10th

ISHS PEACH SYMPOSIUM

Book of Abstracts

X INTERNATIONAL PEACH SYMPOSIUM

30 May - 3 June 2022

Naoussa, Greece

Welcome

It is my pleasure to welcome you in the 10th International Peach Symposium, held under the auspices of the International Society for Horticultural Science (ISHS).

Towards the establishment of new links and collaborations among participants, the Conference aims to bring together researchers from diverse fields of study who share a common interest in peach.

The Conference is comprised of 16 keynote lectures, 54 oral presentations and 69 poster presentations, 5 stakeholder talks and one round table that are expected to provide new knowledge and promote scientific dialogues during the conference. The Scientific Program includes contributions that belongs to the following main sections:

- Breeding (germplasm, rootstocks, cultivars)
- Genetics, genomics and biotechnology
- Plant physiology and abiotic stress conditions
- Plant disease management
- Integrated pest management
- Nutrition
- Irrigation
- Cultivation practices
- Mechanizations
- Fruit quality
- Postharvest physiology and technology/processing

The conference will provide the opportunity for scientists, professionals and students to present their latest findings and discuss their current work related with both basic and applied aspects.

I hope the meeting will promote the exchange of ideas and international cooperation and collaboration among researchers.

George Manganaris

Convenor

Cyprus University of Technology
Department of Agricultural Sciences, Biotechnology & Food Science

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Scientific Program

Monday, May 30

13:00-18:00	Attendee registration (Kioski Venue)
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18:00-18:15	**Maria Fabiana Drincovich** The metabolic diversity of peach fruit and its usage as phytochemicals resources with roles in human nutrition and health [PLE-1] *virtual*
18:15-18:30	**Vassilis Fotopoulos** Priming technologies in peach: where are we now, where do we go from here? [PLE-2] *virtual*
18:30-18:45	**Gregory Reighard** Field performance of peach rootstock cultivars in South Carolina [OP-1]
18:45-19:00	**Livio Trainotti** Peptide hormone genes expressed during peach fruit development and ripening [OP-2]
19:00-21:00	Welcome Reception [The Boston's]

Tuesday, May 31

08:00-09:00	Attendee registration
09:00: 09:30	**Welcome Remarks** George Manganaris, Convener Theodore De Jong, ISHS Council member Nikolas Karanikolas, Mayor of Naoussa George Georgantas, Minister of Rural Development & Food, Greece
09:30-11:00	**Session II: Plenary lectures** Moderators: Theodore DeJong & Laura Rossini
09:30-10:00	**Daniele Bassi** Are we ready for the next peach? A still underexplored crop [PLE-3]
10:00-10:30	**James Adaskaveg** Overview of practices to combat postharvest diseases of peach fruit [PLE-4]
10:30-11:00	**Costas Biliaderis** Conventional and emerging technologies for processing peach products [PLE-5]
11:00-11:30	Morning coffee break

11:30-13:00	**Session III: Breeding (germplasm, rootstocks, cultivars)** Moderators: Ksenija Gasic & Yolanda Gogorcena
11:30-12:00	**Pere Arus** The peach genome and its breeding applications [PLE-6]
12:00-12:15	**Ksenija Gasic** Starting from scratch: 14 years of peach breeding program at Clemson University [OP-3]
12:15-12:30	**Stelios Theodoulidis** Yellow clingstone peaches destined for processing within a global context [Stakeholder Talk]
12:30-12:45	**Rodrigo Infante** The Chilean nectarine breeding program [OP-4]
12:45-13:00	**Yolanda Gogorcena** The genomic analysis of a wide peach germplasm collection revealed a genetic relationship between European landraces and American ferals and landraces [OP-5]
13:15-14:30	Lunch
14:30-16:15	**Session IV: Cultivation practices/Mechanizations** Moderators: Gregory Reighard & Ignasi Iglesias
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15:00-15:15	**Alessandro Botton** Thinning peach with a new-generation GA-based compound: shedding light on bud developmental physiology to improve treatment efficacy [OP-6]
15:15-15:30	**Steven McArtney** Accede is a new thinner for stone fruit based on the naturally occurring compound 1-aminocyclopropane carboxylic acid [OP-7]
15:30-15:45	**George Pantelidis** Evaluating the effects of different mechanical flower thinners on the production cost and fruit quality characters in table and processing peach cultivars [OP-8]
15:45-16:00	**Pedro Dinis Gaspar** Multitask robotic rover for agricultural activities (R2A2): A robotic platform for peach orchard [OP-9]
16:00-16:15	**Gregory Lang** Designing planar peach/nectarine production systems that are adaptable to precision cropping, a range of rootstock vigor levels, and potential autonomous mechanization technologies [OP-10]

16:15-16:45	Evening coffee break
16:45-17:15	**Round table [Stakeholder event]:** The use of fertilizers towards sustainable peach fruit production Moderator: George Manganaris
17:15-19:00	**Session V: Integrated Pest Management** Moderators: Slawomir Lux & Eirini Anastasaki
17:15-17:45	**Nikos Papadopoulos** Challenges and opportunities in management of emerging and alien invasive pest in peaches [PLE-8]
17:45-18:00	**Massimiliano Virgilio** A multi-access identification key to fruit flies (Diptera, Tephritidae) of economic importance in Europe [OP-11]
18:00-18:15	**Apostolos Kapranas** Biological control of Mediterranean fly *Ceratitis capitata* with entomopathogenic nematodes: from laboratory assays to field application [OP-12]
18:15-18:30	**Slawomir Lux** Implications of farm structure and crop management on fruit infestation and medfly IPM [OP-13]
18:30-18:45	**Marco Colacci** The status of medfly and IPM practices based on case studies in Italy [OP-14]
18:45-19:00	**Eirini Anastasaki** Chemical chracterization of the volatile infestation-fingerprint of peaches by *Ceratitis capitata*, *Bactrocera zonata* and *B. dorsalis* and conversion into a detection tool (e-Nose) [OP-15]
19:00-20:00	**Session VI: Out-of-the-box plenary talks** Moderators: Gemma Reig & María Angeles Moreno
19:00-19:30	**Andronikos Mauromoustakos** Exciting times with statistically thinking for industrial problem-solving strips [PLE-9]
19:30-20:00	**Magdalini Krokida** Evaluation of environmental and economic performance using LCA and LCCA tools: the case of peach fruit production [PLE-10]
20:30-23:00	Dinner (Brasserie Home)

Wednesday, June 1

08:30-11:00	**Session VII: Plant disease management** Moderators: James Adaskaveg & Guido Schnabel
08:30-09:00	**Rosario Torres** Advances in management of fungal diseases in peach: the *Monilinia* spp [PLE-11]
09:00-09:15	**Celia Cantin** Influence of anatomy and composition of the fruit cuticle on peach susceptibility to *Monilinia fructicola* infection [OP-16]
09:15-09:30	**Carla Casals** Effect of abiotic factors on *in vitro* and *in vivo* development of *Rhizopus* spp [OP-17]
09:30-09:40	**Ioannis Avramidis** Geoxe: Essential tool for Monilia management before harvest on peaches [Stakeholder Talk]
09:40-09:50	**Dimitris Servis** Revyona: an innovative fungicide for the integrated control of diseases in stone fruits [Stakeholder Talk]
09:50-10:00	**Charalambos Liotsos** Corteva Agriscience: A commitment to growing progress [Stakeholder Talk]
10:00-10:15	**Julien Ruesch** EcoPêche 2: a multipartenarial project to conceive and evaluate innovative peach orchard management to reduce dependance to phytosanitary products [OP-18]
10:15-10:30	**Guido Schnabel** Biology, epidemiology and management of diseases of peach driving the spray program in the southeastern United States [OP-19]
10:30-10:45	**Emine Tanriver** Development of plants resistant to plum pox virus by intergeneric hybridization between peach and other *Prunus* species [OP-20]
10:45-11:00	**Manuel Rubio** Use of almond as interstock for PPV (sharka) protection in peach [OP-21]
11:00-11:30	Morning coffee break
11:30-13:00	**Session VIII: Genetics, Genomics & Biotechnology** Moderators: Maria José Aranzana & Benedicte Quilot
11:30-12:00	**Thomas Gradziel** Exotic genes for solving emerging peach production challenges [PLE-12]

12:00-12:15	**Maria José Aranzana** Molecular-based pedigree reconstruction of peach lines and cultivars [OP-22]
12:15-12:30	**Morgane Roth** Genetic diversity in a new peach core-collection designed for resilience breeding [OP-23]
12:30-12:45	**Sook Jung** Resources for peach genomics, genetics and breeding research in GDR, the genome database for Rosaceae [OP-24]
12:45-13:00	**Pedro Martinez-Gomez** Whole-genome bisulfite sequencing and methylome profiling of homo- and hetero-grafted peach rootstocks uncovers a burst of DNA methylation events with potential impact on gene expression [OP-25]
13:00-14:30	Lunch
14:30-16:00	**Session IX: Climate change / fertilization strategies** Moderators: Davide Neri & Gregory Lang
14:30-15:00	**Pavlina Drogoudi** Climate change and the peach production sector: Challenges and adaptation strategies [PLE-13]
15:00-15:15	**Maria Jose Rubio Cabetas** Advance studies to develop biomarkers for water stresses tolerance in rootstocks [OP-26]
15:15-15:30	**Juan Carlos Melgar** Rational fertilization in peach orchards: considering orchard-specific variables to improve mineral nutrition programs [OP-27]
15:30-15:45	**Maria Paula Simões** Foliar nutrient status of peach orchards and sustainability [OP-28]
15:45-16:00	**Luca Mazzoni** Influence of different nitrogen fertilization rate on vegetative, productive and qualitative performance of three peach cultivars [OP-29]
16:00-16:30	Evening coffee break
16:30-18:30	**Session X: Propagation & Field performance** Moderators: Tiziano Caruso & Dragan Nicolic
16:30-17:00	**Tiziano Caruso** Propagation techniques and nursery management for the production of certified peach plants in Europe [PLE-14]

17:00-17:15	**Davide Neri** Living mulch under the row of young peach orchard [OP-30]
17:15-17:30	**Gemma Reig** Inking on Spanish peach orchards: causes and solutions [OP-31]
17:30-17:45	**Florin Stanica** Dynamics of fruit branches at new peach and nectarines cultivars under Vertical Axis and Trident canopies [OP-32]
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18:00-18:15	**Brendon Anthony** Primary and secondary metabolism crosstalk during peach fruit quality development [OP-34]
18:15-18:30	**Jesús López-Alcolea** New break dormancy spray treatments in nectarine peach (*Prunus persica* var. nectarina), in warm areas [OP-35]
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18:45-19:00	**Hilary Rogers** Common and genotype-specific responses of peach cultivars to chilled storage based on transcriptomic analysis [OP-37]
19:15-19:30	**María Angeles Moreno** Chilling injury in local and modern peach cultivars from a Spanish peach bank germplasm [OP-38]
19:30-19:45	**Damiana Natasha Spadafora** Augmented analysis of sensorial, volatilome and gene expression data from peach cultivars during cold storage to identify markers for fruit quality [OP-39]
19:45-20:00	**Allesio Allegra** Effect of Opuntia ficus indica mucilage edible coating on fresh-cut nectarine cv. 'Big Bang' [OP-40]
22:00-00:00	Cocktail event (Café Neon)

Thursday, June 2

09:00	**Departure from Naoussa**
09:15-10:30	Guided tour [Aristotle's School Cultural Center]
10:30-12:00	Site visit at a Cooperative Units of ACNaousa & ASEPOP Naoussa
12:00-12:30	Brunch
12:30- 15:30	Guided tour [Tombs of King Philip II, Vergina Museum]
16:00-18:00	Free time at the City of Veria
18:30	Return to Naoussa
20:30-01:00	**Gala dinner [Kioski Venue]**

Friday, June 3

09:00-11:00	**Session XII: ISHS Young Mind Awards Competition** Moderators: Alessandro Botton & Morgane Roth
09:00-09:06	**Orestis Giannopoulos** Investigating the impacts of ozone treatments on postharvest quality of peaches [OP-41]
09:06-09:12	**Nathalia Zaracho** Construction of a NIL collection of *P. davidiana* into the peach genetic background [OP-42]
09:12-09:18	**Monica Canton** Epigenetic signatures regulate flower bud endodormancy in peach [OP-43]
09:18-09:24	**Najla Ksouri** Motif discovery within upstream regions of variable length reveals regulatory signatures in peach [OP-44]
09:24-09:30	**Jesús Guillamón** Non-target metabolomics and expression analysis for studying the modulation endodormancy release in peach flower buds [OP-45]
09:30-09:36	**David Sterle** Exploration of environmental and weather variables for peach floral bud cold hardiness prediction in western Colorado [OP-46]

09:36-09:42	**Lefkothea Karapetsi** SNPs identification and association study of fruit quality genes from selected whole-genome sequenced peach varieties cultivated in Greece [OP-47]
09:42-09:48	**Giulio Demetrio Perulli** Peach smart fertigation with wastewater: physiological and nutritional evaluation [OP-48]
09:48-09:54	**Francisca Carrasco-Cuello** Crop load and transpiration reduction effect on fruit and leaf mineralogical content in commercial late-harvest nectarines [OP-49]
09:54-10:00	**Jeff Pieper** The impact of size controlling rootstocks on peach fruit metabolome and internal quality in differing training systems [OP-50]
10:00-10:06	**Jordan Knapp-Wilson** 3D Imaging and Quantitative Analysis of Adult Peach Tree Architecture via TreeQSM [OP-51]
10:06-10:12	**Gianmarco Bortolotti** A computer vision system for in-field fruit quality evaluation: preliminary results on peach fruit [OP-52]
10:12-10:18	**Leonidas Kyrgiakos** Assessment of input use efficiency in peach grove cultivation: a case study of Naoussa region [OP-53]
10:18-10:24	**Vasilis Rodovitis** Population dynamics of Mediterranean fruit fly in mixed fruit orchards in Central Greece [OP-54]
10:24-10:30	**Voting for ISHS Young Mind Awards Competition**
10:30-11:00	Morning coffee break
11:00-12:30	**Session XIII: Plenary lectures** Moderators: Guglielmo Costa & Ioannis Minas
11:00-11:30	**Guido Schnabel** Peach skin disorders: causes and mitigation measures [PLE-15]
11:30-12:00	**Theodore De Jong** Understanding factors influencing peach fruit development and growth [PLE-16]

12:00-13:00	**ISHS Business meeting** Moderators: Theodore DeJong & Florin Stanica

Report of the Working Group Chair
List of potential candidatures for the next Symposium
Candidature presentations and decision
Nomination or re-nomination of the Working Group Chair
ISHS Young Mind Awards
Concluding Remarks

Plenary Lectures, PLE

Code	Presenting Author - Title
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PLE-15 **Guido Schnabel**
Peach skin disorders: causes and mitigation measures

PLE-16 **Theodore De Jong**
Understanding factors influencing peach fruit development and growth

PLE-1

The metabolic diversity of peach fruit and its usage as phytochemicals resources with roles in human nutrition and health

María Fabiana Drincovich

Center for Photosynthetic and Biochemical Studies (CEFOBI, CONICET-Rosario National University), Rosario, Argentina

The fruit is one of the most metabolite-rich organs of plants and as such contains a massive range of chemical complements: metabolites involved in taste and flavor; with nutraceutical properties; and with defense properties against biotic and abiotic stress. The fruit-metabolic diversity depends also on the type of fruit. In this sense, the metabolome of peach fruit is extraordinarily complex, with specific metabolic programs, which sustain its different tissues: the juicy mesocarp and the lignified endocarp covering the seed. Besides, a wide range of peach varieties are distributed around the world displaying a large phenotypic variability. These peach varieties display differential organoleptic and nutraceutical properties and postharvest performance, characteristics related to variety-dependent chemical composition. Moreover, metabolic reconfiguration in peach fruit during ripening and by different pre- and postharvest treatments have been also found to be variety-dependent. Considering that the metabolome represents the ultimate phenotype of the cells, and that is able to modify gene expression and protein function, future major challenges include integration of large metabolic datasets to transcriptomic and proteomic data on different peach varieties and after different pre- and postharvest handling treatments. These data could aid in modelling networks related to traits of agronomic interest, as well as to modify the levels of desirable chemical compounds, leading to the improvement of peach fruit not only to enhance organoleptic characteristics or postharvest performance but also for the benefit of human health.

PLE-2

Priming technologies in peach: where are we now, where do we go from here?

Vasileios Fotopoulos

Department of Agricultural Sciences, Biotechnology & Food Science, Cyprus University of Technology, Limassol, Cyprus

Increased frequency of extreme environmental events resulting from global climatic changes remarkably influences plant growth and development. Close examination of plant-to-plant communication in nature has revealed the development of unique strategies from plants for responding to abiotic stress, with one of the most interesting being through priming for improved defense responses. The process of priming involves prior exposure to a biotic or abiotic stress factor making a plant more resistant to future exposure. Priming can also be achieved by applying natural or synthetic compounds which act as signaling transducers, 'activating' the plant's defense system. A brief overview will be presented describing the research carried out at the Cyprus University of Technology using priming agents towards induced acclimation of fruit crops to environmental challenges. In addition, existing approaches targeting peach in specific in the global research 'ecosystem' will be examined, highlighting potential future directions of this exciting technology.

PLE-3
Are we ready for the next peach? A still underexplored crop

Daniele Bassi[1], Marco Cirilli[1], Stefano Foschi[2]

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A critical evaluation of the role of peach breeding in light of the future of this crop is nowadays strongly recommended, particularly in the light of the long-lasting market crisis worldwide, with few exceptions. Production trends are progressively slowing down and peach is becoming a secondary fruit crop even in Italy, the cradle of modern intensive orchard exploitation. Eating quality is still a cornerstone, but of course under the light of other crucial breeding objectives: increasing yield efficiency, improving resistance to disease (or tolerance) or abiotic and biotic stresses. The recent building of an European network of a genetic collection (the PeachRefPoP) is paving the bases for further achievements under several sides, e.g. fruit quality, stress resistance, economic and environmental sustainability. Although many aspects related to 'fruit quality' have been discussed and prospected for a long time, it seems there is still room for improvement just by digging into the wealth of the crop genetic resources. Developing flesh textures by improving the postharvest features and the flavour array, and shaping custom-tailored new fruits combining the needed amount of acids and sugars is an avenue still largely unexplored. Stresses resistance is unfortunately not a very popular goal for breeders, with a few exceptions worldwide; indeed there are so many traits that could be merged in a 'modern' cultivar, even starting from Sharka resistance, the most devastating plague for peach. The genetic variability of tree architecture, although rather extensively explored, has been only slightly exploited, at least in terms of commercial releases (new commercial cultivars) and there are traits, e.g. the weeping canopy or the narrow leaf, just to mentions only traits suitable for developing new trees matching several 'sustainable' economic and environmental goals. Needless to say, all above must tackle consumer's acceptance, and since recurrent purchase is ultimately a measure of the perceived peach quality, this is a goal that breeders cannot afford alone.

PLE-4
Overview of practices to combat postharvest diseases of peach fruit

James Adaskaveg, Helga Forster

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The management of postharvest decays of agricultural crops employs a wide range of practices that begin with appropriate harvest and handling practices to minimize fruit injuries and end with suitable storage conditions of the commodity at the packinghouse, the market, and the consumer. At the packinghouse, sanitation of equipment and fruit helps to reduce inoculum contamination. Physical treatments such as hot water baths or UV-C irradiation have been used successfully to stop incipient infections of decay fungi on some crops. Additionally, numerous natural products and biocontrols have been evaluated for their ability to reduce decays, but only few have been commercialized. Currently, postharvest fungicide treatments are still considered the most effective strategy to maintain postharvest crop health. The fungicides benomyl, thiophanate-methyl, triforine, and iprodione were previously available for use on stone fruit crops in the United States and were highly effective against the major decays brown rot, gray mold, and Rhizopus rot. Their registrations were withdrawn in the 1980-90s as a result of the United States Environmental Protection Agency's reregistration policy of older pesticides. These cancellations were at first considered the end of effective postharvest decay control, but instead, they spurred new beginnings in postharvest fungicide registrations. The first 'reduced risk' fungicide fludioxonil was identified and registered in 1997, followed by the 'reduced risk' fenhexamid and pyrimethanil. The registration of fludioxonil marked the start of a new era of postharvest safety, and this fungicide ultimately advanced to the most effective and most widely used broad-spectrum postharvest treatment in the world. The advent of marketing pre-ripened peaches and nectarines increased the spectrum of decays that needed to be managed when sour rot became of commercial importance. After testing numerous compounds, the non-reduced risk fungicide propiconazole was developed in the early 2000s and still is the only highly effective treatment available for sour rot control. Growing consumers' concerns on treating fresh produce with synthetic fungicides led to the identification of natural fermentation products with antifungal properties. Natamycin and polyoxin-D were subsequently categorized as 'biopesticides', and these are exempt from residue tolerances in the United States. The evolution of postharvest fungicides is ongoing, and new fermentation products, plant extracts (i.e., essential oils), and biological agents (i.e., bacteria and yeasts) are being evaluated and developed with the goal of broad-spectrum activity and high performance.

PLE-5
Conventional and emerging technologies for processing peach products

Costas Biliaderis[1], George Manganaris[2]

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[2]*Cyprus University of Technology, Department of Agricultural Sciences, Biotechnology & Food Science, 3603 Lemesos, Cyprus*

Peach and peach products have been receiving increasing attention for production and consumption in recent years due to their attractive appearance, good taste and nutritional value, being good sources of many important phytochemicals with well-known bioactivities and health benefits (e.g., carbohydrates – fiber, vitamins, organic acids, phenolics, carotenoids, minerals, etc.). Because of its seasonal, rather brief availability, varietal differences in maturity and fruit composition, tissue sensitivity to physiological disorders (e.g. chilling injury), variation in flesh texture and processing suitability, there is a growing interest among peach growers, scientists and the processing industry to develop new products by exploring both conventional (e.g., canning, freezing, dehydration) and emerging technologies (e.g., ohmic heating, edible coatings and various minimal processing strategies involving high-pressure and other technologies), often applied in a combined way, to improve preservation and end-product quality. Another issue less well explored is the valorization of the by-products generated from the peach processing industry which can become a valuable source of natural products. All these technological approaches require optimization of processing parameters to maximize the nutritional and sensorial attributes (texture, color, mouthfeel perception) as well as the development of an appropriate analytical framework to monitor quality parameters for both product quality grading and assessing shelf-life. This presentation will highlight some aspects of peach processing technologies, addressing their preservation potential and their impact on product compositional issues, sensorial attributes as well as retention of nutrients and other health important phytochemicals.

PLE-6
The peach genome and its breeding applications

Pere Arús, María José Aranzana, Werner Howad, Iban Eduardo

IRTA, Centre de Recerca en Agrigenòmica, Campus UAB, 08193 Barcelona, Spain

Almost a decade after the publication of the genome of a double-haploid genotype from the 'Lovell' peach rootstock, knowledge on the peach and other Prunus genetics has enormously increased, and its applications for breeding have been pushed further forward. Currently there are 22 Prunus de novo sequences available in the genome database for Rosaceae, additionally showing the already known high synteny between all Prunus genomes. More than 60 Prunus major genes, mostly from peach or peach x almond crosses, have been identified, mapped and some of them cloned or have strong candidates responsible for their phenotypic variation. Marker-assisted selection has been integrated as an efficient approach to help breeders, based on the development of tightly linked markers to the genes involved in main characters under selection. New marker-based breeding approaches have been proposed: marker-assisted introgression, for fast introgression of new alleles or genes coming from exotic sources, that has already been successfully implemented. Resynthesis, a strategy to obtain peach lines that, maintaining the basic trait architecture of a top cultivar, can integrate new alleles or genes of interest with non-transgenic approaches, is underway. New tools for phenotypic and genetic analysis have recently been developed, including a multi-site peach reference population (RefPop) and a complete collection of peach-almond introgression lines. Together, they promise a deeper understanding of peach genetics, with the expected consequences of increased peach fruit quality, productivity, and resilience to the potentially devastating effects of climate change.

PLE-7
Peach fruit thinning: can we go beyond the current solutions

Guglielmo Costa

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In peach, fruit thinning has to be performed every year to improve fruit size and quality, maintain a vegetative/reproductive balance and prevent alternate bearing. Manual, chemical and mechanical methods are used. Hand thinning is widely used for peach thinning despite being very expensive, time consuming and requiring a high number of trained personnel in a short span of time. Recently mechanical thinning has been tested and could represent a potential viable option on orchards formed by training system that have been modified from volume to hedgerow to be adapted to mechanical thinner machines. Chemical thinning method certainly would represent the ideal solution but only few bloom or fruitlet thinners are available that so far have not provided consistent results. The research activity is active and recently, a new formulate (1-aminocyclopropane-1-carboxylic acid -ACC-) has been released as chemical thinners for stonefruits and other (ABA and Metamitron) are under evaluation. Other approaches to reduce fruit load applying different formulates at different phenological stages (from the flower differentiation period up to fruitlet stage) give interesting result and are under evaluation. Peach fruit thinning is a complicate task to solve and the ongoing climate change further increases the complexity of the overall thinning scenario. Fruit thinning is an important cultural management operation: since it is difficult to solve as it is in the actual standard orchards why do not propose a new orchard model where the control of the fruit load can be carried out more easily or does not have the importance it currently has on existing peach orchards.

PLE-8
Challenges and opportunities in management of emerging and alien invasive pest in peaches

Nikos Papadopoulos

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Biological invasions is a major threat to biodiversity, ecosystem function, sustainable agricultural production, agricultural cropping patterns, pesticide use, both national and regional economies and public health. Increased goods trading at a global scale, as well as, intensified human mobility that is reported over the last few decades tremendously increased the arrival of harmful organisms into novel areas. Climate change relaxes the barriers of surviving and reproducing into invaded areas substantially contributing to the successful completion of the invasion process. Hence, new pests are emerging as major issues for crop production and trading of agricultural commodities all over the globe. Peach is among the top fruit crops of the temperate zone that is currently phasing several challenges including management of endemic, emerging and alien invasive pests. Commercial peach orchards are intensively managed with frequent use of synthetic pesticides. Ban and use restriction of several insecticide groups, such as organophosphates and neonicotinoids in the European Union and limited availability of alternative plant protection option, is expected to further expose the European peach production to economic burden of unmanaged pest populations. Hence, the whole production system becomes more vulnerable to emerging and alien invasive insects that are frequently arriving in Europe. For example, several fruit flies (Diptera: Tephritidae) are expected to threaten peach fruit production in Europe in the near future. This group of pests include the Mediterranean fruit fly, which in response to climate change expands its geographic range from the coastal orchards of the Mediterranean to northern, cooler, and more continental areas where stone fruits such as peach are produced. In addition, the peach fruit fly, an aggressive invasive species has spread to north east Africa, recently invaded Middle East, and often arrives in Europe via trading of infested fruits. Bringing fruit flies as model organisms, the current paper outlines the challenges that peach production and trading is phasing because of emerging and invasive pest and introduces a strategic approach to manage biological invasions considering novel concepts and approaches.

PLE-9
Exciting times with statistically thinking for industrial problem-solving strips

Andronikos Mauromoustakos

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The free Statistical Thinking for Industrial Problem-Solving online course is the ideal way that researchers could update their statistical toolkit with training that would allow them to master their statistical skills so that they can solve industrial problems. At the University of Arkansas, any graduate student that will take four graduate courses on Statistical Methods, Regression, Designs of Experiments, and Applied Multivariate Methods can apply and receive from the Graduate School the STAN graduate certificate. The STIPS seven modules that a researcher could complete free and online in a week cover most of the knowledge that our graduate students need four semesters to complete since those four graduate courses have prerequisites all the previous in that sequence. In this presentation, we will review with examples key concepts contained in the seven modules of the STIPS course including EDA, Quality Methods, Decision Making with Data, Correlation and Regression, Design of Experiments, Predictive Modeling and Text Mining.

PLE-10

Evaluation of environmental and economic performance using LCA and LCCA tools: the case study of peach fruit production

Magdalini Krokida

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Peach production and peach processing industry are significant agricultural supply chain sectors in Europe. Europe is the second largest producer of peach, counting the 13% of global peach production. Peach production is of great importance in the Mediterranean area with Spain, Italy and Greece being the largest producers of peaches. For canned peaches, Spain is one of the two largest producers in the European Union and together with Greece accounting for more than 90% of the total European production. Peach production and processing include different operations which involve energy, water and raw material consumption as well as waste generation contributing in several environmental impact categories. Nowadays, there is an increasing concern regarding environmental protection issues; therefore, the evaluation of the environmental performance of the processes involved in the peach value chain is being highly important. The aim of this study was the evaluation of the environmental and economic performance of the peach value chain using Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) analysis. LCA was performed according to ISO 14040 & 14044, using GaBi software, utilizing ReCiPe 2016 methodology. The evaluation of carbon, energy and water footprints was performed considering a number of critical factors in the life cycles of products and processes. The results of the analysis were used to determine the main environmental impacts of the overall peach production chain, from cultivation to processing, and to identify the processes with the greatest level of criticality.

