, mainly due to a pronounced increase in the content of Ty and HTy derivatives. As a result, the oils extracted from MJ-treated fruits resulted in a marked increase in the content of Ty and HTy-derived compounds and a decrease in phenylpropanoid compounds such as flavones or lignans.

#66: Exploring sensorial variability and polyphenol content of an olive core collection

Antònia Ninot, Institute of Agrifood Research and Technology

A core Collection previously developed from the World Olive Germplasm Bank of Cordoba (WOGBC), Spain that includes 36 olive cultivars from 9 countries was planted at IRTA's facilities (North Eastern Spain) in 2015. The design is in randomized blocks (8 replication and one tree per replication). The study was carried out for three consecutive seasons. Olive samples (2 kg) were harvested by hand. Olive fruits were described for ripening index and immediately processed by an ABENCOR system, without adding neither water nor talc, in order to avoid polyphenol washing. Oil samples were filtered and sent to the laboratories. The sensorial description was assessed by the Official Tasting Panel of Catalonia, certified by ISO17025 and particularly trained by IRTA for EVOO description, using an expanded profile. Olive oil color was measured by transmittance using a spectrophotometer MINOLTA. Total polyphenol content was measured according to Folin-Ciocalteau method, reporting the results as caffeic acid. Olive oil stability was measured using the Rancimat method, working at 120ºC and 20 L/h dried air pumping. Results were statistically analyzed using both non-parametric and parametric methods. On the one hand, variability for each studied characteristic was assessed through distribution analysis. On the other hand, cultivar and year significant effects were measured through ANCOVA using the ripening index as a covariate. Total polyphenol content ranged from 86 to 612 mg/kg with 50% of the samples between 174 to 324 mg/kg showing a right-tailed distribution. Significant differences among cultivars were observed, with significant trend to lower contents when the ripening index raises. As expected, total polyphenol content is positively correlated with bitterness (r=0.74), pungency (r=0.72) and astringency (r=0.70) and stability (r=0.63). Bitterness ranged from 2.0 to 5.6 following a symmetric distribution with median of 4.0 with significant differences between cultivars and decreasing the intensity for high ripening index values. Pungency ranges from 2.7 to 6.1 with symmetrical distribution, significant differences between cultivars and a tendency to decrease when maturation increases. Astringency shows a left-tailed distribution with a mode of 0.0 meaning that this is an odd attribute with maximum observed of 3.6 on the border of what can be detected by non-trained consumers; however,

significant differences were observed among cultivars and a clear tendency to decrease along ripening. Regarding aroma, fruitiness is the main descriptor, ranging from 3.2 to 6.7 with symmetric distribution and significant differences among cultivars, as well as a decreasing trend with ripening. Fruitiness shows a predominant green smell, that ranges from 0.5 to 4.4 following a left-tailed distribution and medium to high kurtosis. In our knowledge, this is the first time that sensorial descriptors variability is assessed through a core collection that resumes the highest known genetic variability.

#90: The influence of different thermal treatments on the antioxidant capacity and oxidative stability of virgin olive oil

Klara Kraljic, University of Zagreb , Faculty of Food Techn. and Biotechnology

Besides the relatively low extraction yield, one of the problems in virgin olive oil (VOO) production is the loss of bioactive compounds that remain in the by-products. The temperature of the olive paste could influence the activity of endogenous enzymes of the olive fruit, which can improve the quality of the final product. The aim of this study was to determine the influence of the method of heat transfer to the olive paste before malaxation on the antioxidant capacity and oxidative stability of VOO of the Croatian autochthonous variety Oblica. The olive paste was heated by convection, with heating lasting up to one hour (standard thermal treatment - TT), and by conduction, with the paste heated about ten times faster (flash thermal treatment - FTT). In the laboratory-scale production of VOO using the Abencor system, the olive paste was heated to 30, 35 and 40 °C before malaxation. The oil quality parameters, fatty acid composition, phenolic compounds, tocopherols, antioxidant capacity and oxidative stability index were determined in the produced VOO. The results of multivariate data analysis (PCA) show that the quality and composition of VOO are strongly influenced by the heating method. FTT-heated oil samples had higher levels of primary oxidation products (PV and K 268) and higher concentrations of hydroxytyrosol, tyrosol, oleuropein, and ligstroside. TT-heated samples contained higher amounts of secondary oxidation products, as expected, but also higher amounts of total phenolic compounds and tocopherols and consequently higher antioxidant capacity and better oxidative stability. These results suggest that standard heating is more suitable for the production of high-quality oil. However, to draw this type of conclusion, a sensory analysis of the oil should also be performed, since it is known that higher temperatures have a negative effect on the sensory quality of the VOO.