PLE-11

Advances in management of fungal diseases in peach: the *Monilinia* spp

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Brown rot on stone fruit, caused by species of *Monilinia*, is one of the most important diseases in all peach growing areas, and can generate losses of up to 80% in years with favorable weather conditions for disease development. In general, the control of fruit diseases is becoming increasingly complex, and brown rot is not an exception. Current strategies to control brown rot are based on cultural practices and the use of fungicide spray programmes in the field followed, in some cases, by a postharvest treatment. However, the high use of pesticides, associated with growing public concern about the health risk and environmental contamination, has resulted in restrictions imposed by legislations and distribution companies. Consequently, further research is needed to a successful development of control strategies to replace the use of synthetic fungicides to control *Monilinia* spp. In this context, our main goal has been to explore multidisciplinary approaches that allow us to get both a better control and understanding of this disease and hence, to design more effective crop protection strategies. A review of different control strategies used in the entire fruit production chain, i.e., from the field to postharvest, will be shown. Additionally, during the last years, another of our research lines has been focused on deciphering the factors that modulate the interaction between stone fruit and *Monilinia* spp., to know both the virulence mechanisms of pathogens and the defence response of fruit. In this context, an overview of the studies conducted regarding peach-*Monilinia* spp. interactions using pathological, biochemical, and molecular approaches will also be explained. Overall, these last studies can help us to obtain a better understanding of fruit-pathogen interactions and, additionally, establish the basis towards the improvement of disease control strategies in postharvest diseases of fruit.

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PLE-12
Exotic genes for solving emerging peach production challenges

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Peach, a major fresh-market and processing tree crop world-wide, is entering a period of transformation driven by changes in climate, production methods and market trends but where future breeding progress is severely limited by its very narrow genetic base. Peach rootstocks, which are also of global importance, have a long history of utilizing interspecies hybridization to successfully incorporate needed traits for disease, pest and environmental stress resistance. Interspecies hybridizations resulting in commercially successful rootstocks have been made between cultivated peach and its close wild peach relatives, as well as the more distantly related cultivated almond and its numerous and ecologically diverse wild relatives. Hybrids between peach and plum as well as apricot species have also been successful, though more difficult. Recent efforts to further introgress such exotic germplasm for peach cultivar improvement have successfully transferred not only disease and pest resistance but also improved fruit and tree quality as well as greater tolerance to environmental stresses. Associated genetic, genomic and developmental studies provide useful information on trait inheritance and, in many cases, have identified putative linkage group and possible candidate genes. Heritability of most traits derived from exotic germplasm, however, remains poorly studied, though early research suggests genomic and epigenetic modifications may sometimes be involved in addition to more traditionally studied genetic changes. While exotic gene introgression has the potential for transferring novel traits of value for rootstock and cultivar improvement, undesirable but undetected changes can also occur that, because of the long-lived and high-value nature of peach orchards, can ultimately result in severe economic losses.

PLE-13

Climate change and the peach production sector: Challenges and adaptation strategies

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The climate has changed dramatically over the past decades, with higher surface air temperature and the occurrence of more intense and frequent extreme precipitation events. In particular, global warming has affected the rates of chilling and heat accumulation, parameters that are vital for the peach tree flowering and fruit production. In many temperate and warm peach producing areas, historic declines in winter chill have been detected and this trend is projected to exacerbate by future temperature increases. Earlier blooming time of peach trees is recorded that is related with reduced chilling accumulation while the increased heat accumulation compensates for any phenology-delaying effects of reduced chilling. On the other hand reports document that in cold climatic regions there is either an increase or no change in chilling accumulation, partly related with reduced subzero temperatures that does not add to chilling, while earlier blooming and leafing days are documented related with increased heat and not chilling accumulation. Moreover, due to warm winter temperatures and earlier spring phenophases damages caused by a false spring are more often met. Insufficient chilling may result in erratic, prolonged and delayed blooming, low yield and aberrant peach fruit shape. Peach cultivars (cvs) may largely differ in their chill requirements (CR), from very low to moderate and high levels. Knowledge on the cvs CR is based on experiments (field and laboratory based) and statistical analysis of long-term datasets from flowering dates and climatic data, that are all time demanding. Little is known for the CR of commercially available peach cvs, whereas growers in warm regions already need to choose low chill cvs and those in moderate warm regions need to exclude the high chill demanding cvs for stable yields. Several studies showed that increased spring and summer temperatures result in smaller fruit size and shorter fruit developmental period. High summer temperatures also reduce peach fruit skin coloring, increase sugars but reduce storability. Increased temperatures have also resulted in damages from new pests (e.g. brown marmorated stink bug and spotted wing drosophila) in areas where the climate previously excluded their activity. More intense and frequent extreme precipitation events are also recently more often documented that cause significant yield losses related with fruit drop, skin damages and reduced storage ability in peach and nectarine fruits close to harvest. Moreover, rainfall events were related with increased occurrence of split-pits in table peach and nectarine and processing peach cvs during the canning procedure. Considering projected changes in climate, the development of strategies and tools that facilitate the adaptation of peach cultivation in this context is a pre-requisite. Breeding efforts need to focus not only on fruit quality traits and productivity but on plant adaptation to environment and resilience to biotic and abiotic stresses. The identification of home-climatic zones with special attention to the chill accumulation would provide information on the vulnerable peach producing areas at current and future climatic scenarios. Such adaptation requires good understanding of current and projected future climate changes at production sites, and knowledge of the chilling requirements and resilience to biotic and abiotic stresses of the commercially available peach cultivars. 'On-line' decision support systems would help stakeholders to take optimal decisions for current and future cultivations. Finally, insurance programs need to be readdressed, incorporating damages from present climatic conditions in different areas.

PLE-14

Propagation techniques and nursery management for the production of certified peach plants in Europe

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The propagation of fruit trees, particularly peaches, nectarines and cunning clingstone, has reached highly specialized levels since the 1960s. Over the years, the classic seed rootstocks have been replaced by numerous rootstocks produced in vitro, expanding the range of technical solutions for the different soil and climatic growing conditions of several areas. Thanks to the new genotypes from international breeding programs, it was thus possible to renew the cultivated varietal platform several times. Propagation techniques have also undergone an evolution, adopting solutions aimed at shortening nurseries' production cycles by using June budding or micrografting. Finally, there are different types of plants available for peach growers. Bare root plants, potted trees of different sizes with several mixture also activated by bio agents are suitable for the different growing and training systems to be adopted. In order to guarantee trueness to type and plant health and to counteract the introduction and spread of dangerous harmful organisms in Europe, at EU level, production and marketing of plant propagation materials is also regulated by mandatory standards for peach trees, although it is possible to join to voluntary certification schemes which insure higher guarantee to the plants. All these issues will be showed and discussed.

PLE-15

Peach skin disorders: causes and mitigation measures

Guido Schnabel & Juan Carlos Melgar

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Bronzing and streaking skin disorders have significant impact on the production of high-quality fruit in the southeastern United States. Bronzing refers to patches of skin on the fruit that look bronzed on primarily yellow to light red skin background. Depending on severity, the damage may stretch from a single small patch to most of the peach covered. Although research shows that many patches are formed prior to harvest, most of the symptoms only appear after storage. Streaking is referred to symptomology resembling streaks on the fruit finish that follow water droplets formed by dew or rain. The streaks increase in diameter and end abruptly in a club-shaped fashion. Typically, several streaks of similar form and length are being observed on the same fruit in multiple cultivars each season and streaking incidence may range from zero to over 50%. In this presentation we discuss symptomology, probably causes, and management options of bronzing and streaking.

PLE-16
Understanding factors influencing peach fruit development and growth

Theodore M. DeJong

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I have spent the majority of my career focused on the physiology and growth of fruit trees. A central theme of that research was developing an understanding of how environmental and management practices influence fruit growth. The inverse relationship between crop load and mean fruit size on peach trees was well known. However, the dynamics of this relationship and why these relationships vary among seasons and in response to management were less well understood. Fruit growth responses can best be understood by recognizing that fruit growth involves two separate but dependent processes, fruit development and fruit growth (or expansion). Fruit development is a necessary precursor to fruit growth and creates the potential for growth. Rates of fruit development are particularly important during early stages of fruit growth when cells are dividing and differentiating to form specific tissues. Fruit development is highly dependent on heat accumulation during the early stages of growth. Development dictates fruit growth potential of a given cultivar at any given time during fruit growth via a relative growth rate (compound interest rate) function. Potential increases in fruit size during any given interval of time are dictated by relative growth rate functions but actual increases in fruit size are governed by the ability of a tree to supply the resource needs of its fruit for a given growth interval. If the resource demands of the fruit are not met, the fruit will not grow to their potential for that growth interval and that deficit in actual growth will affect all future potential growth because future growth is compounded based on the growth that is actually attained in previous growth intervals. This presentation will further elaborate on how these principles of fruit development and growth can be used to understand fruit growth responses to multiple environmental and management factors such as timing and amount of fruit thinning, seasonal differences in date of fruit maturity and fruit sizing, etc.

Oral Presentations, (OP)

Code	Presenting author - Title
OP-1	**Gregory Reighard** Field performance of peach rootstock cultivars in South Carolina
OP-2	**Livio Trainotti** Peptide hormone genes expressed during peach fruit development and ripening
OP-3	**Ksenija Gasic** Starting from scratch: 14 years of peach breeding program at Clemson University
OP-4	**Rodrigo Infante** The Chilean nectarine breeding program
OP-5	**Yolanda Gogorcena** The genomic analysis of a wide peach germplasm collection revealed a genetic relationship between European landraces and American ferals and landraces
OP-6	**Alessandro Botton** Thinning peach with a new-generation GA-based compound: shedding light on bud developmental physiology to improve treatment efficacy
OP-7	**Steven McArtney** Accede is a new thinner for stone fruit based on the naturally occurring compound 1 - aminocyclopropane carboxylic acid
OP-8	**George Pantelidis** Evaluating the effects of different mechanical flower thinners on the production cost and fruit quality characters in table and processing peach cultivars
OP-9	**Pedro Dinis Gaspar** Multitask robotic rover for agricultural activities (R2A2): A robotic platform for peach orchard
OP-10	**Gregory Lang** Designing planar peach/nectarine production systems that are adaptable to precision cropping, a range of rootstock vigor levels, and potential autonomous mechanization technologies
OP-11	**Massimiliano Virgilio** A multi-access identification key to fruit flies (Diptera, Tephritidae) of economic importance in Europe
OP-12	**Apostolos Kapranas** Biological control of Mediterranean fly *Ceratitis capitata* with entomopathogenic nematodes: from laboratory assays to field application
OP-13	**Slawomir Lux** Implications of farm structure and crop management on fruit infestation and medfly IPM

OP-14	**Marco Colacci** The status of medfly and IPM practices based on case studies in Italy
OP-15	**Eirini Anastasaki** Chemical chracterization of the volatile infestation-fingerprint of peaches by *Ceratitis capitata*, *Bactrocera zonata* and *B. dorsalis* and conversion into a detection tool (e-Nose)
OP-16	**Celia Cantin** Influence of anatomy and composition of the fruit cuticle on peach susceptibility to *Monilinia fructicola* infection
OP-17	**Carla Casals** Effect of abiotic factors on in vitro and in vivo development of *Rhizopus* spp
OP-18	**Julien Ruesch** EcoPêche 2: a multipartenarial project to conceive and evaluate innovative peach orchard management to reduce dependance to phytosanitary products
OP-19	**Guido Schnabel** Biology, epidemiology and management of diseases of peach driving the spray program in the southeastern United States
OP-20	**Emine Tanriver** Development of plants resistant to plum pox virus by intergeneric hybridization between peach and other *Prunus* species
OP-21	**Manuel Rubio** Use of almond as interstock for PPV (sharka) protection in peach
OP-22	**Maria José Aranzana** Molecular-based pedigree reconstruction of peach lines and cultivars
OP-23	**Morgane Roth** Genetic diversity in a new peach core-collection designed for resilience breeding
OP-24	**Sook Jung** Resources for peach genomics, genetics and breeding research in GDR, the genome database for Rosaceae
OP-25	**Pedro Martinez-Gomez** Whole-genome bisulfite sequencing and methylome profiling of homo- and hetero-grafted peach rootstocks uncovers a burst of DNA methylation events with potential impact on gene expression
OP-26	**Maria Jose Rubio Cabetas** Advance studies to develop biomarkers for water stresses tolerance in rootstocks
OP-27	**Juan Carlos Melgar** Rational fertilization in peach orchards: considering orchard-specific variables to improve mineral nutrition programs

OP-28	**Maria Paula Simões** Foliar nutrient status of peach orchards and sustainability
OP-29	**Luca Mazzoni** Influence of different nitrogen fertilization rate on vegetative, productive and qualitative performance of three peach cultivars
OP-30	**Davide Neri** Living mulch under the row of young peach orchard
OP-31	**Gemma Reig** Inking on Spanish peach orchards: causes and solutions
OP-32	**Florin Stanica** Dynamics of fruit branches at new peach and nectarines cultivars under Vertical Axis and Trident canopies
OP-33	**Edwige Remy** Specific chilling requirement as criteria in PSB genetic improvement activity
OP-34	**Brendon Anthony** Primary and secondary metabolism crosstalk during peach fruit quality development
OP-35	**Jesús López-Alcolea** New break dormancy spray treatments in nectarine peach (Prunus persica var. nectarina), in warm areas
OP-36	**Ioannis Minas** Large-scale orchard sensing of the genetic and horticultural impact on peach fruit quality
OP-37	**Hilary Rogers** Common and genotype-specific responses of peach cultivars to chilled storage based on transcriptomic analysis
OP-38	**María Angeles Moreno** Chilling injury in local and modern peach cultivars from a Spanish peach bank germplasm
OP-39	**Damiana Natasha Spadafora** Augmented analysis of sensorial, volatilome and gene expression data from peach cultivars during cold storage to identify markers for fruit quality
OP-40	**Allesio Allegra** Effect of *Opuntia ficus* indica mucilage edible coating on fresh-cut nectarine cv. 'Big Bang'
OP-41	**Orestis Giannopoulos** Investigating the impacts of ozone treatments on postharvest quality of peaches

OP-42	Nathalia Zaracho Construction of a NIL collection of P. davidiana into the peach genetic background
OP-43	Monica Canton Epigenetic signatures regulate flower bud endodormancy in peach
OP-44	Najla Ksouri Motif discovery within upstream regions of variable length reveals regulatory signatures in peach
OP-45	Jesús Guillamón Non-target metabolomics and expression analysis for studying the modulation endodormancy release in peach flower buds
OP-46	David Sterle Exploration of environmental and weather variables for peach floral bud cold hardiness prediction in western Colorado
OP-47	Lefkothea Karapetsi SNPs identification and association study of fruit quality genes from selected whole-genome sequenced peach varieties cultivated in Greece
OP-48	Giulio Demetrio Perulli Peach smart fertigation with wastewater: physiological and nutritional evaluation
OP-49	Francisca Carrasco-Cuello Crop load and transpiration reduction effect on fruit and leaf mineralogical content in commercial late-harvest nectarines
OP-50	Jeff Pieper The impact of size controlling rootstocks on peach fruit metabolome and internal quality in differing training systems
OP-51	Jordan Knapp-Wilson 3D Imaging and Quantitative Analysis of Adult Peach Tree Architecture via TreeQSM
OP-52	Gianmarco Bortolotti A computer vision system for in-field fruit quality evaluation: preliminary results on peach fruit
OP-53	Leonidas Kyrgiakos Assessment of input use efficiency in peach grove cultivation: a case study of Naoussa region
OP-54	Vasilis Rodovitis Population dynamics of Mediterranean fruit fly in mixed fruit orchards in Central Greece

OP-1
Field performance of peach rootstock cultivars in South Carolina

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Three peach rootstock trials were established in South Carolina between 2013 and 2017 to evaluate new rootstock cultivars for yield, resistance to Peach Tree Short Life (e.g., bacterial canker), Armillaria root rot tolerance, and tree vigor. In a high density, Y-trained trial, 'Rootpac® 40', 'Controller™ 7', 'Controller™ 8' and 'MP-29' produced the smallest trees after 5 years – 38 to 48% of Guardian®. 'Rootpac® 20' produced the most suckers. Bloom and maturity dates were advanced 2 to 3 days on 'Rootpac® 20', 'Rootpac® 40', and Guardian® compared to Lovell. Yields were highest for the vigorous rootstocks Lovell and Guardian® as well as 'Rootpac® 20'. 'Rootpac® 40' was 48% smaller than 'Rootpac® 20', which was contrary to the release descriptions. Similarly, 'Controller™ 6' was ~38% larger than 'Controller™ 7' and '8', which was unexpected. At replant sites in the South Carolina Ridge and Piedmont regions, the cultivars Rootpac® 20, 40, 70, R, and Tempropac® had tree mortalities as high as 78-100% due to bacterial canker. European interspecific hybrid rootstocks had fair to poor survival, in contrast to only a few dead trees on P. persica rootstocks. 'MP-29', considered a Peach Tree Short Life resistant rootstock, was partially susceptible to bacterial canker but resistant to Armillaria in the 9-year trials. European rootstock cultivars were not well adapted. Future research will focus on the less vigorous and better adapted 'MP-29' and 'Controller®' rootstocks for intensive orchard systems.

OP-2

Peptide hormone genes expressed during peach fruit development and ripening

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The fruit develops from modifications of the gynoecium after fertilization. In peach (Prunus persica) it is usually made up by a single seed developing from an ovule and from modifications of the carpel generating a structure called pericarp. Fruit development and ripening is essential to warrant the success of reproduction and, as both seeds and pericarps are valuable sources of food, it is also of economic interest. Peptide hormones (PHs) are involved in both short and long distance signaling. There are several gene families encoding PHs and, among those, CLAVATA 3 (CLV3) is well known for regulating floral meristem size and thus fruit size. Less is known on the role of peptide hormones belonging to families other than CLAVATA3/EMBRYO-SURROUNDING REGION (CLE) on fruit development. Even less is known on peptide hormone action during ripening but for the involvement of two ROOT GROWTH FACTOR/GOLVEN (RFG/GLV) peptides during peach ripening. Using public and in house developed omics data, we looked for genes encoding HPs of the CLE, GLV and RALF (Rapid Alkalinization Factor) families in peach. Members of the three HP families are expressed both during fruit development and ripening. For some HPs genes, the developmental and hormonal control of their transcription has been investigated in detail at early stages of fruit ripening to get insights on their contribution to the hormonal regulation of the process. Synthetic peptides designed from the natural sequences have been tested for their biological activities in order to gain insights on their functions and on their role in fruit development and ripening. These findings suggest that these peptides might be used to develop natural molecules to improve fruit quality.

OP-3

Starting from scratch: 14 years of peach breeding program at Clemson University

Ksenija Gasic

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The Clemson University peach breeding program develops high quality peach cultivars adapted to South Carolina environment by addressing key challenges such as climate changes, consumer demands and producer needs. The program is combining disease resistance to bacterial spot and brown rot with large fruit of excellent quality by searching for variability, finding new sources of desired traits, and understanding how these traits are inherited. Traditional breeding approaches are combined with marker-assisted parental and seedling selection to provide efficient way of incorporating desired characters into newly developed peach cultivars that address industry needs and consumer demands. The South Carolina peach industry is the second largest producer of fresh market peaches in the United States, after California, with more than 7,000 ha under the peach production annually valued > $80M. Most of the cultivars grown in the Southeastern US are developed in breeding programs that differ in environmental conditions, emphasizing the need for new improved cultivars suited for our conditions. Since the programs' establishment in 2008 more than 400 crosses have been performed resulting in over 30,000 hybrids planted and evaluated in field. Less than ~2% of initial hybrid seedlings are selected and moved to the advanced selection level, and about 10 were clonally propagated and planted in 7 replicated trials across southeast. Progress, accomplishments and struggles in meeting programs goals will be presented.

OP-4
The Chilean nectarine breeding program

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Chile has a long tradition in exporting nectarines to international markets. Its production goes mainly to Northern hemisphere countries, needing up to 30 days of ship journey before arriving to the final consumer. Till 2015 the only nectarines exported provided from varieties developed by foreign breeding programs, mainly Californian. In general terms, few varieties exported by Chile fitted the required phenotype, the vast majority of them after three weeks in cold storage were prone to develop flesh's internal decay. In 2000, the University of Chile initiated a breeding program aimed in creating varieties that could stand for long postharvest periods maintaining a high sensory quality, thus generating the base for a globalized market for fresh nectarines. At the same time a research program was carried out, focused in developing novel approaches for measuring the targeted traits. The objective determination of the flesh's mealiness and browning was setup through in-house created methods. The actual physiological ripeness of seedling's fruits has been determined non-destructively through the chlorophyll absorption of the skin. The fruit sensory evaluation has been determined through consumer tests and with trained panels as well. A genomic platform was developed, activating tight collaborations with other research groups, aimed to define the genetic diversity of the used germplasm and the implementation of some molecular markers associated to valuable traits. The funding of the program from 2011 to 2021 was provided by CORFO, the national agency that supports applied research. At the present, a new governance model has been built in which some selected Chilean companies are defraying the program costs. The new public-private program, is called "Winter Wonder Nectarines", highlighting its main mission: Supplying exquisite fresh nectarines in the winter time. Further, "Winter Wonder Nectarines" is dealing with the creation of modern orchards assuring more environmentally friendly fruits.

OP-5

The genomic analysis of a wide peach germplasm collection revealed a genetic relationship between European landraces and American ferals and landraces

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The advance of Next Generation Sequencing (NGS) technologies allows the implementation of high-throughput genotyping at a reasonable cost. This open the possibility to learn more about phylogenetic relationships, genetic variability, and the development of new genetic markers for breeding purposes. Previously we developed a ddRAD-seq platform for peach genotyping, in this work that method was applied for the genotyping of two peach collections: the EEA San Pedro (203 genotypes) and the EE Aula Dei (89 genotypes); as well as breeding progenies (34 genotypes of EEA San Pedro and 92 EE Aula Dei). Here we present a joint analysis of a total of 1.4x109 of paired-end (2x250bp) reads belonging to 418 genotypes (3,3M reads/genotype). A total of 687,261 SNPs were discovered and a reduced data set composed 10,076 SNP (MAF > 1% and missing data < 10%) was used in a combination of analyses (Principal Component Analysis, population structure and Phylogeny). The results showed that the ancestral germplasms differ largely from modern peach cultivars. In addition, genetic relationships between Bolivian landraces, Argentine ferals and European landraces (Spanish and Italian) were revealed suggesting a common origin which probably reflect the introduction of germplasm by the Spanish during the colonization period. These results with some outstanding traits of ancestral genotypes (fruit quality, high yield/vigour, pathogen resistance, thermal requirements, etc.) encourage the usage of this germplasm on breeding programs for the development of varieties with agricultural importance.

OP-6

Thinning peach with a new-generation GA-based compound: shedding light on bud developmental physiology to improve treatment efficacy

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Thinning peach still represents one of the most relevant challenges among the temperate fruit crops. New-generation hormone-based thinners are being released to the market, acting either directly on fruitlets or, in the case of Sevengib®, on flower induction occurring the year before bloom. Since these treatments may strongly affect return to bloom, a detailed physiological knowledge base is needed, in order to predict their efficacy in the most accurate way. Nevertheless, the development of Decision Support Systems (DSS) helping the growers to decide the most suitable time/dosage of application represents a desirable tool aimed at rationalizing the use of thinning chemicals and reduce their release to the environment. Sevengib® is a mix of GA4 and GA7 able to inhibit flower induction applied at about 60 days after full bloom in peach. Its efficacy decreases with anticipated or delayed treatments. Therefore, a specific trial was set up to shed light on the physiological background on which the efficacy of this thinner relies on. Bud samples were collected at different times of Sevengib® application and transcriptomic analyses were performed through RNAseq to identify gene expression patterns correlated with the thinner efficacy. A working model was set up including the key players affecting bud physiology and its sensitivity to the chemical. The maximum efficacy was shown to overlap with a sort of «crossroad» of bud development, where exogenous GAs can amplify flowering repression before the process is irreversibly stimulated. Within this model, FT and TFL genes, along with other key processes controlled, among the others, by ethylene and trehalose, may play a pivotal role in determining bud sensitivity to the GA-based thinning treatment.

OP-7

Accede™ is a new thinner for stone fruit based on the naturally occurring compound 1-aminocyclopropane carboxylic acid

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Stone fruit growers are largely reliant on the labor intensive and costly practice of hand thinning to reduce crop load to a commercially acceptable level. Peach growers typically hand thin fruit at the end of the cell division stage, around 30-40 days after bloom. Fruit size potential can be limited when hand thinning is used to establish crop load at such a late stage of fruit development. Accede is registered by the US EPA as a chemical thinner for stone fruits with the naturally occurring ethylene precursor 1-Aminocyclopropane carboxylic acid (ACC) as the active ingredient. ACC is rapidly converted to ethylene by ACC oxidase following application. Stone fruits such as peaches, nectarines and plums can be thinned by Accede application between the pink bud or white bud stage (BBCH 57) and petal fall (BBCH 67). Data from US field trials conducted between 2016 and 2021 will be presented to demonstrate the effects of Accede on fruit set, fruit size, and hand thinning times in replicated field studies on various peach and nectarine cultivars.

OP-8

Evaluating the effects of different mechanical flower thinners on the production cost and fruit quality characters in table and processing peach cultivars

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Nowadays the optimization of the peach cultivation procedure needs to be directed not only for improved fruit quality, productivity and adaptation to biotic and abiotic stresses, but also reduced cost. Thinning in peach trees is costly but necessary for producing marketable product and ensures adequate flowering buds for next year. Although several thinning machines are available in the market, little is known on the effects of mechanical thinning on fruit quality characters in table peach and processing peach cvs during the canning procedure and the economic benefits under the Greek local conditions. In the present study the effects of flower thinning using a hand-held thinning machine (Infaco) and a tractor mounted rotor (Darwin) on yield and fruit quality of the peach cvs 'Catherina', 'Andross', 'Fercluse', 'Everts', 'Vlg' and 'Flatreine' were studied. The application of both thinning machines substantially reduced the cost of thinning compared with control (made by hand) and there was a variation in the cost-benefit (99 to 480 euro/hectare using INFACO and 151 to 632 euros/hectare using DARWIN) resulting from differences in the number and trees/hectare and the speed of the flowering machine used in the present study. The number of total harvested fruit was similar among treatments in all cvs, apart from 'Fratreine' that mechanical thinning reduced the number of fruits produced. The studied treatments induced earliness and larger fruit sizes (increase by 39.2% and 11.6%, respectively) only in cvs 'Catherina' and 'Andross'. Nevertheless, in a peach canning industry when fruit was halved and mechanically pitted, the occurrence of pit-fragments was higher in fruit from flower thinned trees (19.9%), compared with control (7.0%) in cv 'Andross'. In conclusion, mechanical thinning, complemented with manual finishing, is valuable for reducing the peach production cost. However, the earlier thinning time may induce higher % pit-fragments during processing in a canning industry and also its application is restricted only when there is no frost danger.

OP-9

Multitask robotic rover for agricultural activities (R2A2): A robotic platform for peach orchard

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This paper describes the latest innovations in agricultural robotics, specifically for weed control, harvesting and monitoring, considering the challenges of introducing robotics in this sector, such as fruit detection, orchard navigation, task planning algorithms, or sensors optimization. One of the trends in precision agriculture is the introduction of swarm robotics, allowing collaboration between robots. Another trend is in aerial imagery acquisition for ground analysis as well as environmental reconstruction, complemented by field-mounted sensors. Although robots are becoming quite important in the evolution of agriculture, it is still unlikely that all tasks will be automated in the near future due to the complexity arisen by the overall variability of cultures. The analysis of the current state of the art allows the proposal of a robotic rover for multipurpose agricultural activities (R2A2), developed to perform particular and controlled spraying, to pick up fallen fruits and to predict fruit production in peach orchards. These tasks are performed in different period of the campaign, allowing to use the same robotic platform for different activities. The tasks performed by the robotic platform aim to help increasing productivity, by accurate fruit counting, that allows decision making concerning water requirements and the reduction of herbicide and pesticide applications. The design and construction of this platform aims to be an additional contribution for the rising of agricultural robotics.

OP-10

Designing planar peach/nectarine production systems that are adaptable to precision cropping, a range of rootstock vigor levels, and potential autonomous mechanization technologies

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The development of narrow, planar, "fruiting wall" canopy architectures has increased precocious and mature yields, fruit ripening uniformity and quality, and labor efficiency in various tree fruits, most notably apple but also sweet cherry, plum, and others that bear flowers significantly on spurs or short vegetative shoots. Peach and nectarine (Prunus persica), on the other hand, form reproductive buds primarily on lateral shoot extension growth. Also, until recently, vigor-limiting rootstocks were largely unknown for P. persica production, adding to the challenge of developing narrow planar canopies for a species having high annual vigor. We have conducted 10 years of exploratory research on potential planar peach canopy architectures, with the goal of deconstructing the canopy structure into simplified, uniform, vertically-oriented, repeatable fruiting units that improve light interception efficiency and precision in quantifying and achieving balance for leaf area and fruit number. Vertically-oriented leaders, pruned severely to a target number of lateral shoots that will bear a maximum of one fruit per shoot, utilize planar orchard space most efficiently. Summer hedging reduces excessive shoot extension growth and detrimental shade. The results from several 2nd generation experiments begun in 2017 will be presented, including evaluation of tree and individual leader vigor, yield, and fruit quality on eight rootstocks (Lovell; Rootpac 20 and 40; Controller 6, 7, and 8; Guardian; MP-29) that range in vigor from 26% to 128% that of Lovell, as well as the impact of vertical narrow leader number (1, 2, 4, 6, or 8 per tree, with proportional tree spacing), which modulated tree and individual leader vigor on Lovell up to 100%, comparable to that achieved by the diverse rootstocks. The results to date suggest that 3rd generation trials could achieve competitive yields and fruit quality with a vertical leader density of ~6,450 leaders/ha, with leader spacing at 0.62 m x 2.5 m, and number of leaders per tree (in a planar orientation, such as Upright Fruiting Offshoots training) ranging from 1 to 6 in proportion to rootstock vigor, allowing rootstocks most adaptable to localized conditions to be utilized for comparable outcomes. Such uniform, precisely structured canopy architectures have the additional advantage of facilitating future autonomous orchard technologies that utilize imaging/sensing/mapping of simplified structures, such as selective directed spray application equipment and robotic task mechanization, such as pruning and harvesting. Future research to further refine such a planar production system also will be addressed.

OP-11

A multi-access identification key to fruit flies (Diptera, Tephritidae) of economic importance in Europe

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The professional identification of adult insects necessarily relies on the use of dichotomous morphological identification keys which are generally not easily accessible or of problematic interpretation for non-specialists. The lack of readily available tools represents a major hiccup for the routine detection and monitoring of agricultural pests, for which timely and reliable identification is of major importance for pest management. Within the framework of the FF-IPM project (EU Horizon project Nr 818184), we developed an interactive multi-access (i.e. non-dichotomous) identification key for fruit flies (Diptera, Tephritidae) of economic importance in Europe. The key is available on a Lucid3 platform, in which multiple features can be chosen different steps of the identification process (multi-access). Differently from the dichotomous keys, our key allows overcoming a number of problems related to the identification of specimens with damaged or missing body parts. The key contains 51 features and 118 character states in total. Each feature, character state and species is linked to detailed illustrations and/or high-resolution pictures, facilitating its use by non-specialists. The key includes 23 target insect species separated in two groups and corresponding to the genera Bactrocera, Dacus, Zeugodacus on one hand and Ceratitis on the other. A “pre-key” is also available for the initial identification of insects belonging to these two groups. The morphological diagnosis of a species is complemented by dedicated hyperlinks with relevant information on its geographic distribution and host plant preferences. Hyperlinks to the digital images of the Virtual Collection of the Royal Museum for Central Africa, to the formal description of the species and to informal factsheets will further facilitate the species diagnosis to a larger public of users. The key is freely accessible online or downloadable for offline use through the website of the Royal Museum for Central Africa (https://fruitflykeys.africamuseum.be/). A mobile application for the key is currently being developed.

OP-12

Biological control of Mediterranean fly *Ceratitis capitata* with entomopathogenic nematodes: from laboratory assays to field application

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Mediterranean fly *Ceratitis capitata*, Medfly is an important pest of fruits, including peaches. During its life cycle, medfly passes a significant amount of time in the soil; mature larvae drop and pupate in the soil or they overwinter in fallen fruits. We explored the use of entomopathogenic nematodes (EPN) for controlling these stages of Medfly, particularly for off-season or early season control. In laboratory studies, using soil microcosms, we assessed the efficacy and residual activity of commercially available (EPNs) *Heterorhabditis bacteriophora, Steinernema carpocapsae,* and *Steinernema feltiae*. Steinernema feltiae provided the highest suppression, up to 50% because it had the highest immediate activity and long residual activity (4 weeks). Furthermore, S. feltiae, and to a lesser degree S. carpocapsae, were able to move and infect medfly larvae inside infested apples and oranges in the surface of the soil wherein EPN were applied, reducing significantly adult medfly emergence (60–78%). We furthermore examined the efficacy of these species in low and high temperatures indicative of winter and late spring season conditions (10°C vs 25°C), as well as dose regimes: low dose 1.5mi /m^2 vs moderate dose 2.5mi /m^2. Moderate dose led to higher suppression but at low temperatures, efficacy of nematode was harder to sustain. In field trials, low (1.5 mi/m^2) and high doses of (2.5 mi/m^2) of S. feltiae were applied in late March 2021 (early-season) and on October 2021 (off-season) and fly emergence was monitoredin yellow sticky traps set in field cages. A suppression of emerging Medflies by 50-65% was observed. These results suggest that an EPN application scheme where a single, relatively low dose of S. feltiae in autumn, (off season) or spring (early season), targeting overwintering medfly larvae can reducesubstantially the number of adult medflies emerging later in the growing season.

OP-13

Implications of farm structure and crop management on fruit infestation and medfly IPM

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The selection of fruit species and the cultivar phenology spectrum are largely determined by seasonal patterns of market demand and fruit prices. Similarly, the spatial arrangement of cultivars tends to be opportunistic, driven by plot availability at the time of planting new fruit trees. And commonly, fruit thinning is used to achieve premium fruit size and quality. The pest control implications of these practices are seldom carefully considered, in particular because in the case of multi-annual systems empirical evaluation of possible options and their implications is not feasible. Therefore, the in-silico approach – a stochastic simulation of medfly behaviour with the PESTonFARM model was used to assess the combined effects of farm structure, fruit phenology and fruit size management on medfly development, dispersal and fruit infestation. The simulations were based on the data collected during the case studies conducted in Italy in 2019-2021 and using model-generated hypothetical scenarios with various farm-landscapes, fruit arrangement, and fruit size management options. The simulations allowed to estimate the pest (medfly) development and fruit infestation patterns under various scenarios, and quantify the effects of the farm structure, the presence and spatial arrangement of early fruit cultivars, the continuity of seasonal fruit chain, and fruit size management practices on IPM costs and effectiveness. The collected information will be of broader relevance to other Mediterranean regions and useful in improving the application of IPM against medfly.

OP-14

The status of medfly and IPM practices based on case studies in Italy

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Mediterranean fruit fly (medfly), *Ceratitis capitata*, is considered one of the world's most destructive pest. Its economic importance is increasing due to its invasion of new geographical areas. It has high dispersive ability, large host range and tolerance of natural and cultivated habitats over a comparatively wide temperature range. In recent years, medfly is expanding its distribution in temperate areas. Global warming expects the expansion of medfly geographical distribution to higher latitudes will continue and its pest status in the areas currently with low population levels will change. Indeed, in recent years in Italy, medfly began to appear as stable populations of high densities in areas where it was not previously considered a major pest. In this contribution, the status of medfly and IPM (Integrated Pest Management) practices were investigated in two areas of central Italy; one in Molise region near Adriatic and one in Latium region. Within each site, three farms were selected. A detailed characterization of the farms and their immediate surroundings, with the identification of all fruit species and cultivars, was carried out. The following aspects were studied in 2020 and 2021: host fruit phenology; identification of medfly overwintering resources and assessment of their capacity; determining annual patterns of medfly immature stages and adults; collecting socio-economic background information. The investigation allowed to define the spatio-temporal dynamic of medfly in each farm and the key host species for overwintering; to evaluate the pest status for various fruit species and cultivars; to establish the range of pesticides and other means used for medfly control, and calculate the costs related to the implemented IPM practices, i.e., trap monitoring, mass trapping, insecticide spray application, sanitation. The information gathered under these case studies will be of broader relevance to other Mediterranean regions and useful in improving the application of IPM against medfly

OP-15

Chemical chracterization of the volatile infestation-fingerprint of peaches by *Ceratitis capitata, Bactrocera zonata* and *B. dorsalis* and conversion into a detection tool (e-Nose)

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Infestation by true fruit flies (TFF) at early stages is difficult to detect. Destructive inspection is needed for a large proportion of the inspected commodity to detect infested fruits. Therefore, there is a need for the development of rapid, reliable, and cost-effective screening methods for the detection of infestation especially due to restrictions on the trade of products by Phytosanitary legislation. In this study, the aim was to determine infestation-specific volatile compounds-indicators emitted by peaches (Prunus persica var. nucipersica) at different developmental stages by TFF, namely *Ceratitis capitata* (Wiedemann), Bactrocera dorsalis (Hendel) and B. zonata (Saunders) (Diptera: Tephritidae), to develop a rapid, reliable and cost-effective method aiming to reduce the time required for a reliable inspection and to avoid the unnecessary destructive sampling. For the collection of the volatile organic compounds (VOCs) from healthy and TFF-infested peaches the dynamic headspace sampling technique was used. VOCs were analyzed by Gas Chromatography-Mass spectrometry (GC/MS). The specific volatile profiles were further used as a training, validation and prediction set for an e-Nose system. Results showed that specific VOCs are TFF species specific for peaches. Ethyl octanoate was the main ester and γ-decalactone the main lactone. Their levels increased along with the progress of maturation and infestation. Hexanol and methyl heptanoate were only present in B. dorsalis infested peaches. Methyl hexadecanoate was found only in C. capitata infested peaches. Hexyl isovalerate, hexyl hexanoate and 2E-hexenyl hexanoate in B. zonata infested peaches. Different statistical models were developed from the results of e-Nose on detection of infestation by TFF. Models are quite promising in applying this technology toward non-destructive screening methods for detection of tephritid infestation, especially for import and export inspections.

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OP-16

Influence of anatomy and composition of the fruit cuticle on peach susceptibility to *Monilinia fructicola* infection

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Brown rot caused by the fungus *Monilinia* spp, is the disease that causes the greatest losses in stone fruits. Currently, *M. fructicola* is the main species in Spain, and clearly dominant in the Ebro Valley. The cuticle of the fruit is the first barrier of protection against external aggressions, so it can have a key role in the susceptibility to *Monilinia* infection. In this work, the variability in the fruit susceptibility to *M. fructicola* infection in a National Peach Collection at CITA (Zaragoza, Spain) and the influence of the fruit cuticle anatomy on this susceptibility have been studied. Results showed a wide variability in the susceptibility of peach cultivars to M. fructicola infection within the collection, which will allow the selection of less susceptible material for use in breeding, as well as the search for genomic zones that influence the control of the tolerance to this fungal infection. On the other hand, the results obtained from the analysis of cuticle thickness and density, indicated a slight negative correlation between cuticle thickness and susceptibility to infection, suggesting the influence of the cuticle on resistance to this disease. The study of the cuticle composition showed a clear relationship among some cuticle compounds and the susceptibility to M. fructicola infection, which indicates a potential antifungal role of these compounds present on the peach cuticle.

OP-17

Effect of abiotic factors on in vitro and in vivo development of *Rhizopus* spp

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Rhizopus spp. are one of the most important post-harvest decays in stone fruit, after brown rot caused by *Monilinia* spp. Nowadays, pre and postharvest chemical treatments used to control *Monilinia* spp. are highly efficient, but not to control Rhizopus spp. Probably due to the efficiency of treatments in controlling *Monilinia* spp., *Rhizopus* spp. have less competition and it is easier to spread out. Moreover, climate change can also contribute to the development of pathogens such as Rhizopus spp., which showed higher optimum temperature (around 30 ºC), for developing being almost 10 ºC higher than the optimum for *Monilinia* spp. Therefore, the knowledge on the behaviour of Rhizopus fungus is important to understand their development in natural conditions to control it in a more efficient way. This study aimed to determinate the effect of abiotic factors as temperature (0–35°C) and water activity (aw: 0.87-0.99) on the colony growth development of three strains of Rhizopus spp, under in vitro conditions. Experiments under in vivo conditions were also conducted to study the effect of temperature (0-30ºC) on the growth dynamics of decay and mycelium development on peaches and nectarines artificially infected by three strains of Rhizopus spp. Our In vitro results indicated that colony growth of Rhizopus strains was not observed either at 0 or 5 ºC. It is important to note that, increasing temperature from the optimum one, colony growth was decreased as water activity was increased. Our In vivo results indicated that the incidence of infected fruit was lower at 20 that at 30 ºC, but for both temperatures incidences increased with RH. In contrast, disease severity at 30º C was reduced as RH was increased. The eco-physiological information reported in this work for abiotic requirements related to Rhizopus spp. development provides baseline data, basic for the construction of new predictive model to understand and control the disease caused by Rhizopus spp. in stone fruit.

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OP-18

EcoPêche 2: a multipartenarial project to conceive and evaluate innovative peach orchard management to reduce dependance to phytosanitary products

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The EcoPêche 2 (2019-2023) project is financed by the OFB (French Biodiversity Agency) within the framework of the ECOPHYTO Plan and the DEPHY farm network. The EcoPêche 2 Project follows a previous INRAe - CTIFL co-led project, called EcoPêche 1 (2013-2018), whose aim was to reduce the Treatment Frequency Index (TFI) by 50%. The first project demonstrated that the TFI reduction of 50% could be achieved but the agronomic and techno-economic results decreased to varying degrees depending on the cultivar, the climate conditions and the pest and disease pressure. This project aims to conceive and evaluate innovative peach orchard management systems designed to reduce TFI by 80% compared to a conventional management system. Other objectives are to produce pesticide residue free fruits, using a maximum of 4 «non biocontrol» products and no herbicides. The project involves 6 partners evaluating different combinations of levers. Innovative orchard management systems are compared using a global approach, including environmental, agronomic and techno-economic performance. EcoPêche 2 network involve 6 partners: CTIFL, INRAE PSH Avignon, INRAE Gotheron, SEFRA, SUDEXPE and CENTREX. Each partner compares different lever combination to an IFP management. Many type of levers are mobilized: Cultivar choice, orchard management, weeds management on the row, biodiversity, phytosanitary protection, physical levers. First mid-term network results show that the environmental objectives can be achieved (TFI reduction compared to IFP: - 75 % in 2019 ; -84 % in 2020 and -89 % in 2021) , but involve a loss of production (-20 % of commercial yield) and, consequently, important economic losses (partial margin – 13 to -16 % depending on the year). This project highlights how complex it is to attempt to develop new orchard management systems, considering environmental issues. Another axis of research would be to explore the impact of agricultural practices on climate change.

OP-19

Biology, epidemiology and management of diseases of peach driving the spray program in the southeastern United States

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Peaches are grown in many parts of the world and in many different climates. The hot and humid climate of the southeastern United States poses many production challenges to producers and managing pests and diseases are top on the list. There are many pathogens affecting commercial peach production in the Southeast, but only two are driving the spray program needed to produce high quality fruit. They are Venturia carpophila, the causal agent of peach scab, and *Monilinia fructicola*, the causal agent of brown rot blossom blight, green fruit rot, preharvest brown rot, and postharvest brown rot. Management of these diseases requires an integrated approach involving an understanding of their biology and epidemiology, their sensitivity to fungicides, types of fungicides used, fungicide resistance prevention and management, host tissue susceptibility, and cultivar characteristics. Furthermore, increasing pressure to eliminate or reduce fungicides with unfavorable toxicity profiles and retail demand for high quality and low residue fruit poses additional challenges for producers. Using production strategies from the southeastern United States as an example, this presentation will discuss the science-based approach to peach scab and brown rot disease management and how producers cope with these challenges.

OP-20

Development of plants resistant to plum pox virus by intergeneric hybridization between peach and other Prunus species

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Sharka, caused by plum pox virus (PPV), is one of the most important disease of peach [*P. persica* (L.) Batsch] and other Prunus species. PPV has been present in Turkey since 1968 however, contamination level is restricted in some regions depending on PPV strain. PPV-D and PPV-T strains were identified mostly in residential gardens, whereas PPV-M was mostly detected in the commercial orchards. The aim of this study is to identify genotypes that might be tolerant to PPV-M and to monitor the manner in which the resistance is transmitted to hybrid descendants by intergeneric hybridization between peach and other Prunus species. The varieties (Stark Early Orange, Harcot, P. dulcis, P. davidiana and P. ferraduel) identified as having less susceptibility to the attack of PPV were used in interspecific hybridisations for the selection of hybrids to which this characteristic was transmitted. Economically important peach cultivars like J.H.Hale, Cresthaven Flored, Persicum-Tan, UFO-3, Fantasia, Persicum-ATEŞ, Pitarina-CS46, Crimson baby and some rootstocks like Garnem, GF 677 and Patrones-ARDA were used in hybridization studies. The F1 individuals grown in insect-proof screen-hous were submitted weekly to visual inspections and tested twice by DAS-ELISA and RT-PCR in one-year period. According to the all evaluation criteria, 17 individuals were selected for phenotyping studies. They have been artificially inoculated by PPV-M strain for further scoring. According to the pomological trait assessments and phenotyping analysis for the presence of PPV, most of the peach genotypes showed symptoms and were DAS-ELISA and RT-PCR positive, indicating their susceptibility to PPV. On the basis of phenotyping studies 16 peach hybrids from the hybrid families when P. davidiana and P. ferraduel were used as donors were selected for further surveys on resistance to PPV and estimation of agronomic traits under the agro-ecological conditions of Adana-Turkey.

OP-21
Use of almond as interstock for PPV (sharka) protection in peach

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Although no natural sources of resistance have been identified in peach, diverse experiments have demonstrated the possibility of inducing resistance to Plum pox virus through almond grafting. As a result of the 'Garrigues Factor', as we have called it, disease symptoms and virus accumulation progressively decrease in seedlings heavily infected with PPV-D after 'Garrigues' almond grafting. Furthermore, grafting 'Garrigues' onto 'GF305' before PPV inoculation completely prevented virus infection. Based on these previous findings, we have used 'Garrigues' as an interstock (intermediate rootstock, bridge rootstock, intermediate wood, inter-stem, etc.) as an alternative way to protect peach cultivars against PPV. This is the first time that an almond cultivar has been used as an interstock to prevent sharka infection. Thus far, we have only tested ten peach cultivars, which is a small representation of the huge catalog of Prunus persica available in the market. Our tests have included cultivars with white and yellow flesh and cling and free stones, nectarines and platycarpa peaches. The following peach cultivars were grafted: 'Maya', 'Transvalia', 'Romea', 'Catherine', 'Astoria', 'Tirrenia', 'Maruja M13', 'Levante 30', 'Alisio 15' and 'Carioca'. All were grafted onto 'Garrigues' wood that was already growing on 'GF677' and 'Garnem' rootstocks. When the plants were ready (rootstock + interstock + peach cultivar), we tried to inoculate the growing peaches with sharka at least three times, with no success so far. If the results are confirmed, we can say that we have a kind of "vaccine" for PPV on peach ready to be exploited at the commercial level.

OP-22
Molecular-based pedigree reconstruction of peach lines and cultivars

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Pedigree relationships of plant materials used for research or in commercial breeding programs of crop species are often unknown or uncertain. Nevertheless, a detailed and contrasted pedigree information is crucial to understand the genetics of simply and quantitatively inherited traits and to plan appropriate crosses for breeding new cultivars. Even though peach has been used in the last decades as a model species for Rosaceae crops, an automated and extensive pedigree reconstruction encompassing the cultivars with most historical and commercial relevance has not been created to this date. Here we present the pedigree reconstruction of peach lines and cultivars using complete genotypic data and partial historic information based on a metaheuristic approach. We also present the ongoing development of a user-friendly web application to easily access and visualize these pedigree networks. The web will be of great use for breeders and scientist to identify the genotypes that have contributed most to the genetic variation of the cultivated accessions, and to trace back donors of relevant traits, among other uses.

OP-23

Genetic diversity in a new peach core-collection designed for resilience breeding

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Understanding and harnessing crop genetic diversity is critical for a sustainable use of genetic resources. In peach, the narrow genetic basis in the cultivated pool could jeopardize future cultivar improvements but extant genetic resources can be mobilized to alleviate this issue. To this aim, populations called core-collections can be created to represent species' diversity in an optimal way. In this context, we designed a peach core-collection and aimed at validating its suitability for genetic analyses and pre-breeding. Based on pedigree information and expert knowledge, we selected a large panel of individuals among the elite and exotic peach genetic pools. Duplicates were eliminated using a 9k Illumina SNP-array, and the final set of 192 accessions was genotyped at a higher density with a 18k Illumina SNP-array. Discriminant analysis of principal components revealed the existence of three main genetic groups with moderate admixture, which is coherent with the current knowledge on peach genetic structuration. The three groups are well balanced (55, 95 and 42) and correlate with the geographical origin of accessions. Further, we found that linkage disequilibrium persists over 325kb in this population, which is shorter than the previously reported ranges and could allow for an increased preciseness in genome-wide association studies. We also report wide variations in phenology illustrating the large diversity present in the core-collection. Further, phenotyping this population in a multisite experimental design under low pesticide cover will allow us to accelerate the discovery of useful variants for resilience breeding.

OP-24

Resources for peach genomics, genetics and breeding research in GDR, the genome database for Rosaceae

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The Genome Database for Rosaceae (GDR, https://www.rosaceae.org) strives to provide a one-stop online resource that facilitates basic, translational and applied research for rosaceous crops including peach. Integrated data include curated genome sequences, genes, transcripts, genetic maps, markers, SNP array data, QTL, traits, germplasm, and publications, made accessible to browse, query and download through easy-to-use web interfaces and tools. Whole genome assembly data, along with functional annotation done by the GDR team, are available for the two versions of the reference peach genome and for 'Chinese Cling' genome through search pages, BLAST, and JBrowse. A new tool, MegaSearch, allows more powerful and flexible searches for all data types in GDR, allowing users to build datasets using various categories and customize data fields to view and download. Conserved syntenic regions across rosaceous genomes, identified using MCScanX, are accessible through the synteny viewer, allowing data transfer across species. The Breeding Information Management System (BIMS) offers a secure and comprehensive management system for breeders. In this presentation, we will highlight these new features and future development as well as provide an overview of existing resources in GDR for peach research.

OP-25

Whole-genome bisulfite sequencing and methylome profiling of homo- and hetero-grafted peach rootstocks uncovers a burst of DNA methylation events with potential impact on gene expression

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DNA methylation has been described as an efficient epigenetic regulation mechanism together with the histone post-translational modifications involved in different process in fruit trees. In addition, new sequencing technologies have enabled researchers to analyze DNA methylation in the whole genome in a single experiment. In this context, aiming to identify genomic regions with differential methylation states in response to intra and interspecific grafting in peach [Prunus persica (L.) Batsch] rootstocks, we carried out an Illumina reduced-representation genome sequencing on bisulfite-treated DNA. Bisulfite sequencing uses enzymatic digestion for reducing genome complexity and allows detection of marks to study DNA methylation. We analyzed 'GF305' peach seedlings used as rootstock for our grafting experiments with the own 'GF305' (intraspecific control grafting) and the almond cultivar 'Garrigues' (interspecific grafting). A total amount of 283,072,597 reads were obtained and mapped using the v.2 peach reference genome. The mapping rate was of 70.41% providing information about differentially methylated genic and promoter regions in the different studied comparisons and the three contexts CG, CHG and CHH. These epigenetic modifications, among this DNA methylation, represented a potential mechanism contributing to gene expression regulation. Further biological RNA-Seq experiments will contribute to correlate these DNA methylated regions with the differentially expressed genes.

OP-26

Advance studies to develop biomarkers for water stresses tolerance in rootstocks

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Global warming is altering the precipitation regimens, which lead to an increase in extreme events including drought, and waterlogging. Thus, the modern cultivation systems require rootstocks environmentally adapted, with a controlled vigor and tolerant to abiotic stress to do more sustainable orchard. To confront these challenges in peach cultivation, two different studies were conducted: (i) a physiological, biochemical and molecular characterization of the drought response in Garnem® almond × peach hybrid and Myrobalan 'P.2175' plum submitted to different water deficit periods; and (ii) a transcriptomic analysis of the response to hypoxia of Felinem® almond × peach hybrid and Myrobalan 'P.2175' plum to 24-h-root-hypoxia treatment. The drought stress experiments evidenced that water-saver strategy of Myrobalan 'P.2175' is not enough to cope with the drought stress. This genotype triggers the activation of genes involved in signaling-cascade pathways, although without continuing towards a drought-tolerant response. In contrast, Garnem®, with a water-spender strategy, initiates ABA-dependent pathways, which lead to the synthesis of osmoprotectants which allow an osmotic adjustment. Furthermore, genes directly related to WUE, namely ERF023; ERECTA; and NF-YB3, as well as Myb25-like, a repressor of PP2C phosphatase, were selected as candidate biomarkers for use in Prunus rootstock breeding programs. Likewise, we demonstrated that hypoxia-tolerant Myrobalan 'P.2175' plum represses secondary metabolism gene expression avoiding the waste of resources/energy as well as the upregulations of protein degradation genes, which led to structural adaptations conferring long-term tolerance to hypoxia. In that work, three candidate genes involved in the oxygen sensing mechanism were identified as candidate biomarkers for hypoxia-tolerant selection, ERF74/RAP2.12, ACBP1/2 and HCR1. In addition, some candidate genes involved in responses associated with the regulation of plant growth, cell wall formation or nitrogen assimilation are also presented with a differential expression in two almond × peach hybrid rootstocks Garnem® and 'GN-8' with different vigor.

OP-27

Rational fertilization in peach orchards: considering orchard-specific variables to improve mineral nutrition programs

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Over the last few years, we have collected field data from different regional orchards and locations which indicate how critical orchard-specific variables are to accomplish a balanced mineral nutrition program and to maintain orchard productivity. We believe that holistic, orchard-specific fertilization guidelines are needed to provide growers with accurate, timely, efficient, and effective crop nutrient information to maximize orchard growth, productivity, and fruit quality, while improving long-term sustainability of peach farms. In a field study where mature (six-year-old) peach trees annually received either 0.2 or 0.9 kg K/tree, the different application rates did not cause significant differences in nutrient content on aboveground organs between treatments but annual applications, even at the low rate, induced excessive K concentrations after a few years, requiring two years without K fertilization to bring the concentrations down to suggested optimum levels. Thus, local and orchard-specific variables such as historical productivity and management practices, tree characteristics, climatic patterns, and soil nutrient dynamics, should be considered when estimating tree nutrient requirements and adjusting fertilizer applications.

OP-28
Foliar nutrient status of peach orchards and sustainability

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Peach production is an important activity in the middle center of Portugal, which is the main region of stone fruit production, contributing to regional income and people fixation. This region is characterized by hot and dry summers which contribute to decreasing the incidence of some diseases such as Sphaerotheca pannosa and Wilsonomyces carpophilus. However, hot summers can actively accelerate organic matter degradation and, thus, increase the susceptibility to erosion and decrease the soil capacity to retain nutrients. To evaluate the relationship between soil characteristics and peach production, a long-term project was installed based on 25 peach orchards covering the main peach production area. Orchards were monitored since installation collecting soil samples at installation time and after 4 years. Plant development was monitored annually by the evaluation of Trunk Section Area, canopy development by image analysis using a drone to capture the images, nutrition status by foliar analysis at 100 to 120 days after blooming. Simultaneously, weed development in the row and inter-row was evaluated. The main results indicate that peach orchards are very heterogeneous since the plantation. The foliar nutrients are mainly at sufficient levels, except for potassium considering that 30% to 40% of the orchards were at an insufficient level, although the soil has a high content of potassium. Nitrogen level was above sufficient level in 15% to 20% of the orchards and 30% to 40% are at high levels but < 4%. All orchards use weed cover at inter-rows, mowed regularly. In the row, weeds are controlled using herbicides but new techniques of soil cover are being adopted to decrease the use of herbicides.

OP-29

Influence of different nitrogen fertilization rate on vegetative, productive and qualitative performance of three peach cultivars

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Peach is the most cultivated stone fruit in Italy, and in particular in the Marche Region, where this trial took place. The most important production areas are Valdaso (AP-FM), Valle del Foglia (PU) and Valle del Metauro (PU), already well known and appreciated by customer and characterized by a long production tradition. The peach productivity, as well as the nutritional and sensorial quality of the fruits, are determined by the interaction of multiple factors, such as rootstock, cultivar, training method, environmental conditions, and cultivation techniques adopted. Among them, fertilization is one of the crucial factors, and should be applied efficiently, without providing excess nutrients, that may be lost into groundwater or surface waterways (water eutrophication). The aim of this project was to evaluate vegetative, productive and qualitative parameters of peach produced in the Marche Region through the management and reduction of the nitrogen fertilization. Three peach cultivars (Slapi, Romestar and Tardibelle) were cultivated according to three different nitrogen regimes (100%, 80% and 60% of the common nitrogen amount applied by local growers) and evaluated for vegetative (shoots and fruit developments during the season), productive (total production, average fruit weight) and qualitative parameters (fruit overcolor, caliber, sugars, acids, and firmness). Results showed that nitrogen reduction did not strongly affected all the evaluated parameters, and there was a cultivar-dependent behavior in response to the reduction of the nitrogen fertilization. It was demonstrated that, improving the production technique with the correct combination of different cultivars and nitrogen fertilization, will allow to obtain good vegetative and productive performances, and fruits with high sensorial characteristics.

OP-30
Living mulch under the row of young peach orchard

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This research work focuses on living mulch between-trees under-row management that can be used to improve weeds control, yield and quality of main and of second crops eventually with a financial return. The living mulches, namely herbaceous plants with good attitude in covering the soil, play a role in making a new equilibrium with different species biodiversity, crops physiology (i.e. biomass production), yield and quality, soil fertility, and finally augmenting soil C sequestration. These agricultural practices enhance environmental sustainability, soil structure, composition and biodiversity with an increase of organic matter and microbial activity and consequent improvement of root functioning, with a reduction of erosion and mitigation of temperatures and maintain of humidity. In orchards vegetal cover is nowadays common in the inter-row, but the soil along the trees rows is kept bare most of the times using tillage or herbicides. The objective of this work carried out under the financial support of operational group PRO-PLAT (PSR Marche) was to evaluate living mulch in a peach orchard starting from the trees planting. Different species were tested: Trifolium repens L. (dwarf clover), Mentha x piperita L., Fragaria vesca L. compared to chopping of spontaneous weeds. Living mulch has proved to be effective in covering soil in the first year, with clover and mint as the most efficient species to contain undesired spontaneous weeds. Peach trees growth resulted similar in all the treatments without significant reduction due to competition with living mulch. The living mulch in the first year has been hence proven to be a promising technique. Living mulches showed their capability for establishing and maintain a "good degree of biodiversity" and take advantage of all the environmental benefits associate to it. Three main effects of living mulch on the agro-ecosystem can be expected: weed control, fertilization and provision of additional income when the cover crop has also character of cash crop. It could be recommended to the farmers to start testing the use of living mulches in small areas, to verify their adaptation to local conditions, and then to extend the practice to larger superficies.