#91: Diversity Assessment of Virgin Olive Oils from Croatian Cultivated and Wild Olives by their Chemical Traits

Maja Jukic Spika, Institute for Adriatic Crops

Olive biodiversity is characterized by a large number of wild and cultivated varieties, which, unfortunately, is rapidly decreasing due to the neglection, increasingly frequent occurrence of incurable diseases and abrupt climatic changes. The valorization of olive Croatian biodiversity was carried out within the CroP-BioDiv project and included landraces, neglected cultivars and wild accessions. This approach is fundamental for overcoming the mentioned problem, preserving the cultural heritage and maintaining the economic value of this important crop. In this work, the variability of fatty acid composition, composition and proportion of sterols and composition of phenols, determined by gas chromatography and liquid chromatography coupled to triple quadrupole mass spectrometry, was studied in more than fifty virgin olive oils (VOO) from indigenous accessions and selected wild accessions. In addition, the correlations between all chemical characteristics were studied. The data show that the profiles of the analyzes performed in VOO depended strongly on the genotype and showed great variability within olive species. Among the main fatty acids, linoleic acid showed the highest variability, ranging from 4.7 to 16.2%. Among the sterols, app-beta-itosterol was the most abundant, while delta-5-avena-sterol showed the greatest variability, with values ranging from 2.9 to 28.15 mg/kg. Of the 22 phenolic compounds identified, 3,4- DHPEA-EA (oleuropein aglycone) was the most abundant in all samples analyzed, while apigenin had the greatest variability. A high correlation was observed between pHBA content and linolenic fatty acid (R= 0.6232), between stigma sterol and

quercetin (R = 0.629) and stigma sterol and 3,4- DHPEA-EA (oleuropein aglycone) (R = - 0.551). In conclusion, data delivered in this study contributes to the general knowledge of this species and to the knowledge of the chemical diversity of VOOs from Croatian germplasm, with the broader aim of identifying genotypes with specific chemical characteristics useful for the establishment of breeding programs, but also for the inclusion of neglected varieties for commercial use, which will enrich the supply and quality of oils on the market.

#99: Impact of olive genotype on olive oil oxidation during storage

Mario Vendrell Calatayud, School of Advanced Studies Sant'Anna Pisa

Olive oil is a widely recognized and appreciated food commodity, with its quality and health benefits dependent on the extent of oxidation that occurs during production and storage. This study aimed at investigating the effects of the olive genotype on the oxidation rate of olive oil. To approach this issue, we analyzed oil produced form 10 different olive cultivars grown in three different areas (Italy, Spain and California). Different transition metals were added (FeCl 3 and CuCl 2 , independently) to the oil stored in 20 mL vials. Physiochemical parameters such as free fatty acids, peroxides, K232 and K268, were analyzed, along with the polyphenol and sterol profile. The analysis was performed monthly during 4 months of storage time. An alternative methodology was proposed for complementing the oxidation rate evaluation monitoring which consisted in the measurement of the oxygen in the headspace of the vial containing the oil. The results showed that the samples with a transition metal had different patterns of oxidation compared to the non-altered oil, with higher secondary oxidation products and lower primary oxidation products and peroxides. Additionally, the detected polyphenols and sterols revealed different oxidated molecules in the samples with iron and copper ions dissolved, while the oxygen consumption in these samples was higher compared to the metal-less oil. This study provides additional knowledge regarding the factors that influence oxidation in olive oil and its impact on the quality of the final product and highlights the different behaviors of genotypes stored under the same conditions. Further studies are needed to investigate the effects of different olive cultivars in the oxidation process.