OP-31
Inking on Spanish peach orchards: causes and solutions

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Inking has become a frequent skin disorder on peach fruit orchards over the last decade in different production areas of the Ebro Valley, the main peach area production of Spain. It is characterized as discolored brown-and-black spots in the skin. Although inking affects only the fruit's cosmetic appearance, the disorder causes economic losses to the peach industry because blemished fruit are not marketable. According to the literature, abrasion is one of the major precursors of inking, which release phenolic pigments (anthocyanin, chlorogenic acid, etc.) located in the skin cells allowing the reaction of these pigments with metal contaminants (iron, aluminum, etc.). However, we hypothesize that cultivar, different practices on orchard and harvest management, climatic conditions, fruit quality, and maturity stage could also be important factors in inking development on peaches, and therefore, in inking susceptibility (incidence and severity). These factors were evaluated over three seasons (2019-2021). There were differences among cultivars, although the incidence and severity differed among years. However, it was interesting to find out that some cultivars showed the same trend over the years. Grower orchard management also influenced the inking incidence for the same cultivar grown. Other factors such as irrigation dose, harvest method, harvest time, number of harvests and maturity stage had also some influence in inking development. Further experimental data are needed to better understand how these factors all together may help to reduce or increase this skin disorder, since there is still no knowledge to eradicate it.

OP-32

Dynamics of fruit branches at new peach and nectarines cultivars under Vertical Axis and Trident canopies

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The planting system and canopy is an important source of variation for the growth rate, density of annual branches, and tree productivity. This study presents the research results from the 2018 – 2021 period, regarding the dynamics of fruit branches as number, length, and total growth at 15 peach and 16 nectarine new cultivars in the Bucharest area, under Vertical Axis and Trident canopies. The trees were planted in 2017 in the Experimental Field of the Faculty of Horticulture in Bucharest, and an integrated cultivation technology applied. For each cultivar, the annual fruit branches were analysed. Specific results were analyzed regarding the proleptic and sylleptic shoots, which were distinctive for each cultivar. The study compared the evolution of vegetative growth according to Vertical Axis and Trident canopy, influenced by cultivar, in a four-year dynamic correlated to climatic factors. The obtained results showed significant differences between the two canopies.

OP-33

Specific chilling requirement as criteria in PSB genetic improvement activity

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During the last years all over the world, particularly in Europe the climate change affects directly the agriculture sector, including experimental plots and growers orchards. Global warming might induce in plants through direct or indirect changes in dormancy, that means affect the chilling requirement in fruit tree. The expected cold decrease in winter, could threaten the viability of some tree crops and varieties in areas where they are currently grown. On the other hand, these areas allow to study varieties with lower chilling requirement. PSB research and development program study and observe the impact of climate change, focused on chilling accumulation, to be use it as criteria in the selection activity to improve itself. For this purpose, PSB among the several ways to calculate chilling hours, choose mainly two of them: Utah model and Weinberger method (Richardson et al. 1974, Weinberger et al. 1950). The study of chilling need on PSB varieties is carried out both with the Weinberger method and with the Utah model. The data used are collected in different meteorological stations located in Murcia region. The 4 reference stations where the data are mostly collected belong to 4 different Municipalities. Three of them are characterized by a temperate climate, where our production and experimentation orchards are located: Mula, Alhama de Murcia and Librilla. Although the experimental field named Campotejar, Molina del Segura (characterized by warmer climatic conditions) with lower amount of cold hours, it is used to test varieties with lower chilling requirement. During the research we observed that when occur a lower amount of chilling hours during winter, that effect the plant physiology which encounter the orchard productivity at risk. The research and data analysis, allow us to better understand the specific behavior in different climate conditions, and consent us select and suggest the appropriate variety.

OP-34

Primary and secondary metabolism crosstalk during peach fruit quality development

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Preharvest factors, such as crop load (i.e., carbon supply) and canopy position (i.e., light availability) heavily influence peach fruit growth, development, maturation time and harvest quality. Few studies have investigated how these preharvest factors affect the metabolome, especially without the confounding variable of maturity. Recent experiments were conducted to better understand the direct impact of carbon supply and light availability on fruit quality development and the primary/secondary metabolism. Fruit of equal maturity from two distinct carbon supply treatments (C-sufficient vs. C-starved), and fruit from two distinct canopy positions (top vs. bottom), were assessed for their primary/secondary metabolite profiles through non-targeted gas/liquid chromatography mass-spectrometry. In distinct canopy light environments, quality was superior in the top/exposed fruit, when compared to the bottom/shaded fruit, while minimal differences in the mesocarp's primary metabolome were detected between treatments at harvest. In contrast, primary and secondary metabolites were widely distinct in the exocarp of fruit originating from variable canopy positions. In the crop load study, quality differences were minimal early in development, while primary metabolites were highly distinct between carbon supply (C-supply) treatments, priming the phenotypic differences present at harvest. Minimal differences in the primary metabolome were detected at harvest between C-supply treatments, while several differences remained in the secondary metabolome. Although, the majority and severity of the differences between C-supply treatments in the secondary metabolome were greatest early in development, like the primary metabolism, and characterized by up-accumulations of phenylpropanoids. Metabolic signatures of optimal growth conditions (e.g., sufficient C-supply, sun-exposure) and high fruit quality include: sorbitol, sucrose and flavonoids like, catechin, while signatures of inferior quality/conditions include: monosaccharides, amino acids and citric acid. These preharvest factor studies demonstrate distinct responses of the primary and secondary metabolomes in peach mesocarp and exocarp, with connections to fruit quality development found in the shikimate pathway (primary metabolism) and phenylpropanoid pathway (secondary metabolism).

OP-35

New break dormancy spray treatments in nectarine peach (*Prunus persica* var. nectarina), in warm areas

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In the last decades peach culture in warm areas presents adaptation problems due to the climate change effects. Among others, the main issues are the lack of homogeneity in the flowering, pistil abortion, difficulty for vegetative bud development and the drop of flower buds or premature fruits. All these problems are consequence of the non-satisfaction of the chill requirements of the cultivars that had been plant in these areas during along the time. To combat this issue, different chemical treatments for the compensation of not fulfilled chill requirements are have been applied in stone fruits. CEBAS-CSIC has developed a new formulation that was compared with other comercial biostimulant products. This new formulation is known as 'Bloom-Tech®Spray'. In this work, dormancy breakers were applied to nectarine peach cultivar 'Garcima' grafted on 'GF-677' rootstock. The work consisted on five groups of treated trees and a control group in which phenology, bud drop, vegetation intensity and production were compared. The products used were 'Erger + Activ Erger', 'Broston + Nitroactive (1 and 2 application)' and 'Bloom-Tech®Spray (1 and 2 application)'. The application time for the products was when the 60% of the chill requirements of the cultivar had been satisfied. For the measurement of chill accumulation, the Chill Portions model was used. Treatment T5 (Bloom-Tech®Spray in 2 application) stimulated a greater number of flower buds and also produced a more synchronized flowering. In addition, it also produced a significant increase of yield compared with the two products applied. Treatment T3 (Broston in 2 application) showed the earliest flowering but caused a significant drop of flower buds that reduced yield compared to control T0.

OP-36

Large-scale orchard sensing of the genetic and horticultural impact on peach fruit quality

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Improvement of peach quality at harvest for subsequent consumer satisfaction, is achievable through fine tuning of preharvest and orchard factors. Cultivar and rootstock genotype as well as horticultural factors such as crop load management, fruit position in the canopy and training system are important preharvest factors to balance yield, quality, and maturation in peach. However, few studies have addressed how preharvest factors impact quality on fruit of equal maturity. Robust and cultivar-specific multivariate visible (Vis)/near infrared spectroscopy (NIRS) prediction models to non-destructively assess peach internal quality (dry matter content, DMC; soluble solids concentration, SSC) and maturity (index of absorbance difference, IAD) with a single scan were used to determine the direct impact of various genetic and preharvest horticultural factors on peach internal quality. Large-scale field evaluation showed that heavier crop loads reduced peach quality and delayed maturation, upper canopy position advanced both, while extensive tree vigor as affected by cultivar, rootstock or training system might be detrimental for peach internal quality. Manipulating tree canopy size by using dwarfing rootstocks or by using training systems that efficiently diffuse vigor can significantly impact peach fruit quality. Overall, while canopy position and rootstock effects in light environments may facilitate specific regulations in peach fruit quality development, vigor diffusing training systems may play a more significant role in achieving balanced vegetative/reproductive outcomes that lead to optimal yields and quality through altered tree physiology.

OP-37

Common and genotype-specific responses of peach cultivars to chilled storage based on transcriptomic analysis

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Both peaches and nectarines are highly valued fruit but deteriorate rapidly at room temperature. Prolonged chilled storage, needed in the supply chain, can result in chilling injury (CI). This physiological disorder is characterised by changes to the texture, colour and aroma of the fruit. Ethylene signalling plays an important role in CI-associated internal browning and changes in texture have been associated with cell wall modulating enzymes. Nectarines are generally more resistant to CI than peaches, although the effect of chilling is cultivar-dependent. To better understand how CI may be regulated at a transcriptional level, transcriptomes of one peach ('Sagittaria') and one nectarine ('Big Top') cultivar were analysed at five timepoints through a 14-day period of chilled storage at 1˚ C and after an acclimatization phase of 22 °C for 36 h. This treatment did not induce symptoms of CI, which at this temperature do not normally develop until about 3 weeks of storage. To identify potential regulators and early changes in downstream CI-related genes, patterns of expression were divided into "monotone up-regulated", "monotone down-regulated" and transiently either up or down-regulated. Overall, differentially expressed genes (DEGs) increased with storage in both cultivars, although more DEGs were found in cv. Big Top, and expression changed earlier, perhaps linked to the greater resilience of nectarines. Expression of ethylene response factor (ERF) genes correlated closely with expression of genes related to CI development such as cell wall and membrane modulating genes and defence genes. Some of these genes which are activated well before physiological signs of CI may be useful markers to predict CI development during storage.

OP-38

Chilling injury in local and modern peach cultivars from a Spanish peach bank germplasm

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Peaches and nectarines are climacteric fruits with a relatively short storage potential due to rapid ripening and senescence, excessive softening and deterioration. Cold storage is effective in extending shelf-life, and preserving fruit quality properties; however, it can lead to the development of a disorder known as chilling injury (CI), perceived when fruit reaches consumer. Principal phenotypic expressions of CI in peach include mealiness, graininess, flesh browning, loss of flavor, and red pigmentation (bleeding). In the present work, 79 local and 81 foreign cultivars from the peach Germplasm collection established at the Experimental Station of Aula Dei (Zaragoza, Spain) were evaluated over 2 years after storage of fruit at 5ºC (CI inducing conditions) for 2 and 4 weeks. Given the large influence of pre-harvest factors on postharvest performance of peaches, it is necessary to accurately phenotype cultivars at harvest and furthermore during postharvest. Consequently, harvest and postharvest phenotype information was obtained. Basic fruit quality parameters as solid soluble content (SSC), firmness (N), total acidity (TA), and ripening index (SSC/TA) were determined. Similarly, biochemical compounds such as total phenolics content (TPC), flavonoids (TFC), vitamin C (Ascorbic acid - AsA) and relative antioxidant capacity (RAC) were also obtained. In addition, the enzymatic activities of phenylalanine lyase-ammonia (PAL), polyphenol oxidase (PPO) and peroxidase (POX) were determined to correlate with CI symptoms. Thus, phenotyping and biochemical analysis were used to evaluate a large peach collection of 160 accessions and understand stress physiology related with chilling injury disorders. Statistical analyses emphasized differences between the assayed cultivars and highlighted their origin and genetic background as main factors affecting metabolite profiles and susceptibility to chilling injury during cold storage.

OP-39

Augmented analysis of sensorial, volatilome and gene expression data from peach cultivars during cold storage to identify markers for fruit quality

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Peach (*Prunus persica* (L. Batsch) produces high quality but perishable fruit appreciated for their distinctive aroma, and other organoleptic qualities including sweetness, colour, and texture which vary across different cultivars. Peaches are produced commercially in warmer temperate regions such as Southern Europe, and frequently exported to Northern Europe. Due to the long travel distances and complex supply chains peach fruit are transported cold to delay ripening and spoilage. However long periods of cold storage can result in chilling injury and loss of quality. Our understanding of how cold storage affects quality across different varieties can be explored through different approaches. Here effects were assessed in one peach ('Sagittaria') and one nectarine cultivar ('Big Top') through volatilome fingerprinting combined with gene expression profiling. For analysis of the volatile organic compounds (VOCs) contributing to the volatilome, we applied two-dimensional gas chromatography (GC×GC) combined with time-of-flight mass spectrometry (TOF-MS), as well as sensorial analysis. RNA-sequencing was applied to identify differentially expressed genes (DEGs) during post-harvest storage focusing on genes associated with VOCs. Peach fruits were analysed at harvest and during 14 days of cold storage at 1°C. Different numbers of VOCs were identified in the two cultivars: of 159 from 'Sagittaria', and 89 from 'Big Top' fruit. Canonical Analysis of Principal coordinates (or CAP) was able to discriminate amongst VOC profiles from the two cultivars and across post-harvest storage time points. A multitrait analysis of sensory, VOC and gene expression data supported the analysis based only on VOCs showing correlations between the expression profiles of VOC-related genes and VOC abundance. These data are of potential use to peach breeders for improving cold storage resilience in relation to sensory changes, and could form the basis for markers of use in assessing fruit quality through the supply chain.

OP-40

Effect of *Opuntia ficus* indica mucilage edible coating on fresh-cut nectarine cv. 'Big Bang'

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The mucilage obtained from cladodes of cactus pear (Opuntia ficus-indica) is interesting for the production of natural edible coatings to improve the shelf life of fruits. Edible coatings may be used to extend the shelf life of fresh-cut products by controlling physiological disorders. The aim of this study was to evaluate the effect of mucilage edible coating extracted from cladode of Opuntia ficus-indica (OFI) on the quality nectarine slices, cv. 'Big Bang'. After cutting nectarine slices were dipped in different solutions: 1 (MC) distilled water, mucilage, glycerol; 2) (TW) distilled water, mucilage, glycerol; 3) distilled water as control (CTR) and were stored for 3, 5, 7 and 12 days at 5 °C and 95% RH, in polyethylene terephthalate (PET) packages under passive atmosphere conditions. At each storage period, colour, weight loss, visual quality score, carotenoid contents and the microbiological characteristics were measured together with CO2 and O2 content in the packages. The results show that TW treatment showed a significant higher carotenoid contents and a lower weight loss than CTR and MC treatments, until 7 d of shelf life. Moreover, TW treatment showed significant difference on bacteria contents than other treatments.

OP-41

Investigating the impacts of ozone treatments on postharvest quality of peaches

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Ozone can be used as an alternative for disinfection of packing line, process water and surface disinfection of fresh produce or in storage rooms. It can be used as a brief prestorage or storage treatment in air or water, or as a continuous or intermittent atmosphere throughout the postharvest storage period. Ozone can inactivate microorganisms effectively without the use of conventional chemical sanitizers leaving no chemical residues. Produce sanitation ensures food safety and extends the postharvest shelf-life of the product. While ozone treatments in both aqueous and gaseous forms have been used successfully in other commodities, their effects on peach quality have not been fully identified. The most common water sanitation method for fresh-market peaches is the addition of sodium hypochlorite (NaOCL) in the flume or hydrocooling water. A novel technology called High-Oxygen Water (HOW) has risen as an alternative sanitation system which is based on the generation of stable nanobubbles of oxygen in water that can be coupled with ozone. The suspended solution has the property to reduce microorganism loads and could serve as an effective sanitation treatment for peaches during hydrocooling without the generation of chemical residues. Ozone application can also be performed after precooling, during cold storage using an ozone generator which converts oxygen into ozone through a corona discharge mechanism. Our team is evaluating the potential benefits of various forms of ozone application before and during the peach postharvest storage. We are determining the effects of ozone on peach quality, shelf-life extension, decay incidence as well as on food pathogen elimination compared to standard industry practices. Peaches stored at 1.5°C and 90% relative humidity (RH) for 7, 14, 21, and 28 days plus 2 days of ambient temperature storage when postharvest quality traits were assessed. The potential of ozone to substitute or enhance the existing postharvest practices was investigated and the results provide valuable information regarding the efficacy of ozone to the peach industry.

OP-42

Construction of a NIL collection of P. davidiana into the peach genetic background

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MAI is a breeding strategy used to increase the genetic variability of a species by introgressing new traits from closely related compatible species in a short period of time. The proof of concept of the MAI strategy has been recently described using a cross between peach and almond. This led to the identification of several almond genes with a potential use in peach breeding programs. In this study, MAI was applied in interespecific crosses between peach and P. davidiana. Two BC1 populations (NT1Ba and NT1Ca), derived from a cross between the peach cultivar 'Nectatop' and two P. persica x P. davidiana hybrids ('Cadaman' and 'Barrier'), have been developed and are under analysis. Both populations have been genotyped and individuals having a low number of introgressions of P. davidiana covering the whole P. davidiana genome were selected. These individuals have been backcrossed again to 'Nectatop' and this BC2 progenies were or are being selected using a new '96.96 Genotyping IFC' Fluidigm SNP array developed from the resequencing data of the parental lines. In one population, 32 prILs (pre introgression lines; lines with 2-4 introgressed fragments) covering practically the entire genome of P. davidiana have been selected. In this population, a new Powdery Mildew resistance gene was mapped. For the other population, NT2Ca, the crosses have been done and next year a prILs collection will be selected. These populations have been phenotyped for phenology, fruit quality, leaf morphology and resistance traits to identify useful genes from P. davidiana. QTL analysis identified several genomic regions involved in the genetic control of leaf shape, maturity date and bitter flesh taste, among others. These materials will be useful for the identification of new alleles of interest for its use in peach breeding programs.

OP-43
Epigenetic signatures regulate flower bud endodormancy in peach

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Perennial deciduous fruit trees have evolved adaptive mechanisms, such as bud dormancy, to survive critical environmental conditions. Tree buds enter in a dormant state during which visible growth is limited mainly by environmental and genetic factors. After the exposure to low temperature and fulfillment of chilling requirements, mild temperatures promote the release from bud dormancy and growth reactivation. In peach flower buds, an insufficient chilling exposure may lead to the abortion of the reproductive whorls, to low bud burst and non-uniform blooming, with a negative impact on fruit set and quality. Indeed, the selection of cultivars with low chilling requirements is a breeding priority, mainly for milder regions where peach floral buds do not always satisfy their chilling requirement. During the chilling period, the reproductive whorls differentiate very slowly in the dormant flower bud, but the most important developmental events (female gametophyte differentiation pollen formation and maturation) occur at the end of the chilling period. In this work, we focused our attention on peach flower bud development during winter. To understand how bud development progression is regulated we integrate the methylome and chromatin genome-wide data with transcriptional outputs to obtain a complete picture of the main regulatory pathways involved in flower bud dormancy. Until now, a group of six tandemly repeated transcription factors of the MADS-box gene family, named DORMANCY ASSOCIATED MADS-box genes (DAM 1-6) were identified in the peach genome as the major regulators of the dormancy progression. However, we observed that the DAM genes are expressed in all the whorls of flower bud and their transcriptional regulation at the chromatin level is not consistent with a major role in dormancy progression. Indeed, our results highlight the importance of chromatin signature in the regulation of the hormonal balance and chilling adaptation on reproductive whorls differentiation and gamete formation.

OP-44

Motif discovery within upstream regions of variable length reveals regulatory signatures in peach

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Unraveling the mechanisms that regulate gene expression is a complex challenge in biology. A key step to decipher the regulatory machinery is to identify cis-regulatory elements buried in non-coding DNA sequences. Cis elements are short stretches of DNA that serve as binding sites for transcription factors (TFs) and are frequently summarized as sequence motifs or logos. Although much attention has been paid to model species like Arabidopsis thaliana, little is known about regulatory motifs in other plants. Here, we describe a bottom-up approach for de novo motif discovery using peach as an example. These predictions require pre-computed gene clusters grouped by their expression similarity. Proximal promoter regions were defined as four different intervals: Up 1: [−1,500 bp, +200 bp], Up 2: [−500 bp, +200 bp], Up 3: [−500 bp, 0 bp] and Up 4 [0 bp, +200 bp]. Two algorithms from RSAT::Plants (http://plants.rsat.eu) were tested (oligo and dyad analysis). Overall, 18 out of 45 co-expressed modules were enriched in motifs typical of well-known TF families (bHLH, bZip, BZR, CAMTA, DOF, E2FE, AP2-ERF, Myb-like, NAC, TCP, and WRKY) and a few uncharacterized motifs. Our results indicate that small modules size and promoter window of [−500 bp, +200 bp] relative to the transcription start site (TSS) maximize the number of motifs found and reduce low-complexity signals in peach. Spatial distribution of the inferred motifs was unbalanced showing a bell-shaped distribution around the TSS. This approach was benchmarked by testing two different expression-based clustering algorithms (network-based and hierarchical) and, as control, genes grouped for harboring ChIPseq peaks of the same Arabidopsis TF. This works yields a comprehensive collection of Prunus persica motifs without prior knowledge and provides a pipeline that can be applied to other species. A Docker software container is released to facilitate the reproduction of these analyses.

OP-45

Non-target metabolomics and expression analysis for studying the modulation endodormancy release in peach flower buds

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During winter, Prunus species, like peach, enter into a protector state, which allow them to survive the adverse conditions. This state is known as endodormancy and it starts in the early autumn, finishing after the accumulation of a certain quantity of chill. These chill requirements are specific of each cultivar and they must be fulfilled for a proper flowering and harvest. In the last decades, climate change is causing more frequent warm winters, where chilling is not properly accumulated. Thus, in mild-winter areas, different agrochemicals are applied to high-chilling requirement cultivars to counteract the lack of chilling. In this work, we treated, in three different years, the Carioca peach cultivar (intermediate chilling requirements) with the three following combination of agrochemicals: Syncron® + Nitroactive®, Broston® + Nitroactive® and Erger® + ActiveErger®. To study the effects of these agrochemicals in endodormancy release, we performed a non-target metabolomic analysis using an UPLC-QToF (Ultraperformance liquid chromatography – quadrupole time of flight). Parallel to this study, an expression analysis of the genes implicated in endodormancy release was also performed. These analyses showed significant variations in some metabolites and genes related with several metabolic pathways, such as the biosynthesis of phenylpropanoids and the biosynthesis of ABA. We hope that our results in peach, the reference Prunus species, will help in the understanding of the endodormancy release process not only in these species, but also in other perennial plants.

OP-46

Exploration of environmental and weather variables for peach floral bud cold hardiness prediction in western Colorado

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Cold damage to reproductive tissue is the greatest limiting factor for peach production in the intermountain west. A greater understanding of the environmental variables which influence cold hardiness is necessary to be able to reliably predict the current level of cold hardiness. In this study, cold hardiness of 'Redhaven,' 'Sierra Rich,' 'Suncrest,' and 'Cresthaven' was measured in large scale using differential thermal analysis (DTA) for a four-year span from 2016-2020. Hardiness data was analyzed along with climate data to determine which variables were significant drivers of cold hardiness throughout different stages of dormancy. Maximum, minimum, and mean temperature data were found to be strongly correlated with lethal temperature data (LT50) for at least four subsequent days. To better account for the extent to which the previous four days' temperatures impacted hardiness, aggregated temperature variables made of the average of the previous maximum (Tmax, 1-4), minimum (Tmin, 1-4) and mean (TAvg, 1-4) temperatures were also tested and found to have strong correlations. Seasonal progression variables such as photoperiod length, day of year, chill hours (0-7.2oC), dynamic chill portions, and growing degree days (base temperatures 0, 5, and 7oC) were also tested to determine the effects of each at different phases of dormancy. The correlation coefficients between Tmax,1-4, Tmin,1-4, Tavg,1-4 and LT50were 0.67, 0.85 and 0.84 respectively prior to 700 chill hours (nominal endodormancy barrier), and 0.59, 0.45, and 0.70 after 700 chill hours. Post-chill correlations between LT50 and growing degree days with base thresholds of 0, 5 and 7oC were 0.90, 0.82 and 0.74 respectively. These data shed light on the specific relationships between peach cold hardiness and weather conditions in western Colorado towards developing dynamic thermal and weather cold hardiness prediction models.

OP-47

SNPs identification and association study of fruit quality genes from selected whole-genome sequenced peach varieties cultivated in Greece

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In Greece, the cultivation of peach is one of the largest, with table peaches covering a 40% and industrial peaches covering a 60%. Therefore, performing next generation sequence technologies can prove valuable in evaluating present cultivated peach varieties and develop new varieties with consumer approving fruit quality traits. Whole genome sequencing was performed on selected peach varieties (Romea, Virgil, Catherina, Fergold, Crimson Lady, Rubirich, Rebus 028, Early Top) and a local variety called Lemonato. These varieties were selected according to their differences in specific fruit quality traits, such as slow melting flesh, stone adhesion and hardness, fruit color (skin and flesh), fruit size, along with maturity date and fruit productivity. Sequencing was performed using Illumina Nextseq 500/550 platform, with Nextera DNA Flex indexes, resulting in 150 million reads/variety with an average GC of 38.5%. Quality control was performed with Trim-galore and contigs were aligned using Bowtie2 to the Prunus persica reference genome (Prunus persica Whole Genome Assembly v2.0 & Annotation v2.1 (v2.0.a1)) released January 15, 2015. SAMtools/BCFtools were used for SNPs detection and filtering. In general, SNPs positions agreed with the known main genes. The number of SNPs associated with each of these genes and the number of useful SNPs for marker-assisted selection varied accordingly. The aim of this study is the identification of SNPs associated with genes that control important fruit quality characteristics and the development of molecular markers linked to these traits. The molecular markers could further be utilized in peach breeding programs for selecting individuals with favorable traits.

OP-48

Peach smart fertigation with wastewater: physiological and nutritional evaluation

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Wastewater is becoming a real need to support freshwater resources for irrigating and fertigating fruit tree crops. A considerable amount of essential mineral nutrients (e.g., nitrogen, phosphorus) is indeed available in this alterative water source. The aim of this research was to determine the effect of secondary treated wastewater, supplied with a smart online fertigation system, on physiological and nutritional plant performances. The study was performed outdoors in an urban wastewater treatment plant on 3-year-old bearing peach trees grown in 60 L pots. Two irrigation treatments with the same fertigation plan were compared: fresh water (FF) and secondary treated wastewater (SF). The smart fertigation aimed to balance the same inputs of macronutrients (nitrogen, phosphorous, potassium), between the two treatments, based on the constant monitoring of water quality and on water volume supplied with irrigation. During the season, FF received only synthetic fertilizers, while, for SF, synthetic fertilizers were supplied only when needed to compensate the difference with FF. Similar physiological performances were achieved between the two treatments. No particular differences were observed on tree yield and fruit quality parameters. These results, also in light of the new EU Regulation 2020/741 for water reuse in agriculture, are encouraging for the future adoption of wastewater sources in open field conditions, thus allowing both water and synthetic fertilizer savings.

OP-49

Crop load and transpiration reduction effect on fruit and leaf mineralogical content in commercial late-harvest nectarines

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Fruit mineralogical content, and consequently fruit quality and storability, is affected by environmental and orchard factors such as crop load or transpiration. These crucial parameters for postharvest conservation could be improved by preharvest orchard management. For this study, the effect of fruit crop load and transpiration reduction on mineral content in fruit and leaf was evaluated, as well as on dry matter content, in the late-harvest nectarine 'Nectagala'. Tree thinning treatments were applied to obtain different crop loads: non-thinning, commercial thinning and overthinning (half of the commercial thinning). Half of the trees were treated with abscisic acid for two months before harvest, at ~10-day interval, to achieve a constant transpiration reduction. Fruit mineralogical analyses were performed in different fruit maturity stages to understand the progress of fruit mineralogical accumulation and dry matter content under those treatments, as well as leaf mineralogical content. The fruit thinning treatment applied in this work had no significant effect on fruit and leaf mineralogical content in late-harvest commercial nectarines. On the other hand, the reduction of transpiration by abscisic acid applications significantly decreased the mineralogical content in fruit (Ca, K, Mg and P) and leaf (Ca) as well as the dry matter content in fruit.

OP-50

The impact of size controlling rootstocks on peach fruit metabolome and internal quality in differing training systems

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Inadequate light penetration throughout the tree canopy can negatively influence fruit quality and manipulate metabolic profiles. Light availability can be influenced by both rootstock vigor as well as canopy architecture. The internal quality and metabolic profiles of fruit from two cultivars ('Red Haven' and 'Cresthaven'), two training systems (open vase and perpendicular V), and 13 rootstocks of various size controlling profiles were compared in two separate harvests. At harvest, fruit from 1.5 m in the canopy were segregated by physiological maturity (index of absorbance difference, IAD), and analyzed, non-destructively, for dry matter content (DMC, %) and soluble solids concentration (SSC, %) using a handheld visual to near-infrared spectrometer (Vis-NIRS) that has been accurately calibrated in Minas Lab. Pre-harvest photosynthetic active radiation (PAR) (i.e., canopy zone light availability) at 1.5 m was determined for each rootstock. Fruit mesocarp tissue from each rootstock was lyophilized and the metabolic profiles were analyzed through gas chromatography mass-spectrometry. Across both training systems and cultivars, fruit from the most size controlling rootstocks showed elevated DMC and SSC due to increased canopy zone light availability when compared to more vigorous rootstocks. Yield (kg/tree) and fruit count increased significantly with increasing tree vigor (TCSA) and light interception levels. While, DMC and SSC increased significantly with increasing canopy zone light availability and decreasing tree vigor, potentially due to reduced intra-tree shading and better light distribution within the canopy. Metabolite profiles exhibited trends of clustering by rootstock vigor and light availability. These outcomes show that while rootstock genotype, vigor, training system and cultivar influence peach fruit quality, the impact of light availability plays a more significant role in shifting metabolite profiles and achieving optimal fruit quality parameters.