#51: Wild olive trees (Olea oleaster) in Croatia – Chemical and sensory characterization of their olive oils

Mirella Zanetic, Inst.Adriatic Crops Karst Reclamation

In this paper, we investigated the olive oils obtained from wild millennial olives from the Lun Olive Grove Gardens, which are located in the northern part of the island of Pag in Croatia. In this unique locality, more than eighty thousand wild millennial olive trees create the largest wild olive park in the world. The aim of this research was to characterize the olive oils produced from wild olives based on their fatty acid composition, phenolic profile and volatile composition. Olive oil samples were collected directly from farmers who have olive groves within the Lun Olive Gardens. The fatty acids composition were determined by gas chromatography separation of prepared methyl esters according ISO method (5508). The phenolic compounds of the prepared extracts were analyzed by Perkin Elmer high-performance liquid chromatography HPLC system (Waltham, MA, USA). Aromatic profile of the tested olive oils was studied by analysis of volatile compounds' composition by GC-MS gas chromatography. The results for fatty acid composition show the oleic acid content from 72.02 to 74.50%, while the content of linoleic and α-linolenic acid was from 9.14 to 10.52% and 0.31 to 0.37%, respectively. The phenolic composition show the highest variability in the concentrations of hydroxytyrosol and tyrosol between certain oil samples (from 1.19 up to 9.44 mg kg -1 , and 1.80 up to 11.89 mg kg -1 , respectively). Oleuropein and ligstroside derivatives were the main and the most abundant phenolic fractions in all analyzed samples. The most common volatile compounds detected were E-2-hexanal, Z-3-hexen-1-ol and hexanol. Sensory evaluation of olive oils was conducted by professional panel of the Institute for Adriatic Crops from Split. Quantitative descriptive sensory analysis was performed according to the IOC methodology and the aromatic profile of the analyzed olive oils of wild olives was defined. Overall

results indicated significant variability of phenolic compounds in VOOs from wild olives, thus indicating possible superior therapeutic features from certain analyzed oils.

#111: Automated monitoring of table olive storage brines through an innovative sensorized smart system

Rossella Manganiello, CREA Ricerca

Table olive production and consumption have shown a clear growth trend in recent years, worldwide. The quality of table olives depends, to a large extent, on the ability to limit collateral effects associated with post-harvest olive processes, which are needed to debitter and stabilize the final product. Olives ready for consumption must be intact and retain the characteristic flavors and aromas appreciated by consumers. Therefore, control of transformation and storage processes is very important, because changes in environmental conditions, variations in the olive-to-brine ratio or alterations in the brine's chemical and physical parameters can lead to undesirable spontaneous fermentations, thus decreasing the olives' commercial and nutritional value. In this study, an innovative user-friendly system, equipped with low-cost digital and sensorized devices, was realized and implemented for monitoring key fermentation parameters of table olives. Chemico-physical parameters of different olives brines, including temperature, pH, salinity, free acidity, volatile acidity and residual sodium hydroxide, were analyzed using both the automated system and the Official Reference Methods, to test the performance of the prototype and verify the accuracy and repeatability of the measurements. The results highlighted a good linearity for all parameters tested and a relatively low mean deviation between the two approaches, showing that the device provides accurate and reliable data, ensuring that brine compliance can be monitored and thus table olive quality and safety can be controlled. The device provides real-time data, reducing the risk of errors and minimizing the need for human intervention. In addition, real-time monitoring enables immediate adjustment of fermentation parameters, ensuring optimal conditions for the growth of desired microorganisms and minimizing the risk of spoilage. This innovation can help greatly optimize the efficiency and productivity of table olive production, improving product quality.

#30: Evaluation of the mechanical pruning effect on olive yield, in a high density olive orchard of 'Galega cultivar'

Antonio Fernando Bento Dias, Universidade de Évora

The results obtained in traditional olive grove show the advantage of mechanical pruning: reduction of pruning costs without reduction in yield. The scarcity of labour to performed pruning associated with increase of the area of irrigated olive groves led the authors to study the use of mechanical pruning in these orchards.

In 2009, authors started the evaluation of the use of mechanical pruning in a irrigated intensive olive orchard of 'Galega vulgar' variety installed in an array of 7m x 5m.

In this trial, in a randomised complete block design with three replications, four treatments (T1, T2, T3, T4) are being compared leading to 12 plots. The treatments under study are: T1 - manual pruning using manual saws and scissors, performed in 2009, 2013 and 2017; T2 - mechanical pruning: topping the canopy parallel to the ground, in 2009, 2013 and 2017; T3 - mechanical pruning as in T2, followed by manual pruning complement using manual saws and scissors, in 2009, 2013 and 2017; T4 - mechanical pruning: topping the canopy parallel to the ground in 2009, 2013 and 2017. In 2011, 2015 and 2019, treatment T4 was submitted to manual pruning complement using manual saws and scissors.

The evaluation of pruning rate and the average yield per tree for each treatment was measured.

In average, no significant differences were obtained between treatments, revealing that manual pruning complement to mechanical pruning made two years after mechanical pruning seems to have no influence on yield.

#101: Use of vegetation indexes to characterize within-canopy light conditions of pedestrian olive orchards

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Vegetation indexes may provide useful quantitative and qualitative information on light conditions within the canopy. Different vegetation indexes were used to evaluate the effect of pruning on medium to high density pedestrian olive growing systems. Specifically, nine-year-old 'Cerasuola' trees trained to central leader (CL) and spaced at 2x5 m or trained to vase (V) and spaced at 4x5 m were pruned in September and October 2022, and in February 2023. Pruning consisted primarily of eliminating vigorous suckers impairing light interception and reserve accumulation. An AMS 12-spectral-band radiometer (AS7262-visible; AS7263-near infrared) was positioned at 30 cm from the ground and 20 cm from the trunk of each tree in trial. Normalized difference vegetation index (NDVI), green normalized difference vegetation index (GNDVI), green leaf index (GLI), canopy chlorophyll content index (CCCI), normalized difference NIR/rededge index (NDRE) and ratio vegetation index (RVI) were calculated from radiometer measurements. Significant effects of pruning were detected only by NDVI and RVI and were date independent. This is in part expected as GLI, CCCI and NDRE are mostly related to the green color and chlorophyll content. Both NDVI and RVI were lowered by pruning indicating lower canopy thickness, but only in trees trained to vase. No radiometric index was able to detect differences between pruned and unpruned CL trees, suggesting that sucker removal did not significantly improve light penetration levels in those trees. These preliminary results suggest that NDVI and RVI may be useful, quick and non-destructive tools to establish optimal light conditions and pruning intensity in olive trees grown under different systems. Further trials with an approach from above the canopy will confirm the usefulness of vegetation indexes to study the effect of pruning on canopy light interception of pedestrian olive orchards.

#26: OLIVE PRUNING MANAGEMENT WITH MOBILE LASER SCANNER

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Italian olive growing is characterized by small-scale farms and great variability in system management. With regard to pest, irrigation, and pruning, management is becoming more challenging as a result of the rise in extreme meteorological events brought on by climate change. Olive orchard pruning, which is one of the biggest expenses in the olive farm after harvesting, is becoming more important due to rising production costs and a labour shortage. Nowadays, in medium-low density orchards the polyconic vase, with a less geometrical order, was introduced to simplify and make faster pruning, but it requires a very specialized labour. In high-density orchards with an hedgerow canopy the pruning was simplified or eventually done with mechanical interventions, but with problems to maintain constant yield. Both types of orchards would thus benefit of a decision support system that could better organize pruning operations in large farms, or productive areas with multiple farms, with lack of specialized labour. In this experimental work different pruning techniques and intensities have been tested in a medium density orchard (polyconic vase) and in a high-density hedgerow system, supported by the use of a Mobile Laser Scanner (MLS) for canopy volume measurements. Results indicate that different pruning intensities can be described by point cloud data before and after the intervention and even after 2 years. Different

pruning intensities and cultivars can be detected in both density systems and likely the measurements can be useful for a pluriannual organization of pruning in large farms or communities.

#TBA: The effects of the ethephon and accede sprays on fruit detachment force, trunk shaking harvester efficiency and fruit value in Manzanillo table olive

Emily Santos, Department of Plant Sciences, University of California, Davis

Fruit removal force (FRF) is a reliable and predictable indicator of olive fruit maturation and important for mechanical harvesting efficiency. Spray applications of ethylene have demonstrated inconsistent results in accelerating olive maturation. Ethylene applied in September 2021 on three preharvest dates failed to produce a consistent significant decrease in FDF between the control and sprayed trees or significantly increase trunk shaking harvester efficiency. In the following year declining FDF was correlated with GDD to better predict when to apply the abscission agents. These applications did not decrease FRF, increase trunk harvesting efficiency relative to the 52% achieved by the control treatment, or find difference in adjusted value per ton. This lack of treatment effect could be a function of harvesting before the treatments could produce an increase in ethylene production, or related to application volume. A preliminary trial of a new commercially available ethylene generating compound, Accede (ACC), was added to the 2022 trial. Results did not decrease FRF, but did increase trunk harvester efficiency to 61%, significantly better than the 52% achieved by the control. ACC shows promise as a better ethylene generating compound compared to ethephon.

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