OP-51

3D Imaging and quantitative analysis of adult peach tree architecture via TreeQSM

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Peach tree morphology and vigor has seen renewed interest since development of new semi-dwarfing rootstocks. Even so, fruit quality, yield, and disease resistance remain the primary traits of interest in most fruit breeding programs. As such, canopy morphology and tree architecture remain relatively untapped areas of improvement. This is not without reason however, as these traits are considered challenging to study and phenotype because of their inherent complexity and quantitative nature. While challenging, devising methodologies that can quantify canopy morphology and tree architecture would greatly aid in alleviating agronomic burdens felt by growers. Better characterizing tree architecture would allow for easier identification of superior cultivars/genotypes that would innately require less pruning and/or training. This in turn would optimize resource utilization. To accomplish this, large amounts of branching data will be required to sufficiently study and quantify tree architecture. Traditional means of collecting branching data however are difficult. Most traditional methods are destructive and require manual counting/recording. Manually collecting branching data is labor-intensive, repetitive, and prone to human error. A more modern and novel approach to collecting this data is via 3D terrestrial laser scanning (TLS) technology, such as terrestrial LiDAR (tLiDAR). 3D tLiDAR scanners can generate point clouds of scanned trees that can be virtually modelled. Running multiple iterations of these modelling simulations should yield the necessary branching data to begin better characterizing tree architecture. Our goal was to test these 3D reconstructive models and assess their overall fit when compared to our scanned data. The field data, alongside the general fit of these models, provided clarity as to the reliability of the quantitative data recovered from our 3D scans/reconstructions. As a result, further studies into architecture and morphology will be made demonstrably more feasible with the provided methods.

OP-52

A computer vision system for in-field fruit quality evaluation: preliminary results on peach fruit

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In Italy, peaches are paid according to size, color and good appearance (i.e., no external damage). Having information related to these parameters directly at harvest could support growers and fruit chain in improving fruit quality for consumers as well as to increase remuneration for growers. In this study, a computer vision system was developed which aims to quantify and size peach fruit in bins in the field, during harvest. Two different depth cameras (Intel RealsenseD435i and D455) and two different light conditions (natural and artificial) were tested, to assess potential problems (e.g. interference from natural lightning in identifying fruit in the images) and to evaluate the best system set-up for future developments. While fruit identification appears less problematic, the system has largely overestimated fruit size in all the conditions tested. The D435i camera with artificial lighting obtained the best results with a RMSE of 16.7 mm, compared to the reference fruit diameter. The results obtained are however positive and suggest solutions to improve the system. Future work will focus on improving the system for sizing, color estimation (color intensity and % of blushed fruit) and georeferentiation of data directly in the field. The idea is to develop a low-cost plugin for harvesting platforms that can support growers, and the peach chain, to start connecting all post-harvest operations to pre-harvest conditions, and to fruit quality at time of harvest.

OP-53

Assessment of input use efficiency in peach grove cultivation: a case study of Naoussa region

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This study assesses input use efficiency in peach cultivation in table and canned varieties. In order to achieve the evaluation of peach orchards, a three-part questionnaire was distributed to a sample of 111 peach producers in the greater area of the municipality of Naousa, Imathia (Greece). More specifically, the questionnaire was collecting information about socio-economic characteristics of the interviewed farmers (gender, income, age, number of children), total inputs used (tree density, fertilizers, pesticides, diesel, irrigation, mechanical equipment, labor) and total output (production), referring to the growing season 2019-2020. Data Envelopment Analysis (DEA) was performed to measure input use efficiency of each farmer based on the best performers of the region, indicating amelioration points for those who achieve lower efficiency scores. Between the two given options of a) inputs minimization or b) output maximization, an input-oriented approach was selected for reducing production cost and improve environmental protection through reduced use of agrochemicals. Both Constant Returns to Scale (CRS) and Variable return to Scale (VRS) models have been used for computing technical and scale efficiency. Results indicate that the average efficiency score is 0.812, meaning that peach producers can achieve the same production by using 19% less inputs. It should be highlighted that there was a great difference between canned (N=43) and table (N=68) varieties, recording mean efficiency scores of 0.929 and 0.717 accordingly. Concluding, peach production is strongly connected with Naousa region, thus input use efficiency should be constantly monitored for achieving the maximum output with the least used resources, promoting quality and eco-friendly peaches produced at the lowest possible cost.

OP-54

Population dynamics of Mediterranean fruit fly in mixed fruit orchards in Central Greece

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The Mediterranean fruit fly (medfly), *Ceratitis capitata* (Diptera: Tephritidae) is a notorious, invasive, and extremely polyphagous pest of the fruit industry worldwide. Medfly infests more than 350 different hosts, including stone fruits (peaches, nectarines, apricots, plums) and pome fruits (apples, pears, quinces). Monitoring population dynamics of this pest in areas at risk for economic damage is of paramount importance for designing and applying effective, profitable, integrated and environmentally sound management. In the frameworks of the Horizon 2020 funded project FF-IPM "In-silico boosted, pest prevention and off-season focused IPM against new and emerging fruit flies" we studied the phenology and seasonal biology of adult medflies in the coastal area of Lechonia, Central Pelion, Magnesia, Greece. The climate of the area is characterized by wet- warm summers, and rather warm temperate winters without freezing events and it is considered friendly for population development and growth of the Mediterranean fruit fly. A total of 22 Decis and 15 Jackson traps were established in three mixed fruit orchards in autumn 2019, and being serviced at weekly intervals until autumn 2021, with captured adults recorded and removed from the traps. Two of the orchards follow an organic management approach while the third one is conventionally managed. The pilot orchards were characterized by mixed cultivation (generally citrus, apples, peaches, plums, pears, figs, quinces and apricots), thus medfly's hosts were perpetually available. Fruit samples were also collected from all potential hosts to estimate infestation rates during both seasons, as far as phenology and damage are concerned. The first adult captures were reported in both years in May. Peak capture rates were observed in July and October, respectively, while zero captures were recorded in January and February. The highest rates of fruit infestation were recorded in apricots, figs, peaches, and citrus (mandarins, oranges, bitter oranges). Overall, our data depict the details of the seasonal biology of medfly populations in areas with abundance of different hosts throughout the growing season. The results of our study are expected to set the stage for developing spatial adjusted, farm tailored decision-making models towards achieving sound Integrated Pest Management (IPM) to address medfly in mixed fruit orchards.

Poster Presentations, (PP)

Code	Presenting author - Title
PP-1	**Lamis Chalak** Peach saplings as a main element of the Lebanese fruit crops
PP-2	**Dragan Milatovic** Morphological characterisation of peach pollen grains using scanning electron microscopy
PP-3	**Dragan Nikolic** Variability and heritability of flower traits, flowering and fruit set in promising peach hybrids
PP-4	**Dragan Milatovic** Characteristics of one-year-old shoots of peach hybrids from the crossing combination `Flaminia´ × `Autumnglo´
PP-5	**Maria Gladysheva-Azgari** *De novo* assembly and annotation of mitochondrial genome of Prunus persica cv. 'Sovetskiy'
PP-6	**Metka Hudina** Long-term performance of the peach cultivar 'Redhaven' grafted on eleven rootstocks
PP-7	**Luca Dondini** Molecular and phenotypic characterization of a bud mutation delaying maturity date in peach
PP-8	**María Angeles Moreno** The influence of rootstocks in 'Big Top' nectarine concerning chilling injury symptoms
PP-9	**Corina Gavat** Studies regarding the flat peach and nectarine cultivars from the Research Station for Fruit Growing in Constanta
PP-10	**Luca Mazzoni** Sensorial and nutritional characterization of eighteen peach cultivars cultivated in the Mid-Adriatic area
PP-11	**Daniela Giovannini** Evaluation of suitability of peach cultivars and selections for fresh-cut industry
PP-12	**Lefkothea Karapetsi** Identification, morphological and genetic characterization of peach genetic resources in different areas of Greece
PP-13	**Pedro Jose Martinez Garcia** Genome-wide association study of interesting traits in peach using two Spanish peach germplasm collections

PP-14	Chunxian Chen Inheritance of the rough skin trait in peach
PP-15	Chunxian Chen Retrospection of some century-long peach chill, yield and other production data for breeding prospects
PP-16	Pedro Martinez-Gomez Hight-throughput sequencing of small RNAs evidenced the role of different plant viruses in the activation of RNA silencing-related genes and the induced resistance to plum pox virus (sharka) in peach by `Garrigues´ almond grafting
PP-17	Morgane Roth Phenotyping peach orchards with increased accuracy and throughput: perspectives of digital phenotyping
PP-18	Najla Ksouri ddRAD-seq variant calling in peach and the effect of removing PCR duplicates
PP-19	Jorge Mas Gómez Genetic diversity along peach genome in Spanish germplasm collections
PP-20	Corina Gavat The nectarine assortment created in Romania
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PP-1
Structure of peach nursery trees in Lebanon

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Peach represent an important element of the Lebanese agricultural production system with a cultivated area of 3,560 ha and an annual production of 31,905 tons. Information about saplings is not yet available in the country. In this study, we present the first report on the peach saplings status, of whether they are locally produced or imported to Lebanon and the resulting impact on the diversity of the Lebanese fruit germplasm. The work was mainly based on an exhaustive desk analysis of the registers of the Ministry of Agriculture over 2012-2014. Data recorded indicated an estimated yearly average of 50,788 registered imported saplings representing 3.5% of the total imported samplings of fruit tree crop species. For locally produced saplings, peach had a yearly average of 152,789 saplings, making peach the second fruit crop after apple with produced quantities higher than those imported. At the germplasm diversity level, saplings of 125 varieties are regularly registered of which 31 varieties constituted the major share (72%). Among these varieties, six are strictly locally produced (Armking, Caldisi, Laure, O'Henry, Springtime, Venus), 16 are strictly imported (Royal glory, Platicarpa, Nucipersica 'Big Top', Red elegent, Jade¸ Crimson lady, Rich lady, Italia, Crimson baby, Bigbang, Big Sunshine, Monsat, Rome star, Rain run and Ordiga), two are traditional varieties (Mokhmali and Kozbari), while eight varieties are both imported and locally produced (Red heaven, Maycrest, Springcrest, Fayette, Dixired, Red top, independence and Suncrest). These varieties are all high yielded and mostly divided between low pulp peach, white pulp peach and yellow nectarine. These data certainly reflect the high diversity of the Lebanese peach germplasm and indicate the potential of this prosperous fruit crop in the country.

PP-2

Morphological characterization of peach pollen grains using scanning electron microscopy

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Morphology and ultrastructure of pollen grains were studied in five peach and six nectarine cultivars using scanning electron microscopy (SEM). The following characteristics were examined in dried pollen grains: length of polar axis (P), length of equatorial axis (E), P/E ratio, length of the colpus, width of the mesocolpium, and exine characteristics (number of ridges per a 100 μm^{-2} of surface area, width of a ridge, and width of a furrow). All studied cultivars had isopolar, radially symmetric and tricolpate pollen grains, which had been classified as large in size. Length of polar axis ranged from 60.9 μm in 'Royal Glory' to 64.7 μm in 'Orion', and length of equatorial axis from 30.7 μm in 'Springbelle' to 32.4 μm in 'Maria Lucia' and 'Orion'. Pollen shape was identified as prolate in seven cultivars, and as perpolate in four cultivars. All studied cultivars had striate exine ornamentation. Number of ridges per 100 μm-2 of the exine surface area was the lowest in cultivar 'Caldesi 2000' (21.0), and the largest in cultivar 'Flavorcrest' (25.3). Ridge and furrow width varied in a range of 0.29-0.38 μm and 0.26-0.33 μm, respectively. Nectarine cultivars had lower density of ridges, as well as larger ridge and furrow width compared with peach cultivars. SEM examination indicated that some pollen morphological characteristics such as size, shape, and exine ornamentation can potentially be used in the identification of peach and nectarine cultivars.

PP-3

Variability and heritability of flower traits, flowering and fruit set in promising peach hybrids

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In eleven promising peach hybrids obtained from crossing 'Flaminia' × 'Autumnglo', the flower traits, flowering and fruit set were studied during a two-year period. Significant differences among the hybrids were found, except for petal shape index. Regarding flowering and fruit set, significant differences among hybrids were found only for the abundance of flowering and initial fruit set. The highest diameter of flower (5.0 cm), length of petals (2.4 cm) and width of petals (2.1 cm) were found in hybrid FA11. Petal shape index was the highest in hybrid FA6 (1.16) and length of pistil in hybrid FA4 (1.5 cm). Start of flowering ranged from March 29 to March 31, full flowering from March 31 to April 3, and end of flowering from April 7 to April 14. The highest abundance of flowering was found in FA2 hybrid (5.0), and the lowest in FA5 hybrid (2.0). The initial fruit set ranged from 55.5% (hybrid FA4) to 85.2% (hybrid FA8), and the final fruit set from 22.8% (hybrid FA11) to 42.0% (hybrid FA5). The lowest values of coefficient of variation were found for start of flowering (2.3%), full flowering (2.4%) and petal shape index (2.6%), while the highest values were found for end of flowering (14.3%), final fruit set (17.6%) and abundance of flowering (21.1%). The values of the heritability coefficient were the highest for diameter of flower (93.1%), width of petals (90.0%) and length of petals (88.3%). For other traits, coefficient ranged from 9.1% (length of pistil) to 67.4% (abundance of flowering).

PP-4

Characteristics of one-year-old shoots of peach hybrids from the crossing combination `Flaminia´ × `Autumnglo´

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During a two-year period, the characteristics of one-year-old shoots in eleven promising peach hybrids obtained from the 'Flaminia' × 'Autumnglo' crossing combination were studied. Length and diameter of shoot, length of internode, number of flower buds and vegetative buds per shoot, ratio of flower to vegetative buds, number of flower buds per node and 1-m length of a shoot were determined. Most of these characteristics varied significantly between the studied hybrids. The highest variability was found for number of flower buds per 1-m length of a shoot and length of internode, and the smallest for diameter of shoots. The length of shoot varied from 35.1 cm (hybrid FA1) to 51.3 cm (hybrid FA6). The length of internode was consistent with the length of shoot. The highest number of flower buds per shoot and node was found in FA10 hybrid (36.0 and 1.52, respectively), and the lowest in FA5 hybrid (20.3 and 0.79, respectively). The number of flower buds per 1 m length varied from 57.1 (hybrid FA5) to 96.7 (hybrid FA1). Hybrids with the highest density of flower buds (FA1, FA9, and FA10) were singled out as potentially the most yielding. These hybrids may be of interest for growing in areas where there is a risk of frost and in breeding when creating new peach cultivars of high yield potential.

PP-5

De novo assembly and annotation of mitochondrial genome of *Prunus persica* cv. 'Sovetskiy'

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The study of the genetics of fruit crops is necessary for understanding their properties and further successful breeding and genomic editing. Peach (Prunus persica) is one of the fruit crops that is considered to be well studied genetically. For P. persica cv. 'Lovell', a high-quality reference assembly of the nuclear genome has already been presented, and the sequences of chloroplast genomes of various cultivars have been published. However, there is no information in international databases on the mitochondrial genomes of peaches, despite the importance of mitochondrial DNA products for metabolic processes. In this work, we present the complete assembly of the mitochondrial genome of P. persica cv. 'Sovetskiy'. DNA was isolated from young leaves by a modified phenol-chloroform extraction method with CTAB-buffer and used to prepare libraries for further sequencing using Oxford Nanopore technology. For the de novo assembly, long readings obtained on the GridION Oxford Nanopore sequencer were used. Using long reads, genomic contigs were assembled using the de novo assembler Canu. All circular contigs were analyzed using the BLAST program using other plant mitochondrial genomes as references. The obtained mitochondrial DNA sequence of the peach cultivar is necessary for further research in the field of comparative genomics and genomic editing of organelle DNA. Data on the variability of mitochondrial DNA will help in understanding metabolic processes in the organs of fruit crops.

PP-6

Long-term performance of the peach cultivar 'Redhaven' grafted on eleven rootstocks

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Peaches are the third most important deciduous tree fruit in the world and have a long history. Peach trees are usually formed from a combination of scion and rootstock, so a good union between scion and rootstock is required. Rootstocks of different genetic origin have an influence on vigour, yield, phenology and fruit quality of peach trees. The influence of different rootstocks for peach on vigour, productivity and fruit quality was investigated in the Fruit growing centre Bilje near Nova Gorica in 7 consecutive years. The cultivar 'Redhaven' was grafted on different rootstocks: 'GF 677', peach seedling, 'Monegro', 'Barrier', 'Cadaman', 'Adesoto', 'Mrs 2/5', 'Julior', 'Isthara', 'Penta' and 'Tetra'. The rootstock had a significant effect on the individual tree circumferences, crown volume, number of fruits per tree, yield per tree and per hectare, yield efficiency and also on fruit quality (fruit size, soluble solids content and firmness). The vigorous trees were on virgin and replant soils on rootstocks 'Monegro' and 'GF 677'. Under replanting conditions, rootstocks 'Isthara' and for virgin soil peach seedling, 'GF 677' and 'Isthara' showed the greatest potential.

PP-7

Molecular and phenotypic characterization of a bud mutation delaying maturity date in peach

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Maturity date (MD) represents a key trait in peach given the relatively short shelf-life of fruit and one of the main goals of the peach breeding programmes worldwide. The recent literature reports the presence of a major QTL linked to the trait in LG4 not only in peach but also in related species such as apricot and plum. A NAC candidate gene has been described as the best candidate gene for the control of this trait. Several years ago, a bud mutation causing a significant delay in the maturity date was identified in a tree of the nectarine cultivar 'Caldesi 2000'. A progeny segregating for maturity date and slow ripening, obtained by the self-pollination of this mutated genotype, is being characterized at the phenotypic and molecular level. This information will offer the opportunity to shed light on the trait segregation and to identify new candidate genes involved in ripening.

PP-8

The influence of rootstocks in 'Big Top' nectarine concerning chilling injury symptoms

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Nectarines and peaches are climacteric fruits that ripen and deteriorate quickly after harvest. To increase shelf life, cold storage is the most common method applied. Nevertheless, chilling injury (CI) symptoms, including mealiness, browning and leathering, limit the storage life. The present work aims to characterize the influence of different Prunus rootstocks budded with the 'Big Top' nectarine cultivar, with special interest on CI disorders. Among the twelve rootstocks used in this study, peach-almond hybrids, plum-almond hybrids, hexaploid plums and plum x peach-almond hybrids are included, some of them under process of selection. Trees were established at the Experimental Station of Aula Dei (Zaragoza, Spain) and evaluated over two years at harvest and after 2 and 4 weeks of storage at 5ºC. It is well known the influence of Prunus rootstocks with different genetic background on agronomical characteristics and biochemical fruit compounds, such as sugars and antioxidants. However, the effect of peach rootstocks on the postharvest quality has hardly been explored. Agronomical basic fruit quality traits as firmness, soluble solids content (SSC) and titratable acidity (TA) were determined both at harvest and postharvest to have more accurate phenotyping information. Similarly, biochemical compounds as main individual sugars and organic acids, total phenolic content (TPC), total flavonoids content (TFC), relative antioxidant capacity (RAC), vitamin C and anthocyanins content were also quantified. In addition, total protein content (TPC) and activity of enzymes such as phenylalanine ammonia lyase (PAL), polyphenol oxidase (PPO), peroxidase (POX) and catalase (CAT) were determined. Expression of related genes was also studied. Statistical analysis allowed to find differences between rootstocks and improve knowledge about stress physiology caused during cold storage. Results may be helpful to develop scion-rootstocks graft-combinations with lower CI susceptibility.

PP-9

Studies regarding the flat peach and nectarine cultivars from the Research Station for Fruit Growing in Constanta

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Flat peaches and nectarines are appreciated fruit for their nourishing and therapeutically qualities, both in Romania and abroad. The peach is a species with good adaptation and it grows in south eastern part of Romania and there were made effort to create valuable native cultivars. The aims were to obtain new peach, pavie, and nectarine cultivars with high qualities of fruit; big and constant productivity of trees; different habits of trees; various ripening time, etc. In the last 25th years very good results had: MONICA, FILIP and FLORIN-peach cultivars; IUSTIN- clingstone varieties; CREOLA and MARINA- nectarine cultivars.

PP-10

Sensorial and nutritional characterization of eighteen peach cultivars cultivated in the Mid-Adriatic area

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Peach results to be the species with the highest number of new varieties licensed on the market. The genetic improvement of peach is focusing on multiple productive and qualitative aspects, even if the very high availability of cultivars with very different characteristics tends to confuse the producer when choosing the cultivar for a new orchard. The types available on the market are the traditional peaches and nectarines. The characteristics that are generally searched by the consumer are the firmness of the pulp, the color of the skin and pulp, the sweetness and acidity and their balance. Genetic improvement in recent years has focused a lot on reducing titratable acidity, favoring the taste of the consumer who is increasingly appreciating cultivars with sub-acid flavor fruits. Furthermore, interest in nutritional and antioxidant properties is increasingly growing. The aim of this study is to evaluate the varietal collection present in a farm located in the Mid-Adriatic area, in the Marche region (Italy), in order to determine which of the cultivars is best performing for the area and presents fruits with the most interesting characteristics. The trial was carried out in 2020-2021 years, and were involved a total of 18 different cultivars (comprising both peaches and nectarines). To evaluate the fruit quality, both sensorial (overcolor, caliber, firmness, sugar and acid content) and nutritional parameters (total antioxidant capacity, total polyphenols and total anthocyanins) were considered. The obtained results underline the differences among the different analyzed cultivars, evidencing that the available genotypes can satisfy the sensorial and nutritional expectations of many consumer classes. At the same time, these results are essential for the company to understand which cultivar offers the aimed characteristics, for a better planning of a new orchard.

PP-11
Evaluation of suitability of peach cultivars and selections for fresh-cut industry

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Peaches can be minimally processed to successfully produce ready-to-eat fresh-cuts fruit. Cutting operations induce wounding stress, which may accelerate the qualitative deterioration processes including water loss and oxidative browning, thus limiting the shelf-life of fresh-cut produce. The aim of this work was to study the suitability to fresh-cut industry of 27 peach and nectarine genotypes (24 advanced selections of CREA peach breeding programs and 3 cultivars) with different flesh color and textural typologies. Their suitability to be processed as fresh-cut product was then investigated based on their browning potential, non-enzymatic antioxidant system, and polyphenol oxidase activity (PPO) after processing. All selected genotypes displayed significant variability in total soluble solids and titratable acidity, as well as in their non-enzymatic antioxidant system. The preliminary results demonstrated that browning index was influenced by flesh colour, the white-fleshed fruits generally displaying the highest colour changes and browning index as compared to the yellow-fleshed and the red-fleshed ones. However, due to the significant variability within the white- and yellow-fleshed groups, genotypes with a surface browning index as low as that found in the red-fleshed genotypes were also identified. The method adopted in this work seems to allow efficient screening of the breeding material most suitable for fresh-cut industry.

PP-12
Identification, morphological and genetic characterization of peach genetic resources in different areas of Greece

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It is well known that local fruit tree cultivars are essential raw material for breeding because they contain a unique set of genes that ensure adaptability and productivity, however little is known on the peach local cultivars/accessions in Greece. With the aim to explore the peach local genetic resources, expeditions were made in the mainland of Imathia and Magnesia and the islands Andros, Ikaria, Kythira, Lesvos and Samos. The peach local accessions identified were morphologically and genetically characterized and results were compared with foreign peach cvs with long history of cultivation in Greece. Eighteen peach local accessions were identified in Imathia and the studied islands. Moreover, 9 promising selections of 'Lemonato peach', being a local white flesh cv with long history, were isolated in Magnesia. Fruit and leaf morphological characterization was done in situ using 13 and 32 qualitative morpho-physiological descriptors, respectively, following the protocol of the Community Plant Variety Office. The genetic variability of the studied cultivars/ accessions was studied using Inter Simple Sequence Repeat (ISSR). The resulted DNA profiles were scored as present (1) or absent (0) and further analysis was done using GenAlEx 6.5, including genetic distance matrices, Analysis of Molecular Variance and Principal Coordinates Analysis. Results are discussed in the frame of distinguishing accessions with promising pomological characters as well as establishing the genetic distance matrix where peach accessions were clustered into groups.

PP-13

Genome-wide association study of interesting traits in peach using two Spanish peach germplasm collections

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Deep genetic characterization of large peach germplasm collections using new genomic tools can provide useful Single Nucleotide Polymorphisms (SNPs) for their use in breeding. In the current study, the two Spanish Peach Germplasm Collections placed in the Agrifood Research and Technology Centre of Aragon (CITA) and in the Experimental Station of Aula Dei (EEAD)-CSIC were genotyped using the new peach SNP chip (9+9K). Genome-Wide Association Study was carried out and 34 SNP-trait association were identified with the type of gland leaf (TLG), fruit hairiness (FH), and fruit texture (FT). The impact of these 34 significant SNPs was detected by SnpEff. Affected genes encoded several important proteins such as ankyrine repeat domain (ANK) protein (Prupe_7G125700), MADS-box gene protein (Prupe_5G208500) with high similarity with GhMADS11 and AGL8 (AGAMOUS-LIKE 8), and associated to fiber cell elongation, and COBRA-LIKE 4 protein (Prupe_5G208100). Our results showed new candidate genes whose role may have influence in the studied traits.

PP-14

Inheritance of the rough skin trait in peach

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Pubescence in peach (*Prunus persica*) fruit is controlled by the g locus, with the homozygous recessive alleles (*gg*) resulting in the glabrous-skinned nectarine while the heterozygous or homozygous dominant alleles (*GG* or *Gg*) producing the hairy peach. Differing from normal peaches and nectarines that have long or no trichomes (hairs) on their fruit, respectively, accessions with the rough skin character have short epidermal stubs visible under a microscope, but which is rough to the touch and appears dull compared to that of hairy peach or shiny nectarine. A pleiotropic effect is lack of hairs on the dormant leaf and flower buds, making them noticeably shiny to the naked eye, unlike normal peaches and nectarines. The rough skin character appeared in 3 of 70 seedlings from the cross of 'Pekin' × 'Durbin'. The remaining seedlings all produced normal peaches. Selfed seedlings of 'Pekin' and 'Durbin' have not expressed the recessive form of the gene. Possibly a limb of the 'Pekin' tree (now gone) used for the crosses had mutated to the recessive form at one or both loci. The origin of the mutation is unclear. The homozygous rough skin progeny would have then been inadvertent self-pollinations rather than hybrids, since none of them segregated for nectarine. Sibling F2 progenies segregated for peach and nectarine, and in one case, for rough skin as well, indicating the cross was valid. Results from numerous crosses and F2 populations indicate this trait, designated as "roughskin", is controlled by a single recessive gene, which is hereby designated *rs*. Nectarines homozygous for this gene (i.e., *ggrsrs*) have glabrous buds, but otherwise appear as normal nectarines. Possible use of the rough skin trait in breeding was discussed.

PP-15

Retrospection of some century-long peach chill, yield and other production data for breeding prospects

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Peach (Prunus persica) production is complicated. Seasonal yield depends on the performance of a sequence of many cultivars with the cooperation of favorable climatic conditions. Peach chilling requirements, in terms of cumulative chill hours, must be satisfied during winter dormancy to ensure timely bud break and maximize potential yield. In this report, some century-long peach chill, yield, and other production datasets from Byron, GA and the U.S. were analyzed to show the trends and relationships among those factors, as they relate to breeding prospects for peaches. Chill hours at Byron, GA, varied greatly year by year, but the averages of every three, five, and ten years all showed a declining trend. Viewed by months, the smallest to largest declining slopes in turn were October, November, December, January, and February, suggesting declines in the last two months contributed most to the declining annual chill hours. Annual chill hours over the last century approximated a normal distribution using 100-hour bands ranging between 500 and 1700 chill hours, with a mean of 1044. Years with chill hours below 700, 700-899, 900-1299, 1300-1499, and above 1500 accounted for 3.2%, 21.3%, 62.3%, 9.8%, and 3.2% of the total years, respectively. It appeared that chill hours in the higher ranges occurred more in the earlier 5 decades (average 1087 hours) than the more recent 5 decades (959). Peach production yields both in GA and the U.S. changed from year to year and also steadily declined over the past century. The significantly lowest yields occurred mostly in years with spring freeze and/or chill inadequacy. However, both farm values and price per ton increased steadily over time, suggesting that increasing prices might sustain similar market values and profits with smaller yields. The potential use of the data and results in determining future peach cultivar breeding objectives was discussed. Improvement of genetic traits with resilience to unfavorable weather conditions is likely among the priorities to offset or minimize the negative impact on peach yield.

PP-16

Hight-throughput sequencing of small RNAs evidenced the role of different plant viruses in the activation of RNA silencing-related genes and the induced resistance to plum pox virus (sharka) in peach by `Garrigues´ almond grafting

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Plum pox virus (PPV) causes the serious sharka disease in Prunus trees. Peach trees are severely affected by PPV and no definitive source of genetic resistance has been identified at this moment. Previous results showed that PPV-resistant 'Garrigues' almond was able to transfer its resistance to 'GF305' peach through grafting, preventing these trees from PPV infection and reducing symptomatology and viral load in PPV-infected plants. Recent work tried to identify genes responsible for this effect by studying mRNA expression through RNAseq data in peach and almond plants, before and after grafting, and before and after PPV infection. In our work, we used the same peach and almond samples, but focused the high-throughput analyses on small RNAs (sRNAs) expression. We studied massive sequencing data and found an interesting pattern of sRNAs overexpression linked to antiviral defense genes that suggested activation of these genes followed by downregulation to basal levels. We also discovered that 'Garrigues' almond plants were infected by different plant viruses that were transferred to peach plants. The large amounts of viral sRNAs found in grafted peaches indicated a strong RNA silencing antiviral response and led us to postulate that these plant viruses could be collaborating by cross-protection in the observed 'Garrigues' effect.

PP-17

Phenotyping peach orchards with increased accuracy and throughput: perspectives of digital phenotyping

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Phenotyping genetic resources extensively and accurately has the potential to boost cultivar improvement but current methods remain low throughput and error-prone. In fruit tree breeding such as in peach, most measures are visual and difficult to replicate, and some tree features such as tree vigor and health status remain difficult to harness. With the digitalization of agriculture, new tools are becoming available which can address this gap and need to be seized by breeders. A promising method is to extract traits from images by combining the use of Red-Green-Blue (RGB) information with powerful machine learning algorithms. Here, we propose to test this dual approach in peach orchards using unmanned aerial vehicle and a phenotyping pole equipped with a RGB camera to first set-up a large image databank. Images of whole trees are currently collected in a peach core-collection planted in two sites over the vegetative phase and visual scoring of phenology and disease occurrence is completed in parallel. In a second step images are being pre-processed and will be further used for direct trait estimation (e.g. plant height, volume) or further annotation (e.g. disease symptoms). Deep learning algorithms will be run on annotated pictures to estimate target traits and the preciseness of the method for trait prediction will be assessed via cross-validations. This work pioneers the use of digital phenotyping for the evaluation of peach genetic resources. We expect in the future to develop an integrative methodology which can be easily transferred to peach breeders.

PP-18
ddRAD-seq variant calling in peach and the effect of removing PCR duplicates

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Double digest RAD-seq (ddRAD-seq) is a flexible and cost-effective strategy that has emerged as one of the most popular genotyping approaches in plants. It relies on combining two restriction enzymes for library preparation followed by PCR amplification of the template molecules. However, PCR introduces sequence duplicates and may erroneously inflate the confidence of genotype calls at a particular site. Although the process of variant calling is relatively straightforward, it is time-consuming, involving multiple steps. Thus, removing any unneeded steps would reduce the computation time and simplify the analysis. Hence, the primary aim of this study is to evaluate the necessity of PCR duplicates and their effects on SNP and indel calling in peach. On the other hand, the accuracy of genetic variant identification in plants is a crucial step towards understanding phenotypical traits and monitoring breeding programs. However, false positive calls are a common issue that could hamper the detection of relevant variants. Thereby, a good combination of computational tools for alignment and variant calling is crucial to tackle these artifacts. In response to this challenge, three variant callers (GATK-HaplotypeCaller, BCFtools-mpileup and Freebayes) were combined on top of the BWA-mem read mapper. Variants derived from the intersection of these callers are selected as a high confidence set and flagged for subsequent analysis. The pipeline is documented and available as a set of Makefiles that can be adapted to any species. This work provides useful guidelines and a reproducible workflow for variant detection using ddRAD-seq data.

PP-19
Genetic diversity along peach genome in Spanish germplasm collections

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Artificial selection performed by growers and breeders had influence in the genetic variability of different regions of the peach genome depending on their aims. Here, the two Spanish Peach Germplasm Collections placed in the Agrifood Research and Technology Centre of Aragon (CITA) and in the Experimental Station of Aula Dei (EEAD)-CSIC were genotyped using the new peach SNP chip (9+9K) to study the genetic diversity along the genome. Diversity analyses were carried out in the studied collections detecting low diversity regions in chromosomes 1, 2, 5, 7 and 8. Moreover, Spanish peach cultivars showed a lower diversity in chromosome 4 in comparison with the whole set. Our results identified some affected regions which previous studies associated with phenological and fruit quality traits. The phenotyping of quality traits of both collections, which is being performed, will be able to provide more precise knowledge about the role of such regions in interest traits.

PP-20
The nectarine assortment created in Romania

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The nectarine tree (Prunus persica var. nucipersica), a spontaneous mutation of the peach tree has special taste properties, specific appearance and flavor, being highly appreciated by consumers. Its cultivation is lucrative, as the selling price of nectarines on the local market is similar to that of peaches. In Romania, nectarine varieties have been created over the past 20 years based on the requirements of fruit producers and market demands with the following characteristics: standard or semi-dwarf habitus, round or flat fruit shape and white or yellow pulp color, for fresh consumption or for industry, resistant to handling and transport, etc. Eight cultivars were released and are now propagated in fruit tree nurseries: 'Costin', 'Mihaela', 'Tina', 'Creola', 'Liana', 'Marina'; 'Valerica' and 'Anemona' (brugnone cvs.). The paper describes the main characteristics of the varieties and presents data on fruit production obtained between 2017 and 2020. In the climatic conditions of the south-eastern part of the country, the fruit ripening period is between the first decade of June ('Costin') and the second decade of August ('Valerica'). Fruit productions between 25 kg and 40 kg per tree were recorded in the studied varieties. The quality of the nectarine varieties is superior, the pulp of the fruit is fine and juicy, and they have a high dry matter content of 12.3-15% and a total acidity of 0.60-0.82 %.

PP-21

Novel breeding strategies for tackling present and future challenges in *Prunus* species

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The CRISPR-Cas9 technology has revolutionized plant breeding by allowing the surgical introduction of specific mutations into the plant genomes, thus enabling the selection of plants in which only the trait of interest is modified, and no foreign DNA is integrated in their genome. In the present work, CRISPR-Cas9-based genome editing is being used in Prunus species to address major agronomic aspects: i) the introduction of resistance to the Plum Pox Virus (Sharka); ii) the enhancement of light interception efficiency and the facilitation of agronomic operations through the modification of plant architecture and iii) fastening breeding procedures and production through the reduction of the juvenile phase. For the recessive resistance to Sharka disease, single guide RNAs were designed for the knock-out of the host susceptibility gene eIFiso4E, known to be involved in Prunus in the host-virus interaction: two sgRNAs were designed on exon 1 and exon 3, respectively, and were individually cloned following the Golden Braid methodology, into 3 different plasmid vectors harboring the hCAS9 cassette with BlpR or NptII as the selection gene or NptII fused to the DsRed reporter gene. PpeTAC1 is the gene responsible for the tree architecture in peach, due to its role on defining the branches angle: its silencing, leading to more vertical branches, can promote yield through a more efficient interception of the light. For PpeTAC1 knock-out, two sgRNAs were designed on the gene with the aim to obtain a deletion of 400 bp and cloned into a vector harboring the hCAS9 cassette and NptII as the marker gene. Lastly, for the modulation of the flower biology in Prunus, the strategy followed involves the knock-out of the PpeTFL gene, to induce early flowering, through the excision of a 1100bp fragment by a double guide CRISPR/hCAS9 construct. All the above expression cassettes were used on Prunus materials for transformation using different strains of A. tumefaciens (LBA4404, GV3101 and AGL1). Multiple plant material (both adult explants, from in vitro shoot culture, and immature embryonic tissues) from apricot (cvs. Boccuccia spinosa, Bella di Imola and San Castrese) and peach (cvs. Independence, Rich Lady and Royal Glory) and a peach x almond hybrid (rootstock GF677) were infected with different constructs and placed onto an appropriate growth medium for regeneration. The material is under molecular analysis for the evaluation of possible editing events. This work is funded by the Italian Ministry of agriculture (Project BIOTECH-BIOSOSFRU).

PP-22

Transcriptome analysis of photosynthetic adaptation in peach rootstock leaves under waterlogging stress

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Waterlogging is a severe abiotic stress that is occurring with increasing frequency worldwide, and may cause crop yield declines. However, the molecular mechanisms of waterlogging responses in peach rootstock are poorly understood. In this study, we employed transcriptional profiling to explore the response status under waterlogging and gene response patterns during the recovery period in peach rootstock 'Baisha'. There were differences in photosynthetic metabolism responses between the non-waterlogging and continuous waterlogging stages. Compared with the control group, the differentially expressed gene (DEG) number increased along with waterlogging time. However, the DEG number decreased 12 d after starting treatment (AST) to less than the number at 4 d after terminating treatment (ATT). In total, 3,960 DEGs were identified after a comparative analysis of 12 d AST and 4 d ATT. A gene ontology analysis annotated 49 terms, including cellular process, metabolic process, cell part, membrane, catalytic activity and transcript activity. In total, 303 metabolic pathways were identified by KEGG analysis, among which photosynthesis and photosynthesis–antennal protein pathways were significantly enriched. Although the core proteins D1 and D2 in the Photosystem II complex were not significantly changed, other proteins in Photosystems I and II were significantly down-regulated. In addition, as time increased, the cytochrome, photosynthesis electron transport chain and active ATP enzyme factors decreased AST, while opposite trends occurred ATT. Thus, peach leaves have different response patterns under waterlogging and recovery conditions. The factors sensitive to stress and recovery were the cytochrome, photosynthesis electron transport chain and most active ATP enzyme factors in the photosynthesis metabolism process.

PP-23

Gene expression analysis in peach during endodormancy release

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Endodormancy for Prunus species like peach (Prunus persica (L.) Batsch) is a protector state that allows the survival against the adverse conditions of winter. During this period, growth, as well as many other metabolic processes stop. At the same time, buds start to accrue chill and only after the accumulation of a certain amount of it, they will be able to release from endodormancy. In the last decades, the effects of climate change endanger chill accumulation in mild-winter areas, producing incomplete flowering with organ-damaged flowers. Because of this, agrochemicals for advancing endodormancy release and so on flowering are used to alleviate this issue. In this work, we have applied three treatments (Syncron® + Nitroactive®, Broston® + Nitroactive® and Erger® + ActiveErger®) for the promotion of endodormancy release in the Carioca peach cultivar (intermediate chilling requirements) during three years. The endodormancy release date from all treated trees, as well for a group of untreated ones was measured. In addition, flower buds from all treated and untreated trees were collected weekly for extracting their RNA aiming to study the variation of some genes involved in the endodormancy release process. The RT-qPCR analysis unveiled that several genes involved in processes like ABA or phenylpropanoid biosynthesis were hugely upregulated in both treated and untreated samples during endodormancy release. Given the importance of this topic, we hope that this study will serve to develop biomarkers for endodormancy release in Prunus and other perennial plants species.

PP-24

The use of medium to high molecular weight linear anionic polyacrylamide solutions in enhancing chill accumulation in deciduous fruits in the Riverland and Sunraysia regions of the Southern Australian Murray Darling Basin

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This work stems from research conducted originally at Menindee into the use of calcium carbonate, and later zinc oxide suspensions in the Riverland, and the impact this had on reducing heat accumulation. These studies showed significant yield increases could be obtained in low chill years through enhancing chill accumulation by heat reflection. However, the cost of the product and difficulty in handling suspension products led to further research into the possibility that linear anionic polyacrylamides could offer a cheaper and more effective means of chill enhancement for stone and pome fruit production in areas where chill hour accumulation may be marginal. Studies in chill accumulation since 2008 have shown that on crop years are associated with chill accumulation that begins in late April to early May and poor crop loads are seen where chill accumulation that begins until early June. PAM solutions at rates of 1-5L/1000L were applied to crops in field sites at Bookpurnong, Renmark North, Loxton North and Wood Wood during mid to late May 2016 onwards. In all cases positive yield responses were seen. Variance according to variety was observed but, in all cases, positive increases in fruit counts were achieved. In some varieties these yield increases were highly significant. This suggests that the use of cooling polymers with early applications for enhancement of chill accumulation, is worth considering for areas where chill accumulation can be inadequate.

PP-25
Investigation of pistil doubling of low-chill peaches with early ripening

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'KU-PP1' and 'KU-PP2', the low-chill peach cultivars with early ripening, were bred for producing early peach season using the forcing culture technique. However, a frequently occurring problem of these cultivars is pistil doubling. Understanding the process of floral bud formation and the factors inducing the formation of the double pistils is vital for solving this problem effectively. Conversely, there is little data about the process of floral bud initiation and double pistil formation in low-chill peach cultivars with early ripening. Hence, we examined the timing of floral induction and differentiation stages as well as the double pistil occurrence of low-chill cultivars ('KU-PP1' and 'KU-PP2') and 'Hikawa Hakuho', a high chill peach for two years in a row (2016 and 2017). Afterward, the relationship between the double pistil formation and temperatures was clarified. Our study found that the first indicator of bud differentiation in low-chill peaches occurred in late June, while 'Hikawa Hakuho' occurred in early August. All buds of 'KU-PP1' and 'KU-PP2' had formed pistil primordia in early September. Whereas the buds of 'Hikawa Hakuho' had differentiated pistil primordia by early November before dormancy. The highest frequency of pistil doubling occurred in 'KU-PP1' (30%), followed by 'KU-PP2' (18%) and 'Hikawa Hakuho' (10%). Subsequently, the influence of temperature on double pistil formation in 'KU-PP1' was elucidated under controlled conditions. The temperature treatments were conducted from Sep. 29 to Nov. 23, 2017. The air temperatures were varied at 20, 25, and 30°C. When the air temperature reached 30°C, the occurrence of double pistil markedly increased. Furthermore, high temperatures retarded the flower differentiation progress. Although the high-temperature exposure during bud development induced double pistil formation, the occurrence of this disorder depended on the cultivar. This knowledge could be used to solve a pistil doubling problem and design proper cultural practices for low-chill peaches.

PP-26

Effects of different LED wavelength absorption spectra on in vitro shoot proliferation, leaf anatomy, photosynthetic pigments and photosystem II photochemistry of GF677 rootstock

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Plant growth and development is strongly influenced by the spectrum of light in their environment. In this study, the in vitro shoot proliferation, photosynthetic pigments, leaf anatomical traits and photosystem II photochemistry of GF677 rootstock (Prunus persica x Prunus amygdalus) was investigated under three light wavelength absorption spectra including 400-700 nm (mainly blue-green, White Fluorescent Light, WFL), 450-550 nm (mainly blue-red, LED1) and 450-660 nm (blue-green-yellow-orange-red, LED2) with 40 μmol m-2 sec-1 intensity. The culture medium used was the MS enriched with 3.1 μM BA, 0.05 μM NAA, 0.3 μM GA3, 20 g/L sucrose (pH 5.8) and 6 g/L Agar (30 days, 16h photoperiod, 22±2 oC). WFL, LED1 and LED2 gave similar shoot formation (85.7-96.4%), shoot numbers or proliferation rates (1.9-2.2) and shoot lengths (0.4-0.5 cm). LED1 presented the significantly highest rate of stressed explants, with their leaf anatomy being severely affected, as leaves were thinner and with fewer layers of palisade and spongy parenchyma. Under WFL the highest significantly different values of explants fresh weight were observed and leaf anatomy was not affected. Similarly, LED2 did not seem to negatively affect explants proliferation and leaf anatomy. There were not significant differences among the treatments in the allocation of absorbed light energy, which are the effective quantum yield of photochemistry (ΦPSII), the quantum yield of regulated non-photochemical energy loss (ΦNPQ) and the quantum yield of non-regulated energy loss (ΦNO). No significant changes were observed in the maximum efficiency of PSII photochemistry (FvFm), in the electron transport rate (ETR), in the photochemical quenching (qP) and in non-photochemical quenching (NPQ). Likewise, photosynthetic pigment content (chlorophyll a, chlorophyll b, carotenoids) did not differ under any treatment. Consequently, the overall results showed that WFL appears to be the most beneficial, while LED1 the worst, with LED2 having no significant difference compared to WFL.

PP-27

Estimation of chilling and heat requirements of peach and nectarine cultivars grown in the EUFRIN trials located in Lleida, Spain and Naoussa, Greece

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Climate change is already depicted as an increase in winter temperatures resulting in lower chilling accumulation that is required for proper flowering and subsequent fruit set in temperate fruit species. Since temperature requirements are cultivar-specific, the knowledge of these requirements may be valuable for predicting the adaptability of each cultivar (cv) to particular areas. The most widely used method for estimating chilling requirements is the Tabuenca test where branches are collected from the field at increasing chilling exposures during the winter period and forced in a growth chamber where the time of dormancy release is assessed. However, little is known on the stability of results obtained from the above methodology in different years or pedoclimatic conditions. For this aim experiments were carried out in Naoussa (Greece) and Lleida (Spain) on 14 peach and nectarine cvs, representing a wide range of pomological and phenological characteristics, belonging to the EUFRIN testing trial network. Lowest chilling requirement were found in Carla (48 CP), followed by Big Top and Patty (52 CP), whereas highest was found in Catherina, Nectaperf and O'Henry (65 CP). Heating requirements was lowest in Patty, Big Top and Nectaperf and highest in Venus, Gladys and Sweetregal (2.9-3.5 and 4.0-4.6 x103 growing degree hours, respectively).

PP-28

Adaptability of peach cultivars `Royal Glory´ and `Caldesi 2000´ to different environmental conditions

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The adaptability of two peach cultivars ('Royal Glory' and 'Caldesi 2000') to different environmental conditions in four localities in Serbia (Grocka, Rača, Niš and Bela Crkva) was examined during the two-year period (2020-2021). Genotype significantly influenced the variation of fruit weight, stone weight, flesh rate, soluble solids content, total acid content and total sugar content/total acid content (TSC/TAC). For most traits, significant differences were observed between the localities, while the year had a significant impact only on the variation of fruit weight, stone weight and flowering time. Response of cultivars to meteorological conditions was different, which could be explained by differences in genotypes. A greater influence of meteorological factors on the studied traits was found in 'Royal Glory' cultivar. In this cultivar, significant correlations were found between temperature on the one hand and fruit weight, flesh rate and flowering time on the other hand. Precipitation sum was significantly correlated with fruit weight, total acid content and flowering time. In 'Caldesi 2000' cultivar, significant correlations were found between temperature and flowering time, as well as between precipitation sum and fruit weight and TSC/TAC. Four principal components with eigenvalues higher than 1, were obtained from principal component analysis (PCA). Traits with higher scores on PC1 are stone weight, soluble solids content, total sugar content and TSC/TAC. The highest contribution of PC2 corresponded to total acid content, flowering time and fruit development period. The PCA showed that peach cultivars were differentiated according to stability to meteorological conditions. Cultivar 'Royal Glory' was homogenously distributed while the 'Caldesi 2000' cultivar was dispersed on scatter plot. The obtained results showed importance of cultivar adaptability testing before recommendation for planting in a particular region.

PP-29

Climate changes influence flowering and fruit setting at peach and nectarine cultivated in the Bucharest area

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The flowering, respectively the fruit setting phenophases are correlated to annual temperature, rainfall, and solar radiation intensity. This study aims to present the results of the evolution of 31 peach and nectarine cultivars growth stages correlated to local climatic factors, between the 2018-2021. 15 peach and 16 nectarine new cultivars were planted in the Bucharest area under Vertical Axis and Trident. BBCH-identification keys were used for flowering (BBCH65; 69), fruit development (BBCH72; 79), and fruit and seed maturity (BBCH85; 87). The number of related flowers was analysed for each cultivar after pruning (BBCH65). The related fruits were monitored and counted after physiological fall and manual thinning. The sum of the biologically active temperature presented similar values for the corresponding BBCH 65 stage; each year reporting differences in occurring date (2020 year presented 11 days in advance compared to 2019 for the flowering stage). The obtained results showed also differences between cultivars in fruit development, some of them maintaining the same growth rate until the maturity stage and others, presenting differences correlated with canopy or rootstocks ('Royal Jim' or 'Royal Summer').

PP-30

Transmission of sharka resistance induction to almond × peach interspecific hybrids

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Plum pox virus (PPV) causes the serious sharka disease in Prunus trees including peach. In this species trees are severely affected by PPV and no definitive source of genetic resistance has been identified at this moment. Previous results showed, however, that PPV-resistant 'Garrigues' almond was able to transfer its resistance to 'GF305' peach through grafting, preventing these trees from PPV infection and reducing symptomatology and viral load in PPV-infected plants. Based on these previous findings, we have created three different inter-specific families crossing 'Garrigues' almond and the peach cultivars 'Maya', 'Transvalia' and 'Maruja M13', with two main objectives. Firstly, we would like to confirm the PPV resistance of the interspecific almond × peach hybrids to be used as PPV resistant breeding lines. Additionally, we like to assess the induction of PPV resistance of these inter-specific hybrids after grafting onto a susceptible peach rootstock (GF305) which will be later PPV inoculated. Regarding the first objective, the transmission of resistance from almond to peach has been confirmed, since around 85% of the inter-specific hybrids showed sharka resistance after two phenotyping cycles. However, preliminary results show a very low rate of PPV resistance induction in infected GF305 peach rootstocks after grafting them with ten descendants of each family. Grafting of interspecific almond × peach hybrids does not protect GF305 peach plants to PPV inoculation. Most infected GF305 seedlings showed symptoms.

PP-31

Historical 1929 and 1930 phony peach disease (caused by *Xylella fastidiosa*) incidence data and relationships to physical variables and climatological data

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Phony peach disease (PPD), caused by Xylella fastidiosa subspecies multiplex (Xfm), has been a constant threat to peach (Prunus persica) production in Georgia (USA) since its first report in 1885. Subsequently, PPD spread to several peach production states in the southeastern USA. Arguably, the height of the epidemic in Georgia occurred in 1929, as a federally-sponsored government eradication program was initiated, resulting in over a million trees being destroyed by 1933. Fortuitously, records were preserved of PPD incidence by county in 1929 and 1930, allowing for accurate mapping of the incidence across the state at that time. While the relationship between environmental parameters and incidence of Pierce's disease and almond leaf scorch have been studied, indicating that cold winter temperatures negatively impact disease establishment, environmental effects have not been explored for PPD. Relating climatological data to PPD incidence for 1929 and 1930, valuable insights can be determined with implications for modern epidemics. Latitude and elevation of each county capital was used for location, and long-term climatological data (30 y) was obtained for the period 1981 to 2010. Weather variables included total rain, min temp, mean temp, and max temp. Linear regression, stepwise multiple regression, and a principal component analyses were conducted. A synopsis of the results indicated that decreasing temperature, whether associated with latitude or elevation, was negatively associated with disease incidence. The results are useful in predicting where PPD remains a threat in the USA, and where it will likely spread if introduced to other international peach production regions. Other factors including vector species and abundance or alternative hosts could also play a role in regional disease spread, so in addition to potential climatological effects, future research may further elucidate the mysteries associated with the PPD epidemic of ~100 years ago in the southeastern USA.

PP-32

Historic and current prevalence of phony peach disease (caused by *Xylella fastidiosa*) in the United States

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Phony peach disease (PPD) is caused by the phytobacterial pathogen *Xylella fastidiosa* subspecies multiplex (Xfm). Peach is an economically important specialty crop in several regions of the world, and PPD is a major disease of peach in the southeastern U.S. PPD is characterized by progressive symptoms including shortened internodes, darker green foliage, early bloom and most importantly, a reduced fruit size and quality. Subsequent to the initial discovery of PPD in 1885 in the state of Georgia, it was not considered important until 1915, when the epidemic had impact on peach production. Further major outbreaks of the disease had detrimental effects on production beyond Georgia in the southeastern U.S. in 1929, 1951, and 1976. In the intervening years PPD remained prevalent in orchards in the region, despite a strict eradication program. In 1959, a map was published showing the distribution of PPD in the southeastern U.S., but no survey has been conducted since to gauge the current prevalence of the disease. During the summer of 2020, surveys were performed in peach orchards in Georgia, Alabama, South Carolina, and Florida and additional written surveys were sent to fruit pathologists in 15 other states where the disease was reported historically. Resulting data indicated 6statesreported the disease since 1970, and in both Georgia and Alabama the disease remains prevalent. Although PPD is restricted to the southeastern U.S., there is the potential for it to spread to other major peach growing regions in the U.S., or internationally. More research is needed to improve our knowledge of pathogen diversity, host range, detection and epidemiology of the strain of Xfm causing PPD. Further fundamental and applied research will contribute to improved management of the disease, reduced risk of spread, and reduced impact of Xfm on peach production in the southeastern U.S.

PP-33

Assessment of Armillaria root rot resistant rootstock `MP-29´ for sustainable peach production in Alabama

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Armillaria root rot (ARR) disease caused by a soilborn fungus (*Armillaria tabescens*) is the second leading cause of peach tree mortality in the southeastern United States with estimated production losses averaging more than $8 million annually. Currently available chemical controls are not considered to be cost effective. Guardian® is presently the dominant rootstock for the southeastern peach industry primarily due to its superior tolerance to peach tree short life (PTSL). However, Guardian® is highly susceptible to the ARR pathogen. 'MP-29' is a recently (2011) released clonal interspecific hybrid peach rootstocks that provides superior resistance to ARR without the adverse effect on scion fruit size and productivity. 'MP-29' is also a dwarfing rootstock that provides tree size control. To compare rootstock tolerance to ARR and evaluate tree size, phenological development, yield, and fruit quality of 'Julyprince' and 'Bounty' peach cultivars grafted on 'MP-29' and Guardian® rootstocks, a site with a documented ARR history was selected at the Chilton Research and Extension Center near Clanton, AL in 2019. The experimental design is a randomized complete block with 12 single tree replications. Our data suggest both 'Julyprince' and 'Bounty' trees grafted on 'MP-29' were smaller during the period of initial establishment, while yields and fruit quality were comparable to the trees on Guardian®. Studies will continue to more completely evaluate the overall rootstock performance in ARR naturally infected field sites. The outcomes can provide a management solution for improved economic and environmental sustainability in peach production in Alabama.

PP-34

Viruses and viroids infecting peaches in Serbia

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Peach and nectarine trees were surveyed from 2005 to 2021 to investigate the presence of virus and viroid diseases in Serbia. Samples were collected from commercial orchards in the main peach-growing areas and from nurseries and mother blocks. A total of 482 samples were tested on the presence of 11 viruses (plum pox virus, prune dwarf virus, prunus necrotic ringspot virus, apple mosaic virus, cherry leaf roll virus, cherry necrotic rusty mottle virus, cherry rasp leaf virus, little cherry virus-1, little cherry virus-2, tomato black ring virus and tomato ringspot virus) and peach latent mosaic viroid. Molecular RT-PCR test was used for the detection of each pathogen with virus/viroid-specific primers. Analysis confirmed the presence of plum pox virus in 16.2% of tested samples from commercial orchards. Further molecular characterization revealed the presence of PPV-M and PPV-D strains in positive samples. The incidence of peach latent mosaic viroid infection was 5.9%. No other viruses were detected in collected samples.

PP-35

Studying *Xanthomonas arboricola* pv. pruni strains from Montenegro for copper sulfate and streptomycin sensitivity *in vitro*

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Stone fruit production is compromised by pathogenic activity and wide distribution of *Xanthomonas arboricola* pv. pruni (Xap) causal agent of bacterial spot. During the 2017/18 survey of stone fruit orchards in Montenegro, leaf and fruit spot, twig necrosis and cankers were observed on peach and sweet cherry. A total of 38 strains were isolated and based on their morphological, pathogenic, biochemical and molecular characteristics were identified as Xap. Control of the disease is based on an integrated approach, including the use of tolerant or resistant cultivars, cultural practices, biological and chemical treatments. However, frequent use of copper-based bactericides, may lead to occurrence of resistant bacterial strains. Therefore, we studied in vitro sensitivity of the 38 Xap strains to different concentrations of copper sulfate and streptomycin sulfate. The bacterial cultures, grown on Nutrient agar for 48 h, were suspended in sterile distilled water to approx. 1x108 CFU/ml. The suspension droplets of each strain (3 µl) were spotted on the surface of sucrose peptone agar (SPA) plates, amended with either copper sulfate (100, 200 ppm) or streptomycin sulfate (25, 50 ppm). *Xanthomonas euvesicatoria*, strain E-3 (KFB 062), resistant to these compounds, was used as a control. Strains able to grow at 28°C for 48h at given concentrations of the bactericides were scored as resistant. All Xap strains grew on SPA plates amended with 100 ppm and 200 ppm of copper sulfate, indicating high level of resistance in Montenegrin Xap population, while streptomycin sulfate inhibited growth of all studied strains at the lowest concentration tested, with exception of the control strain. Antibiotics are not permitted in plant protection in Montenegro, but bactericidal effect of streptomycin indicated that this antibiotic based treatment could improve the disease control efficacy. Therefore, the possibility of controlled use of antibiotics in stone fruit protection should be reconsidered.

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PP-36

Occurrence and phenology of the Mediterranean fruit fly, *Ceratitis capitata* (Diptera: Tephritidae) in the peach producing area of Central Macedonia, Greece

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The Mediterranean fruit fly (medfly), *Ceratitis capitata* is a major pest of many fruit commodities growing in tropic, subtropic and temperate areas, including peaches and other stone fruits. Besides direct damage on fruits, its presence in an area may impede fruit trading and impose quarantine regulations. Detection and population monitoring of medfly populations is of great importance to develop response strategies and establish long term management plans. Earlier studies suggest that medfly can only sporadically occur in central Macedonia, Greece, which is one of the main stone producing areas of Europe. However, because of climate change and changes in agronomic practices in recent years there are reports of medfly infestation in commercial areas in this area. In the frameworks of the Horizon 2020 funded project FF-IPM "In-silico boosted, pest prevention and off-season focused IPM against new and emerging fruit flies" we studied the occurrence, spatial dispersion, and seasonal phenology of the Mediterranean fruit fly in Central Macedonia, Greece. Overall, 25 trap stations of conventional traps (plastic McPhail; baited with Biolure; and Jackson trap baited with trimedlure) were deployed in the area of Pella, Imathia and Katerini following a structured experimental plan. Traps operated from June 2020 until November 2021. They were serviced weekly and captured insects were counted and removed from traps. The traps were placed to appropriate hosts based on seasonality of ripening. Hosts included apples, persimmons, nectarines, peaches and quinces. Capture data were coded by the coordinates of trap location, host, date and sex and were entered into a structured database. First analysis of the data showed that nearly zero captures of adults in traps up to the end of summer (August) and a substantially increase towards autumn, with peak captures in October. Adult captures declined in November and cease in mid-December. Overall adults were detected in all three regional directorates. Our results demonstrate in a thorough and systematic way that low populations of medfly are wide dispersed in central Macedonia and hence the risk for the commercial fruit commodities in the areas is substantial. We discuss the possible measures that should be taken to reduce the impact of medfly dispersion of fruit production and trading.

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PP-37

Using soil disruption followed by cover crops and rootstocks to alleviate peach replant disease

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Replant disease (RD) is characterized by reduced crop productivity resulting from repeated plantings of genetically related crops. This globally relevant disease is thought to be primarily caused by soil borne pathogenic microorganisms with specialized antagonistic traits towards the specific crop. We hypothesize that using cover crops or different rootstock genotypes grown in disrupted soils could be employed to beneficially alter the microbiome of RD soils for peach orchards. Steam autoclaving was used to disrupt the soils to amplify the microbiome interactions in the soil. Four different crops (corn, tomato, fescue, and alfalfa) were grown in disrupted and non-disrupted RD soil from Grand Junction, CO under greenhouse conditions. We show that soil disruption significantly increased biomass of all crops (alfalfa $p= 0.0415$; corn $p < .0001$, fescue $p= 0.0019$, and tomato $p < .0001$). Cover crops were reincorporated into the soil and subsequently RD susceptible Lovell peach saplings were planted. After 12 weeks, trees in non-disrupted soils were significantly larger (height $p= 0.0055$, diameter $p < .0001$). Crop type alone had no significant impact on tree size, however when considering soil sterilization, alfalfa in non-sterilized soil resulted in increased tree height, and total leaves. These preliminary results suggest that alfalfa could alleviate peach trees in RD soil. For the genotype experiment, the growth of 7 rootstocks (Hansen, Trio-2507, Trio-2207, Krymsk86, MP-29, RootPack20, and Controller6) were compared to RD susceptible Lovell trees in disrupted and non-disrupted RD soil. Peach trees in disrupted soils grew larger (height $p = 0.0001$, diameter $p = 0.0022$). Controller6, Krymsk86, MP-29, and Trio-2507 may be RD resistant by showing diameter growth but no significant differences between soil treatment. Future studies will reveal if a shift of the microbiome can be correlated with peach health, to develop a cropping technique that can be applied to other tree fruit systems with RD.

PP-38

Short- and long-term solutions for Armillaria root rot in *Prunus*

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Armillaria root rot (ARR) is a major threat to the long-term productivity of stone-fruit and nut crops across the major production areas in the U.S. There are no efficient methods of eradicating the long-lived inoculum buried in the soil before replanting, nor are there therapeutic methods to offset reduced productivity and tree death. Loss of productive land for the stone fruit and nut producers due to ARR is already happening; without immediate short- and long-term actions, prime Prunus orchard land will be permanently out of production, resulting in a devastating effect on the industries and local communities. Causal pathogenic fungi consist of three geographically isolated species: Armillaria mellea in California, A. solidipes in Michigan, and Desarmillaria tabescens in the southeastern U.S. The most economical and sustainable approach to prevent the loss of peach, cherry, and almond production due to Armillaria infection is to develop ARR-resistant, horticulturally acceptable rootstocks. A trans-disciplinary, multi-crop, multi-institutional team of researchers, and growers and nursery representatives are dedicated to providing short- and long-term solutions for Armillaria Root Rot replant issue affecting the U.S. stone fruit industry. This project will provide the 'building blocks' needed to enable and accelerate on-going Prunus breeding programs, as well as support the testing of cultural practices as short-term solutions to increase tree longevity on replant sites.

PP-39

Implementation, customization and functional evaluation of a location aware decision support system for precise management of Lepidoptera in Greek peach orchards of Pella, Greece

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Professionals in the agricultural field, along with growers, extension agents, and researchers, need a facility to predict region specific pest activity and optimize pest management. The objective of the current study is the implementation, customization and functional evaluation of a commercial web-based Decision Support System (DSS) for predicting the emergence and seasonal activity of important Lepidoptera that are damaging peach including: Anarsia linetella, Grapholita molesta and Adoxophyes orana. In addition, the spatial assessment of the pest predictions at different location in Pella Prefecture in Northern Greece is of special interest. The DSS that is installed consists of two parts: a remote weather station that deliver real time data to a cloud server and the software system which generates Degree-Days (DDs) pest predictions. The DSS was initially customized to generate predictions for the species of interest by using pest specific growth parameters that were developed in previous field studies. In a second phase the network of the DSS weather stations has been expanded to provide pest predictions in to new peach growing areas characterized by different microenvironmental conditions. So far, the functionality and the performance of the DSS is judged well since it provides predictions for the start (10% of moth emergence) and the peak (50% of moth emergence) that are in most cases ate acceptable levels. The investigations on the DSSs performance in terms of pest predictions into new areas are ongoing. Nevertheless, preliminary results suggest that the DSS has the perspective to be extended into new areas and especially to nearby locations that share similar landscape characteristics. Concluding, since the use of pesticides is still a vital component of Integrated Pest Management (IPM) in peach production the current work providing a means for increasing their efficacy and contribute to their rational use.

PP-40

Evaluation of the sensitivity of new peach and nectarine cultivars to bacterial diseases and oriental peach moth attack

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This study presents the 2018-2021 research results regarding the sensitivity of 15 peach and 16 nectarine new cultivars to bacterial disease (Xanthomonas arboricola pv. pruni (XANTPR), Pseudomonas syringae pv. persicae (PSDMPE)) and oriental peach moth (Anarsia lineatella, Zeller) under the influence of planting system, canopy and rootstocks. The new peach and nectarine orchard was planted in 2017 in the Experimental Field of Faculty of Horticulture in Bucharest using Romanian and foreign varieties grafted on Myrobalan 29C, Saint Julien A, Adesoto and GF677 rootstocks and an integrated orchard technology was applied. The incidence of the bacterial diseases was measured using a scanner and WinFolia Software. For oriental peach moth attack, during the winter period all annual shoots were analysed and the first, second and third generation's attack was counted. The results showed that the intensity of the bacterial disease and oriental peach moth attack was influenced by the cultivar and by the canopy. Significant differences between Vertical axis and Trident attack were noticed at nectarine cultivars.

PP-41

Deficit irrigation and reflective mulch effects on peach fruit quality and storage performance

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The effect of deficit irrigation and reflective mulch underneath the tree canopy on quality at harvest and during cold storage of 'Royal Glory' peaches (Prunus persica L.) was studied for two consecutive growing seasons. Four treatments were applied: 1) control, irrigation at 100% of crop evapotranspiration (ETc); 2) deficit irrigation (DI), irrigation at 75% of ETc in the last 3 weeks before harvest and 50% of ETc postharvest; 3) reflective mulch Extenday™ underneath the tree canopy; 4) the combined treatment of reflective mulch and deficit irrigation. Quality was assessed in fruit from the upper (sun-exposed) and lower (shaded) tree canopy at harvest and after 2, 4, and 6 weeks cold storage at 2 °C plus 1-day shelf life at 20 °C. The quality parameters measured were fruit mass, skin color, flesh firmness and specific conductivity, juice acidity and soluble solids content (SSC), per cent dry matter (DM) and total phenolic content in the edible part. Incidence and severity of chilling injury (CI) symptoms were also evaluated. Furthermore, tree fruit productivity and solar radiation (UV and PAR) above and underneath the tree canopy were measured. During cold storage, skin color changed slightly, fruit softened and the specific conductivity, SSC, acidity and per cent dry matter decreased, while total phenolic content and CI symptoms increased. Reflective mulch application improved light availability and fruit quality, especially in the lower tree canopy. Peaches grown under DI had similar fruit quality and CI symptoms as the control fruit and decreased yield and fruit size. Peaches from the reflective mulch treatment were more mature at harvest than the fruit from other treatments and had better quality (especially the lower canopy fruit), and similar storage performance compared to control fruit. The fruit from the combination treatment behaved like the separate DI or reflective mulch treatments.

PP-42

Transpiration influence on 44Ca uptake and location in peach rootstocks using the in vitro GreenTray® bioreactor

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Plants uptake Calcium (Ca) through their roots xylem vessel and it has been related to leaf transpiration. In peach, Ca is a crucial macronutrient for plant development and fruit quality and storability. For this study, the relationship between transpiration and Ca uptake was characterized using 44Ca as a stable isotope tracer added to the in vitro culture medium without sugar of a new in vitro temporary immersion system named GreenTray®. Two Prunus rootstock, Rootpac®20 and Garnem G×N, rooted plantlets, were grown with and without aeration to achieve two different transpiration conditions. Frequent aeration increased 44Ca uptake and transport to aerial part of the plantlets, suggesting that a better plant transpiration could improve Ca uptake and mobility. G×N presented a significantly higher % 44Ca excess on the roots than Rootpac®20. That could be related with the highest foliar and root areas of the G×N rootstock. In addition, higher % 44Ca excess in roots than in shoots were observed for both different aerations and clones, maybe related with the low mobility of Ca in plants. On the other hand, GreenTray® bioreactor, that allows a frequent air renewal favouring plantlet autotrophy, is a culture system emulator of the in vivo conditions.

PP-43

Nutrient inputs and outputs in commercial clingstone peach orchards in Greece after local or sustainable fertilization practices

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Clingstone peach production is important in Greece as large amounts of processed peaches are exported throughout the world. Fertilization of peach farms is still applied empirically with substantial amounts of N, P and K applied in late winter with basic fertilizers followed by one or two more N and K or Ca applications in spring. A more sustainable fertilization program was followed using < 50% N, minor quantities of P, and similar or higher quantities of K than that applied with the local regime with a different schedule compared to local practices in a number of farms and commonly cultivated cultivars. Inorganic nutrients were measured in fruits and prunings after two years of sustainable fertilization practices. Fruit yield and prunings volume was measured. The macronutrient inputs in the sustainable program were (in kg/ha): in 2019 < 70 N, around 30 P2O5, < 100 K_2O, and in 2020 < 70 N, around 30 P_2O_5, < 150 K_2O. Outputs with fruit normalized for 40 Mg/ha (most farms over the two years had lower yield) in 2020 were (in kg/ha): < 50 N, < 11 P_2O_5, < 4.3 CaO, < 4.4 MgO, < 80 K_2O. Outputs with prunings in 2020 were (in kg/ha): < 25 N, < 4 P_2O_5, < 30 CaO, < 3 MgO, < 11 K_2O. The balance between inputs and outputs was improved using the sustainable fertilization program, while fertilizer cost was slightly reduced and the possible environmental burden due to pollution decreased without affecting yield or fruit quality.

PP-44
Effect of 3-indol-acetic acid (IAA) on iron deficient Prunus rootstocks

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Iron deficiency in calcareous soils causes enormous economic losses in fruit trees grown in Mediterranean areas. In this study, we have examined the effect of IAA, a plant hormone involved in the root-shape architecture, on iron uptake in Prunus spp. Two different peach rootstocks were used (GF677 and Cadaman) to asses those experiments. Several experiments, with a randomized complementary factorial design, have been carried out to evaluate the effects of IAA on iron sufficient and deficient plants grown under control conditions. Propagated plants were grown in aerated hydroponic culture with ½ Hoagland pH 5.5 for 14 days, then plants were transferred to fresh nutrient solution with or without iron, supplemented or not with IAA (+Fe, –Fe, +Fe+IAA or –Fe+IAA). After seven days, Fe-deficient plants were supplemented with complete ½ Hoagland solution while Fe-sufficient plants were transfer to iron free ½ Hoagland solution for seven days more. Morphological and physiological parameters, such as root and shoot length, ferric-chelate reductase (FC-R) activity and SPAD, were recorded along the experiment in both rootstocks, although major changes were found in GF677. After seven days of treatment, root length in both control and deficient GF677 plants were shorter in IAA-treated plants. It seems that SPAD values were higher in IAA-treated Fe-deficient plants compared to non-treated Fe-deficient plants. FC-R activity increased significantly only under iron deficient conditions, but not when IAA was added to the media. On the contrary, IAA-treated iron deficient plants supplemented with iron displayed a high increase in the FC-R activity compared to non-previously IAA-treated plants. Based on these preliminary results, we can hypothesize that the addition of IAA in the nutrient solution modifies iron absorption. Further experiments need to be performed in order to obtain solid conclusions.

PP-45

Influence of rootstock on the content of heavy metals, micro and macroelements in the fruits of peach

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Heavy metals are among the most hazardous substance present in the environment. Their presence in soil results in contamination of plants and consequently the food. Consumption of contaminated food (fruits and vegetables) is the major cause of toxic metals transfer into human body. Cadmium (Cd) and lead (Pb) are among the most toxic heavy metals and cause serious health problem in humans. Peaches are one of the most preferred seasonal fruits, and a reliable source of nutrients. The current study was conducted to evaluate the effect of rootstock on the content of heavy metals, micro, and macronutrients in the fruits of peach. The study was conducted in Brestnik village, situated at 3.5 km distance from the source of pollution - the Non-Ferrous Metal Works near Plovdiv, Bulgaria. Peach cultivar 'Radhaven' was budded on the rootstocks GF 677 and Garnem. Preliminary washed with water fruits were analyzed for the content of heavy metals, micro, and macroelements. The differences in metal content of the fruits were proven by application of statistical analysis. The obtained result showed that concentration of Pb in soils exceeds the standard limit approved for Bulgaria while Cd concentration in soil was recorded within safe limit. The content of heavy metals, micro and macroelements in the fruits is different for each rootstock. Peach fruits tested negative for the presence of Cd, whereas Pb levels were higher than maximum permissible concentration. The effect of rootstocks on the accumulation of micro and macroelements (K, Ca, Mg, Fe, Zn, Cu, Mn and B) was significant. The results showed that the rootstocks strongly affected the fruit element uptake of peach.

PP-46
Utilizing nanocellulose as freeze protection in peach trees

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Nanocellulose is a major component of the cell wall in plants. It has high thermal stability and low thermal conductivity, and can be applied as a film. Nanocellulose has been shown to improve cold-hardiness in dormant grape and cherry floral buds. Th objective of this study, was to determine the effectiveness of nanocellulose as a freeze protection strategy in dormant peach floral buds. Fruiting wood of cv. 'Flavorich' was collected weekly in early spring from a commercial orchard in middle Georgia. The fruiting wood was randomly placed into four different treatment groups: control (water) and three concentrations that were serial dilutions of a commercial product 'Valida', composed of nanocellulose fibrils (NCF). The stems were placed in Styrofoam trays and sprayed with each treatment solution using a CO_2 pressurized sprayer. Samples were then cut into 5 cm stems and randomly assigned to ten different temperature treatments for a freezing tolerance test. The freezing tolerance tests were conducted by using a programable freezing chamber to decrease the air temperature inside the freezer at a rate of -4^{0}C·h-1 from -2^{0}C to -27^{0}C. The bags were taken out of the freezer at each temperature treatment then held in a refrigerator to thaw. Visual evaluations were conducted to assess the mortality rate of the floral/vegetative buds and stems. NCF provided promising results, however its effectiveness was not consistent across each evaluation date. In two evaluation dates, the NCF treated vegetative buds and stems had a higher cold hardiness than the untreated samples. Additional studies are needed to determine the effects of nanocellulose and the optimal concentration to utilize as an active freeze protection strategy.

PP-47
Nitrogen dynamics and bud dormancy: A transcriptomic study in peach

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Climate change is a growing threat to all life on earth and especially the plants that are used to seasonal weather patterns. Over recent years agriculture systems dependent upon fruit trees have been challenging due to these trees not meeting the required climatic conditions necessary to produce an adequate yield. Proper growth of trees does not only determine fruit yield, but it also affects the uptake of nutrients and hence the efficiency of fertilization measures. Nitrogen regulation is a key process that can be observed to understand the underlying mechanisms in plants during its growth. This is much more significant in the case of seasonal trees that are subject to varying weather conditions. In this study we observed the activity of some key genes in peach involved in the transport and regulation of nitrogen during dormancy to understand the role of nitrogen regulation during the same. Existing transcriptomic data from peach floral buds was used as a starting point to identify significantly expressed genes involved in nitrogen regulation and further RNA sequencing was conducted on genetic material from vegetative buds. Comparisons were drawn between floral and vegetative buds to understand the differing levels of nitrogen regulation as a factor of the developmental activities taking place in the respective buds. A putative Nitrate transporter involved in the redistribution of nitrogen before, during and after the onset of dormancy, showed an interesting expression profile in flower buds. The study further discovers the activity of trehalose phosphate phosphatase genes which links the Carbon and Nitrogen pathways. The activity of the identified genes was used to compare the regulation of nitrogen in peach with a model developed in poplar.

PP-48

Alternative fertilization effects on peach and nectarine plant and fruit characteristics

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Over- or under-fertilization is common farmers' practice in Greek peach orchards. During 2019 and 2020 based on leaf and soil analyses, vegetative growth and expected yield < 40% N, < 50% P and > 160% K were applied to Onora peach and Big Top nectarine mature trees compared to farmer's practice (control). Even though both cultivars were grown on the same orchard, soil properties were different with higher clay and pH in Big Top compared to Onora planting area. All leaf macronutrients were at sufficiency levels and were not affected from the changes in fertilization practice. Soil surface temperature increased probably due to reduced vegetative growth and increased light penetration in alternative fertilization. Each cultivar showed different behavior to alternative fertilization. There were no effects on fruit size and yield, but peach fruit quality was improved and nectarine fruit quality was lower in alternatively fertilized trees compared to control. Plant (Fv/Fm, crop water stress index, stem water potential) and leaf (specific leaf weight, chlorophyll, carotenoid and proline concentrations, relative water content, total phenols, antioxidant activity) response were differently affected from the alternative fertilization in each cultivar studied and each period of measurements (late June, early October). Reduced N and P and increased K fertilization did not negatively affect fruit quality, but showed various positive or negative effects on plant and leaf characteristics studied.

PP-49

Irrigation scheduling based on stress coefficient (Ks) estimations in two different peach cultivars

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In the era of global climate changes, the accurate estimation of plant's water needs is considered crucial for a sustainable agricultural production. Central Macedonia is the main peach growing area in Greece producing a high quality of fruits. However, due to the high evaporative demand during the summer period a well evaluated irrigation scheduling strategy is needed capable to apply the proper amount of irrigation water at the right time, thus preventing significant reduction in crop yield. In this frame, the ability to monitor the onset and water stress intensity could be essential for the implementation of an effective irrigation strategy. Water stress can be quantified by stress coefficient Ks, which according to Food and Agriculture Organization (FAO) could be estimated based on soil properties. Improvement of the Ks estimations based on 'in situ' collected data of both hydrological and ecophysiological parameters have already been proposed. In the present study, the new methodology of Ks estimation was evaluated in two different peach varieties grown under different soil conditions. The results indicate that the proposed adjusted method could better determine the onset and the intensity of water stress compared to the FAO method.

PP-50

The effect of the girdling time on growth and fruit quality of low-chill early ripening peach cultivar `KU-PP2

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The production of low-chill peaches has increased in recent years. However, they are comparatively less acceptable to consumers than high-chill peaches due to their low fruit quality compared with high-chill peaches. Hence, the production of high-fruit quality is essential in low-chill peaches. In the present research, we applied the girdling treatment at two, four and six weeks (G1, G2 and G3, respectively) interval after full bloom. The girdling was conducted with the width of 2 cm in each treatment except control. We compared the effects of girdling on fruit growth, shoot growth, and fruit quality in the year 2021 using the low-chill early ripening yellow-fleshed peach 'KU-PP2' bred at Kagawa University. All the girdling treatments improved the fruit quality parameters: e.g., fruit weight, size, soluble solids contents(TSS) and red coloration. Timing of girdling application showed better results in G2 treatment. Also, among all the treatments, the G2 treatment improved fruit size and TSS more effectively. The highest fruit weight was observed in G2 treatment by 42.4% than control, where, TSS was found the highest by 12.5% in the G2 treatment. However, the skin color L*, a* and b* was observed the highest in the control, G1 and G3 treatment, respectively. In conclusion, we found that the girdling treatments improved the harvested fruit qualities and that the treatment of 4 weeks after full bloom was the best treatment for low-chill early ripening peach cultivar 'KU-PP2'.

PP-51

Robotic arm and gripper to pick fallen peaches in orchards

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Agriculture is increasingly lacking in labor due to the exodus from rural to urban areas, combined with an increasing aging of the world's population. Despite this reduction in human resources, the agricultural sector is essential to the survival of the humanity and therefore cannot stop. The introduction of robotics in certain activities such as fruit harvesting, weed control, monitoring, spraying, soil handling, autonomous navigation, among others, contribute technologically to the sector efficacy and efficiency. The paper presents the design of a robotic gripper for picking up fallen fruits, aiming to contribute for the sustainability of the agricultural processes. The prototype is coupled to a robotic platform's Cartesian manipulator. The technical specifications of the gripper were set through a decision matrix based on a literature review. The gripper was modeled three-dimensionally (3D) using computer-assisted design (CAD), leading to 3D printing model by polylactic acid (PLA) fused deposition modeling (FDM). The control, regulation and command of the gripper are accomplished by an Arduino microcontroller connected to end-switches to limit the work envelope, and to DC motors that carried out the Cartesian manipulation arm and gripper movements. Experimental tests were carried out to evaluate the performance of the gripper in picking fruits, depending on the inclination of the robotic platform and positions of the fruit (central and lateral). The experimental results allow to conclude that the robotic gripper fulfills the objectives for which it was developed.

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Development and evaluation of a smart irrigation peach app in a young peach orchard in Georgia, USA

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A crop's water requirement depends largely on the crop's developmental stages and the environment in which it grows. A site-specific irrigation scheduling system based on crop water requirements is important to ensure optimal plant growth. Georgia's (USA) current irrigation scheduling system has been based on studies from other regions, with different soils and environmental conditions. It is imperative to have a Georgia-specific irrigation scheduling tool for peach production. A smartphone app, known as SmartIrrigation Peach App, was developed by the University of Georgia for irrigation scheduling based on peach's water requirements at different developmental stages throughout the years of establishment and production. The main objective of this study was to compare the SmartIrrigation Peach App, sensor-based irrigation scheduling, and no irrigation (standard commercial grower practice) in a young peach orchard. A commercial cultivar 'Julyprince' grafted on 'Guardian' and 'MP-29' rootstocks were planted in April 2020 in approx. 0.2 hectares at spacing 6.1m × 4.6m. Variables measured were canopy volume, trunk cross-sectional area, stem water potential, and the amount of water used per scheduling method in 2020 and 2021. The results indicated that plants grafted on 'Guardian' rootstocks were significantly and consistently larger than 'MP-29' since establishment. There was no significant difference in plant size among the three irrigation methods, but non-irrigated trees were comparatively smaller (although not significantly different). Water consumption was similar across treatments in the first year but in 2021, the SmartIrrigation App saved 374 gallons per tree compared to a sensor-based system. Plants grafted on 'Guardian' used 411 gallons more water per tree than MP-29 in 2021 (second-year-old trees). Overall, our results indicated that the SmartIrrigation Peach App can be used as an efficient irrigation scheduling tool for young peach orchards.

PP-53

Development of an innovative smart-farming and decision-support service to improve clingstone peach cultivation

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AgroNIT is an integrated IoT framework aiming at the development of innovative solutions for the optimization of clingstone peach production in central Macedonia, Greece. AgroNIT features energy-autonomous mesh Wireless Sensor Networks (WSN), Cloud Computing and decision-support systems using artificial intelligence. It serves as a hybrid smart-farming service, as well as a large-scale Living Laboratory (testbed). The AgroNIT system consists of three services-tiers: the data collection (Edge System), the data analytics (NITOS Cloud) and the data presentation service (Software Application). The WSN testbed is extended to 15 pilots across central Macedonia, consisting of 25 custom-made IoT sensing devices and 13 LTE gateway nodes. The end nodes feature various sensors separated in two main functional types: (i) the agrometeorological node for monitoring key crop, soil and climatic parameters at field or microclimate level, and (ii) the visual crop node, an image-aware module equipped with an RGB camera to enable crop monitoring via 2D image collection. The gateway nodes are responsible for the collection and transmittance of the sensed data to the proprietary Cloud via the internet. The Cloud is a data aggregation and data analytics service, whose purpose is to extract knowledge from the raw data by employing big data analysis, machine/deep-learning and data mining algorithms. The produced knowledge can contribute to the sustainable production management through the precise determination of peach phenological stages including bud dormancy breaking (winter chill, heat units), targeted plant protection, critical stages for optimal fertilization and irrigation, severe weather phenomena forecasting and management, fruit maturity rate and yield prediction. For the data visualization the AgroNIT software application was developed for Web and mobile devices and integrates various decision-support services related to key cultivation practices supporting all the involved parties (farmers, advisors, industry).

PP-54

Navigation system of autonomous multitask robotic rover for agricultural activities based on computer vision through tree trunk detection - Application to peach orchards

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Introducing Robotics in agriculture can allow a raise in productivity and a reduction on costs and waste. Its capabilities can be enhanced to or above the human level, enabling a robot to function like a human does, but with higher precision, repeatability and with little to no effort. This paper develops a detection algorithm of peach trunks in orchard rows, as an autonomous navigation and anti-bump auxiliary system of a terrestrial robotic rover for agricultural applications. The approach involved computational vision, more specifically, the creation of an object detection model based on Convolutional Neural Networks. The framework of the algorithm is Tensorflow, for implementation in a Raspberry Pi 4. The model's core is the detection system SSD MobileNet 640x640 with transfer learning from the COCO 2017 database. 89 pictures were captured for the database of the model, in which 90% were used for training and the other 10% for testing. The model was converted for mobile applications with a full integer quantization, from 32float to uint8, and it was compiled for Edge TPU support. The orientation strategy consists in two conditions: a double detection forms a linear function, represented by an imaginary line, which updates every two simultaneous trunks detected. Through the slope of this function and the horizontal deviation of a single detected bounding box from the created line, the algorithm orders the robot to adjust the orientation or keep moving forward. The arithmetic evaluation of the model shows a precision and recall of 94.4%. After the quantization, the new values of these metrics are 92.3% and 66.7%, respectively. These simulation results prove that, statistically, the model is able to perform the navigation task.

PP-55

GPS-based autonomous navigation system for multitask robotic rover for agricultural activities with augmented reality web application for supervision support - Tests in peach orchards

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As a result of the increasing world population and the growing demand for food, there is a great need to increase agricultural productivity. However, the problem is aggravated by the population migration from rural areas to cities, which causes a decrease in the workforce in the agricultural sector. In this regard, within the concept of agriculture 4.0, the introduction of autonomous robots in agricultural activities may face these problems, supporting the growing lack of labor and promoting increased agricultural productivity.This work exposes the algorithm used to perform autonomous navigation, based on Global Positioning Systems (GPS), of the robotic rover for agricultural applications (R2A2) multitasking aimed at performing herbicide spraying. An augmented reality (AR) web application has also been developed to assist in the supervision of the autonomous vehicle. A code in C/C++ was developed for the autonomous movement of the robotic platform using an Arduino Mega2560 as the main microprocessor and the AR web application based on positioning which was developed using the AR.JS libraries and the A-FRAME Framework compiled in a code HTML. The application was tested in a peach orchard and presented an average of approximately 94% of correct answers, which reveals the accuracy of the technological solution developed. Also exposed are the results and conclusions of the autonomous movement algorithm and the web application.

PP-56

Use of photo-selective nets in Y system with flat peach Platibelle

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Modern agriculture focuses the improvement of fruit quality on the need to increase yields and environmental sustainability. This implies the use of technical advances as the photo-selective nets that are an improvement of the commonly used anti-hail or anti-insect nets. The photo-selective nets can protect cultures from excessive radiation (as well as from hail and parasites) and improve environment under the net as for temperature and humidity. Some possible countereffects can be yield and/or quality reduction, therefore net characteristics (mesh, color, shading) must be adapted to climate and plant species and cultivar. In 2021 a study was conducted on flat peach (Prunus persica (L.) Batsch. var. compressa Bean.) cultivar Platibelle trained as Y system (4x2 m) under the financial support of Operational Group (PRO-PLAT – PSR Marche region). Anti-hail photo-selective nets of different colors (red, yellow, pearl with mesh 2,4x4,8mm) were tested to evaluate the effect on plant physiological and productive response. Some differences were recorded on qualitative and quantitative fruit characteristics, under yellow net fruits had a higher weight and diameter, while °brix were lower under red net. Similar behavior was observed in gas exchange of plants under different colors even if shading was higher under red net. The analysis of those data can help in understanding the effect of different net characteristics in the specific location and help the producer in their choice of the best net to meet their objectives.

PP-57
Fruit quality and yield in planar training systems for peach

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Two-dimensional training systems for fruit trees can improve light distribution and spray coverage, simplify harvest, and facilitate mechanization. However, these systems require extensive training, pruning, and trellising, increasing costs per hectare. Further, the lack of dwarfing peach rootstocks to control vigor has hindered adoption of planar systems for peach production. We trialed three planar training systems in peach to identify a system which reduces excess vigor, improves yield, and enhances fruit quality. The planar styles Upright Fruiting Offshoots (UFO), Super Slender Axe (SSA), and Dual SSA (DSSA) were compared to a three-dimensional style, Quad SSA (QSSA), which is similar to open vase training. Trees trained in UFO and QSSA were planted at moderate density (~2.5 m x 3.5 m), while SSA and DSSA were at high density (~1 m x 3.5 m and ~2 m x 3.5 m, respectively). Cultivars with three growth habits were used. Bounty trees (standard habit) were trained in all systems, while Sweet-N-UP trees (upright habit) were trained to UFO and SSA, and Crimson Rocket trees (pillar habit) were trained to UFO. Total fruit weight and fresh weight of pruned branches were measured to evaluate yield and excess vigor during the first harvest (4th leaf in 2021). Fruit weight, cheek diameter, ^{0}Brix, percent dry weight, and fruit firmness were sampled to assess fruit quality. For both Bounty and Sweet-N-UP, the highest yield per hectare in 4th leaf was in SSA. For Bounty, SSA and UFO had increased yield per pruning weight. Training style did not impact fruit size. For Bounty, percent dry weight and ^{0}Brix were slightly higher for QSSA than for SSA, but not significantly different for other comparisons. In conclusion, preliminary data suggest that planar, high-density systems have the potential to improve early yield per acre and growth resource allocation, without reducing fruit quality.

PP-58
Influence of Vertical Axis and Trident planting systems on peach and nectarine fruit quality

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This study presents the evaluation of fruit quality of some new cultivars of peach and nectarine cultivated in the Experimental field of the Faculty of Horticulture in Bucharest, Romania. A collection of 33 cultivars was evaluated between 2019-2021, using fruit physical and biochemical parameters like size and weight, flesh firmness, total soluble solids (TSS), fructose and glucose, dry matter (DMC), titratable acidity (TTA), and IAD index (IAD). Peach and nectarine cultivars were planted in 2017 under two planting systems: Vertical Axis and Trident. 'Honey Royale' had the highest values for fruit size, both on Vertical Axis and Trident canopy, while, 'Gladys' presented the highest total soluble solids content. Statistical differences for TTA have been reported for cultivars cultivated on different rootstocks. An interesting variation on TSS content, correlated with climatic factors (temperature, rainfall) was observed, higher in Vertical Axe compared to Trident. The results showed that the planting system influences the fruit quality, according to the cultivar analyzed.

PP-59

Analyses of selected chemical compounds of different pomological groups in peaches

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The one of aspects for assessing the complex quality of fruit of peaches and nectarines is in addition to pomological properties also the chemical composition of the fruits. Selected group of varieties from different pomological groups maintained in the national gene – pool collection at Mendel University, Horticultural Faculty in Lednice was evaluated in this study. The orchard was established in 2010 and trees were trained to the open vase training system, as the rootstock was used peach almond hybrid GF 677. The weather is typical for temperate climate zone. The average annual temperature is 9.7°C and annual rainfall averages at 537 mm. In this area the early spring temperatures often fluctuate and are accompanied by spring frosts in the time of bloom and fruit development. Trees were planted with the spacing of 5 × 3 metres. The soil type is classified as loamy sand, alluvial and the soil group being chernozem. Standard fertilization and plant protection treatment was applied in the orchard. Such as control variety was chosen Redhaven. Evaluated were 11 varieties of traditional and modern character, yellow and white flash, clings, and free stone peaches, early and late ripening varieties as well. The experiment included the following peach varieties Avalon Pride, Benedicte, Fidelia, Helene, Krasava, Lakomyj, Redhaven, Romea, Royal Glory, Suncrest and UFO 3. Basic fruit composition was described from titratable acidity, soluble solid content, total phenolic content, flavonoids, antioxidant capacity, carotenoids, total anthocyanin content and sucrose point of view. Highest level of titratable acidity (1.3%) and as well as highest soluble solid content (15,7 °Rf) and flavonoids (53.2 mg GAE 100 g^{-1}) had white flash peach variety Benedicte. Next white flesh variety Krasava has the highest total phenolic content (334 mg GAE 100 g^{-1}) and highest antioxidant capacity (250 mg 100 g^{-1}). The highest level of carotenoids was determined for the cling, yellow flesh variety Romea (4.74 mg 100 g^{-1}). The highest total anthocyanin content had white flesh peach variety Helene (3.75 mg 100 g^{-1}).

PP-60

Use of chemical treatments to reduce browning colour of white fresh-cut peaches, harvested in summer and late crop

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Fresh-cut white peach is very perishable, discoloration or browning are the main factors affecting loss of consumer acceptability. In fact, colour and appearance are the first drivers of liking for consumers during the purchasing phase. The aim of this study was to investigate the effect of chemical treatment on fresh cut peaches fruit 'Pesca di Bivona' landraces 'Murtiddara' and 'Settembrina di Bivona' harvested in summer season and late crop. White peach fruits were harvested at commercial harvest stage, after cutting and dipping in different solutions with ascorbate calcium (ASC) and hydroxypropyl methylcellulose (HPMC), fruits were stored for 3, 5, 7 and 12 days at 5°C and 95% RH, in polyethylene terephthalate (PET) packages under passive atmosphere conditions. The results show that effect of ascorbate calcium is visible on the fresh cut slices peach harvested in summer crop, in terms of colour and firmness while the treatment wit sdh hydroxypropyl methylcellulose increased the translucency and the colour change from white to grey respectively. The treatments (ASC and HPMC) had no significant effect on fresh-cut slices peach harvest during late crop (cv. 'Settembrina di Bivona') until 5 days of storage at 5°C.

PP-61

Review of 10 years of studies on peach and nectarine: identifying the least susceptible varieties to storage diseases

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Cultivar choice is a really important lever for the success of fruit orchards. In France, a network involving 4 sites, assesses new cultivars in various pedoclimatic conditions. Cultivars are evaluated on different traits: tree management technicity, phenology, productivity and fruit quality attributes (appearance, texture and flavour). Since 2009, a study aim also to identify peach cultivars with a lower susceptibility to monilia spp. Brown rot, caused by *Monilia* spp., is a major problem in peach and nectarine production because of the damage caused in the orchard, during the post-harvest period, and after purchase. Professionals are increasingly left with fewer control options, particularly following the withdrawal of certain active ingredients, and the alternatives available to them, in particular prophylaxis or biocontrol products, are not always as effective as synthetic plant protection products. To find alternative control methods, one line of research aims to identify varieties that are less susceptible to brown rot. However, due to the multifactorial nature of the development of these fungi (climate, crop management, etc.), this evaluation requires a large number of repetitions in order to even out the effects of site, year and cultivation practices. A study conducted from 2009 to 2020, within the framework of the evaluation network of new peach varieties, has made it possible to compare the susceptibility of nearly 240 varieties (with more than 4 repetition). A common post-harvest protocol was established (60 fruits sampling, 8°C during 2 days storage, then 21°C and 80%RH storage). Even if no resistant cultivars were identified, this study has led to the acquisition of knowledge on the behaviour of recent cultivars. These results should prove very useful to growers when choosing their cultivars, due to the future challenges they face of developing environmentally friendly production systems and the withdrawal of certain plant protection products.

PP-62

Quality alterations in different stone fruit cultivars due to a low dosage of methyl bromide fumigation

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Australian peaches and nectarines exported to China must undergo fumigation treatments prior to shipment. 660 fruit from each of the three cultivars: 'August Bright' (AB) nectarines, 'Snow Flame' (SF) and 'August Flame' (AF) peaches were harvested from the Stone Fruit Field Laboratory, Victoria, at commercial maturity based on index of delta absorbance (IAD). Afterwards, as a biosecurity disinfestation treatment, fruit were fumigated with methyl bromide (MB) at a low dose of 18 g/m^3 for 5.5 h at a core temperature of 18°C, with a subsequent cold storage period at 2°C and 4°C for 5 and 9 d to simulate air freight transportation. Following fruit quality parameters were measured during shelf life (SL): firmness, IAD, total soluble solids (TSS), total titratable acidity (TTA), weight, ethylene production and respiration. Our data showed that fumigation without a cold storage (CS) period afterwards produced a greater decrease in firmness and IAD in all three cultivars during SL compared with no fumigated fruit. Fumigated peaches had a much higher ethylene production, with a peak after 4-6 d in SL. Nevertheless, no differences due to fumigation were observed during the SL evolution of weight loss, or TSS/TTA ratio. When after fumigation fruit were submitted to a CS period, no differences in the SL evolution of F, IAD, weight loss and TSS/TTA ratio were observed. However, fumigated fruit had higher ethylene production than no fumigated. In peaches the ethylene production reached a maximum after 2-4 d in SL. During the SL period after 9d of CS fumigated 'SF' peaches showed problems of mealiness. No differences on the SL fruit quality due to CS temperature (2-4ºC) were observed. In summary, the effect of a low dose of MB application on fruit quality was masked when after fumigation fruit was submitted to a cold storage period.

PP-63

Controlled atmosphere storage and fruit quality of 'Sweet Henry' peach cultivar

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Peach is a climacteric fruit and is very perishable because firmness decays rapidly in close dependence with environment temperature. Cold storage is the most widely used method for peach conservation, delaying fruit deterioration. This paper describes the experimental tests developed to evaluate the evolution of peach characteristics under different storage conditions of controlled and normal atmospheres. Tests were performed in refrigeration chambers of industrial and laboratory facilities, throughout 3 years. In the controlled atmosphere chamber, the tests were performed with 3 different concentrations of O_2 and CO_2, namely 3 treatments of Controlled Atmosphere (2% O_2-5% CO_2, 2% O_2-10% CO_2, and 2% O_2-15% CO_2), 2 treatments of Normal Atmosphere (at Research Centre and at Farmers Organization) were used with 'Sweet Henry' cultivar. From each treatment of the controlled atmosphere, peach samples were extracted and analyzed at 14, 21, 28, 35, 42, 49, 56, and 62 days. The analysis of the biometric parameters (size, weight, color, hardness, Brix, acidity) was performed in order to evaluate the quality of the peach. The results show that the controlled atmosphere maintains the fruit quality in terms of weight, appearance, SSC, color, and texture, thus increasing fruit shelf life. A significant and consistent decrease in acidity content was observed in all the treatments, and treatment 2% O_2-15% CO_2 results in the minimal decrease of acidity content. Similar incidence of chilling injury and rotten fruits were observed for controlled atmosphere treatments but not between years.

PP-64

Impact of winter and spring temperatures on flowering phenology of peach and nectarine cultivars grown at different European sites

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In recent years, climate change represents a threat for food security and the peach production systems needs to adapt to more variable climatic conditions. A valuable tool for studying the influence of climatic conditions on the peach phenology and adaptation is the EUFRIN testing trial network, where the same pool of commercial peach and nectarine cultivars (cvs) is being evaluated under different climatic conditions at different locations of Europe (Greece, France, Italy, Rumania and Spain). The aims of the present study were to: a) extrapolate the effects of winter and spring temperatures on the peach phenological stages, and b) assess the effectiveness of the Tabuenca test and Growing Degree Hours method when applied in different pedoclimatic conditions and years. Chilling and heat accumulation were calculated with different established models while bud break and flowering dates were recorded in 18 peach and nectarine cvs grown in 9 sites. Chilling accumulation initiated earliest in Cuneo (5th of October) and last in Rome (10th of November). By the end of February, the chilling accumulation followed the order: Cuneo (101 Chilling Portions-CP) > Tebano, Forli, Lleida, Bucurest > Zaragosa, Bellegarde > Naoussa > Roma (69 CP). The chilling requirements in the studied cvs were fully, or sometimes marginally, covered depending on the cv and experimental site. The flowering duration was usually longer at Rome and for some cvs at Naoussa, being the sites with the lowest chilling accumulation, which may be an initial symptom of insufficient chilling. There were important differences among cvs in the flowering dates but also among sites. It was interesting to find out that results from the Tabuenca test on estimating the Chilling and Heat requirements made in Naoussa during the winter period 2020-2021, predicted well the flowering dates of the studied cvs in other locations and years. Further climatic and experimental data are needed to improve the accuracy of the present experimental data and extrapolate potential plasticity of peach cvs under different climatic conditions.

PP-65

Agronomical performance, physiological response and fruit quality of several commercial flat peach varieties grown in the Ebro Valley, Spain

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In Spain, flat peach (Prunus persica (L.) Batsch. var. compressa Bean) production started to be relevant 10 years ago, accounting today 20% of the total production. Worldwide breeding programmes have done significant improvements in internal and external characteristics, such as fruit shape, fruit size, skin colour, taste, flavour, among others. However, these improvements need to be tested under different pedoclimatic conditions from those where they were bred to verify their adaptability. Fruit production needs nowadays to meet the customer's requests, that are more and more leading to high quality in terms of taste and nutritional characteristics. For these reasons, this study (under the financial support of the operational group PRO-PLAT, PSR Marche) evaluated, in 2019, the effect of 15 new commercial flat peaches (grafted on vigorous rootstock) on agronomical performance, physiological response, morphological appearance, fruit quality attributes, and nutritional content. The experimental irrigated orchard is located at IRTA-Lleida (Spain), under a cold semiarid Mediterranean climate. Theses varieties covered a range of maturity from June to September. Fruits were freeze dried and analysed for polyphenol and flavonoid content at Polytechnic University of Marche (Italy). There were differences among cultivars on all traits evaluated. The physiological response of each cultivar varied depending on the time of the evaluation (after manual thinning and 5-7 days before harvest). At this last period of evaluation, the response of each cultivar was also influenced by the climatic conditions. It was interesting to find out that fruit weight and diameter resulted higher for late-maturity cultivars, but all the varieties showed a good °Brix/acidity ratio that placed them in the sweet and sub-acid categories. Finally, Mistral-30, Caramba, Flatstar and Flatdiva varieties showed interesting high nutrient values.

PP-66

Agronomical, fruit and canned product quality traits from newly released non-melting peach cultivars/selections

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The peach canning industry requires fruit with optimal morphological characters and best performance during processing mainly related with low pit fragment incidence as well as producing a high-quality product. Following the creation and release of new fruit tree cultivars (cvs) it is important to evaluate their adaptability under the same environmental conditions by addressing a range of agronomical and fruit quality characters related not only to the industry but also the grower's needs. In the present study agronomic traits such as yield, yield efficiency and fruit dimensions were made in nine non-melting peach cvs grown in a cultivar evaluation orchard, while fruit size, shape and color characteristics, the occurrence of pit-fragments or stem residues during processing and sensorial attributes of the canned product were studied in fruit from 24 cvs harvested from the same and nearby orchard, during a two-year study. The study was made in recently released (8), older (4) cultivars as well as sports and breeding selections (12). The studied material included sports of cvs. 'Catherina', 'Andross' and 'Everts' separated for higher yield and desirable fruit quality characteristics. Results highlighted the difficulty in finding a cultivar with all desired traits which is probably attributed to the fact that cvs were developed in other countries. However, some cultivars achieved a sum of desired traits.

PP-67

Comprehensive protocols to determine textural properties on fresh and canned peach fruits

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Tissue firmness is a key qualitative factor that determines the quality of both fresh and canned peach fruits. The most common large deformation mechanical test for firmness determination is the puncture test that is primarily used to measure the required force to penetrate the fruit flesh at a fixed distance with a steady speed rate of the moving probe. It is a straightforward assay, used for both fresh and processed fruit and is often adopted compared to a compression test due to the simplicity of conditions to replicate the test. Peach tissue firmness is typically measured on two equatorial sides of each fruit, after the removal of a 1 mm thick disk of skin from each side of the fruit, using a penetrometer fitted with an 8 mm plunger tip and the results are expressed in Newtons (N). A commercial standard in terms of fruit firmness was set by EU at 64 N (maximum levels) using the typical 8 mm diameter probe (Commission Regulation (EC) No. 1861/2004), while a fruit is considered as "ready to buy" when firmness is in the range 18-35 N. Regarding processing peaches, a critical requirement is its ability to maintain a tree-ripe flesh firmness of 30 N or greater through harvest, transport, and processing. In the current work we present an array of assays that we have developed to determine textural properties of canned halved peaches with the employment of a TA-XT Plus texture analyzer by applying three discrete large deformation tests: (a) puncture test with a flat cylindrical probe; (b) texture profile analysis (TPA) with a flat compression plunger; (c) Kramer shear test (KST) cell with a bladed fixture. These tests resulted in a total of nine textural properties, namely, "puncture firmness" (individual halves), "Kramer" hardness (applied in a complex mixture of peach slices), "TPA" hardness (central section of halves), fracturability, consistency, cohesiveness, springiness, chewiness, and total hardness. The established protocols, providing complementary information, are readily applicable to the canning industry in setting up qualitative tests to determine product shelf life as well as to assist on going breeding programs for the evaluation of new candidate clingstone cultivars.

PP-68

Flat peach: consumer test, sensory analysis and valorization of nutritional properties

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The increasing consumer's awareness of the health benefits of fruit consumption has consequently augmented the demand for both fresh and processed fruits. For this reason, in the last years, many fruit producers have employed innovative agronomic strategy, in order to enhance the nutritional properties of the final product. In this regard, in this study under the financial support of the operational group PRO-PLAT, PSR Marche, have been conducted two consumer test with adults (46 males and 54 female between 18-55 years old) or children (10 males and 18 females with 7 years old average) participants, in order to compare both taste and texture liking of two post-harvest maturation (ready to consume vs cold storage) of (Prunus persica (L.) Batsch. var. compressa Bean.) cultivar Platibelle. In both cases, the flat peach harvested and ready to eat was more appreciated than the cold storage flat peach in terms of flavor, sweetness, crunchiness and texture. Moreover, paper packaging with nutritional indications was the most favorite kind of pack. Furthermore, sensory analysis on cultivar Leo was performed by 14 professional tasters (ISO 8589:2014) by Quantitative Descriptive Analysis (QDA) method (ISO 13299:2016) highlighting herbaceous smell and taste with peach and exotic hints. In conclusion, this study has showed that flat peach ready to eat, in particular cultivar Platibelle, is more appreciated by consumers, independently from the age, than flat peach kept in cold storage, probably for its particular nutritional properties, which should be preserved by innovative agriculture processing. Finally, cultivar Leo could represent a valid alternative in the market of flat peach not only for its particular sensory profile but also because it is able to provide a tasty early fresh product.

PP-69

Studying the kinetics of ozone decomposition during postharvest treatments in fresh-market peaches

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Ozone is a very potent oxidizing agent which is effective in killing a wide spectrum of microorganisms by oxidation of their cell membranes. It is reported to have 1.5 times the oxidizing potential of chlorine which makes it a good alternative surface sanitizer for fresh fruits and vegetables. Furthermore, ozone is a very unstable gas which decomposes in a very short time to molecular oxygen leaving no chemical residues or undesirable byproducts. This instability, however, necessitates on-site generation and timely application as ozone cannot be stored or transported. Since ozone is a gas, it has low solubility in water and it has been found to dissipate rather quickly when mixed in aqueous solutions. A novel technology called High-Oxygen Water (HOW) has risen as an alternative sanitation system which is based on the generation of stable nanobubbles of oxygen in water that can be coupled with ozone. Since nanobubbles are very small in size, they rise slowly to the water surface and allow for the gas inside them to be completely dissolved in the water. There exists a gaseous treatment of ozone which can be applied overtime in cold rooms containing fresh produce. Gaseous and aqueous ozone decompose at different rates depending on various external factors such as the temperature of application, relative humidity, pH as well as organic matter present. In this study we investigated the effect of organic matter presence in the form of freshly harvested peaches on ozone decomposition rates. Our team mapped the kinetics of different forms of ozone application and studied the reduction in oxidative potential with the addition of unsanitized peaches which were harvested from a commercial orchard. This work clarifies the constraints of using ozone as a sanitizer based on the oxidative potential reduction over time.

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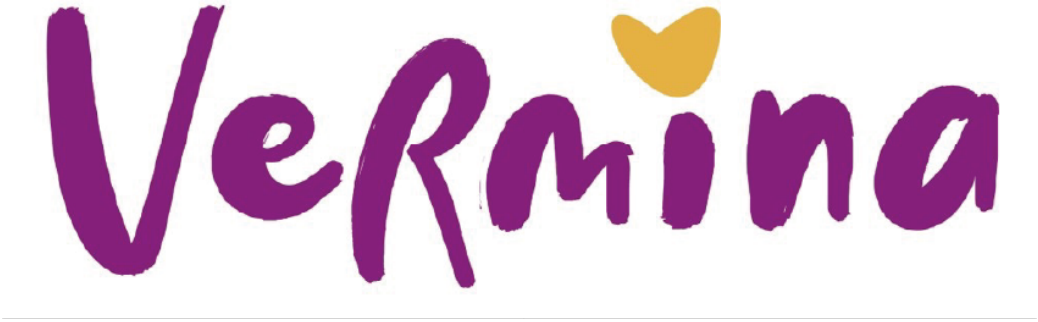
NAOUSSA

ACN Naoussa numbers 1457 members-producers and is perhaps the most dynamic cooperative in Greece, channelling over 25,000 tonnes of fresh fruit to the domestic and international markets each year. The Cooperative wishing to ensure the highest possible quality for the consumer has developed a dynamic system of integrated production management certified by AGROCERT for peaches, apples, cherries and plums. The Agricultural Cooperative of Naoussa owns a property of 41,259 sq m at Kopanos Anthemion and 3,437 sq m at Naoussa. The facilities, which cover a total of 13,682 sq m, are among the best in the country as they are located at the heart of fruit production areas.

Diamond sponsor



ASEPOP Naoussa is collecting agricultural products from the agricultural producers-members of the Cooperation, who cultivate the most fertile regions in Imathia, on the feet of the «Vermion» Mountain. The unique microclimate of this specific region has led to the naming of the cultivated peaches as Products with Protected Designation of Origin (PDO Products). ASEPOP Naoussa has been a dynamic presence in the market for more than half a century and is always beside its customers with the best fruit and vegetables. Now, it is launching a new initiative which will give a boost to its PDO peaches and all the other its produce. It has created a strong new brand with VERMINA as its trade name and logo. VERMINA comes from a combination of the names Vermio and Naoussa. It combines all the positive aspects of the wonderful Vermio mountain range with the tradition and know-how of the producers from Naoussa who cultivate the highly fertile areas at the foot of the mountains.

Platinum Sponsors

Venus Growers is an Agricultural Cooperative activated in Northern Greece, dealing with the farming, harvesting and processing of Deciduous fruits (peaches, Nectarines, Pears, Apricots etc.). The capacity is 60.000 tn and the turnover is ca. 80 M€ with more than 97% of sales exported to Retail and Institutional markets worldwide. The fruits are sourced from associated members-famers and other cooperatives located mainly in Central Macedonia and other regions in Greece. The processing is done in two modern facilities installed in 19 Ha. The vertical structure of the company (from the plantation of the trees to the delivery of the finished products) secures the sustainable growth of the business for the farmers and Venus Growers.

Yara grows knowledge to responsibly feed the world and protect the planet. Supporting our vision of a world without hunger and a planet respected, we pursue a strategy of sustainable value growth, promoting climate-friendly crop nutrition and zero-emission energy solutions. Yara's ambition is focused on growing a nature positive food future that creates value for our customers, shareholders and society at large and delivers a more sustainable food value chain. To achieve our ambition, we have taken the lead in developing digital farming tools for precision farming, and work closely with partners throughout the food value chain to improve the efficiency and sustainability of food production. Through our focus on clean ammonia production, we aim to enable the hydrogen economy, driving a green transition of shipping, fertilizer production and other energy intensive industries. Founded in 1905 to solve the emerging famine in Europe, Yara has established a unique position as the industry's only global crop nutrition company. We operate an integrated business model with around 17,000 employees and operations in over 60 countries, with a proven track record of strong returns. In 2021, Yara reported revenues of USD 16.6.

Platinum sponsors

Syngenta Crop Protection and Syngenta Seeds. Our ambition is to help safely feed the world while taking care of the planet. We aim to improve the sustainability, quality and safety of agriculture with world-class science and innovative crop solutions. Our technologies enable millions of farmers around the world to make better use of limited agricultural resources. Syngenta Crop Protection and Syngenta Seeds are part of Syngenta Group with 49,000 people in more than 100 countries working to transform how crops are grown. Through partnerships, collaboration and The Good Growth Plan, we are committed to accelerating innovation for farmers and nature, striving for carbon neutral agriculture, helping people stay safe and healthy, and partnering for impact.

BASF creates chemistry for a sustainable future. We combine economic success with environmental protection and social responsibility. Around 111,000 employees in the BASF Group contribute to the success of our customers in nearly all sectors and almost every country in the world. Our portfolio comprises six segments: Chemicals, Materials, Industrial Solutions, Surface Technologies, Nutrition & Care and Agricultural Solutions. Farming is fundamental to provide enough healthy and affordable food for a rapidly growing population while reducing environmental impacts. Working with partners and agricultural experts and by integrating sustainability criteria into all business decisions, we help farmers to create a positive impact on sustainable agriculture. That's why we invest in a strong R&D pipeline, connecting innovative thinking with practical action in the field. Our portfolio comprises seeds and specifically selected plant traits, chemical and biological crop protection, solutions for soil management, plant health, pest control and digital farming. With expert teams in the lab, field, office and in production, we strive to find the right balance for success – for farmers, agriculture and future generations.

Platinum sponsors

Corteva Agriscience Hellas is a pure-play agriculture company that provides farmers with the most complete portfolio in the industry - including a balanced and diverse mix of seed, crop protection and digital solutions focused on maximizing productivity to enhance yield and profitability. With some of the most recognized brands in agriculture and an industry-leading product and technology pipeline well positioned to drive growth, the company is committed to working with stakeholders throughout the food system as it fulfills its promise to enrich the lives of those who produce and those who consume, ensuring progress for generations to come.

Hellagrolip is a leader in the Greek market, as the only producer and commercial fertilizer company in Greece. Our market presence is the result of high quality, deep knowledge and long experience in crop nutrition. The multiple advantages and excellent quality features of our products create strong brands, recognized among the top in the world, and their name is inextricably link to the development of Greek Agriculture. We utilize research and our highly-trained staff, and we produce a full line of innovative nutritional products, covering the entire range and the requirements of modern agriculture.

Gold sponsors

Vitro Hellas was founded in 1986 with headquarters in Niseli Alexandria in Imathia. The mission of the company is the production and distribution of high-quality plant material through the monitoring of new trends in the agricultural sector and the expansion of collaborations and research activities in order to develop new technologies, products and markets.

Tsesmelis Fruit and Nut nursery is dedicated to the production of healthy, certified and high-quality young tree plants. We represent the best breeders of varieties. Varieties that are making a big difference for our local and international clients. We are a family business and our experience of more than 40 years is guiding us to the future.

Neos Alikakmon was founded in 1968 when a group of peach producers decided to work collectively to sell their production. Today the coop uses modern refrigerator and sorting facilities with new technology equipment, continuously investing in the quality of the products. The cooperative produces apples, cherries, apricots, pears, plums, lotuses (persimmon) and pomegranates, but the main production is peaches, nectarines, and kiwis. The whole production process is certified according to the standards ISO 9001/2000, ISO 22000/2005, BRC and IFS, while also an integrated management system is implemented in accordance with national standards AGRO 2 and the GLOBAL G.A.P Protocol.

Gold sponsors

Felix Instruments: Applied Food Science was founded in 2012 as a subsidiary of CID Bio-Science, Inc., putting 30 years of experience engineering plant science tools to work for the commercial agriculture sector. Focusing on pre- and postharvest applications, Felix Instruments helps fresh market professionals maximize the value of their products with their lines of NIR and gas-analysis tools. Felix Instruments' devices are used by over 500 agriculture organizations globally.

ECOMATIK GmbH presently represents one of the world's leading manufacturers of plant sensors such as dendrometers, fruit growth, transpiration, and foliage temperature sensors. In deserts and rain forests, in polar regions and the tropics, ECOMATIK sensors are valuable measurement tools in bio-, geo- or environmental sciences as well as in practical applications in agriculture, forestry, horticulture and viticulture. Plant and environmental sensors, image & video, remote data transmission, online data visualization, IoT sensor networks feeding real-time data on plant and climate parameters into intelligent algorithms of smart farming service providers. Our open framework enables us and our partners to integrate our own sensor products in addition to those from other manufacturers for use in comprehensive, customer-specific measurement and data systems. In synergy with our steadily growing network of prominent partners and selected quality suppliers, the ECOMATIK team supports you with the drive of an innovative, flexible and enthusiastic start-up combined with the experience of an established 30-year old company.

Timac Agro | ΛΥΔΑ is a subsidiary of the French group Roullier. The Roullier Group is a global power in the Agri-food sector with more than 96 production units worldwide, producing 4.8 million tonnes of finished product annually with a turnover of over 2.5 billion Euros. The aim of the Roullier Group and Timac Agro is to continuously create innovative solutions with the main aim to meet the needs of tomorrow's Agriculture. For this reason, the Roullier Group has established the world's largest specialist nutrition research center, called the CMI (Center Mondial de l'innovation Roullier), which hosts more than 100 scientists of different specialties from 15 different countries and its sole purpose is the creation of new technologies for new generation fertilizers. Our products aim not only to maximize the production, but also to optimize the quality, ensuring a greater and more sustainable income for all farmers.

Silver sponsors

EuroChem is a vertically integrated agrochemical company, combining natural resources and production bases, supported by wholly owned logistics assets and a global advisory, sales and distribution platform. Our production base is becoming more international, with assets in Russia, Lithuania, Kazakhstan and Belgium, plus a joint venture in China. These assets have ready access to key markets through our logistics and distribution network that currently covers more than 25 countries. We currently manufacture nitrogen and phosphate fertilizers and will soon launch potash operations to further enhance our product mix. Our range is of high quality and includes the well-known granular NPKs Nitrophoska®, which have about 100 years of life, but also ENTEC® and UTEC®, which through the nitrification and urease inhibitors they contain respectively, ensure the optimal use of nitrogen with the least possible losses to the environment. In recent years, the portfolio of EuroChem has been enriched with the full range of water-soluble fertilizers Aqualis™, which include raw materials and NPK fertilizers, giving tremendous flexibility to every farmer and crop.

AgroFresh is an AgTech innovator and global leader with a mission to prevent food loss/waste and conserve the planet's resources by providing a range of science-based solutions, data-driven digital technologies and high-touch customer services. AgroFresh supports growers, packers and retailers with solutions across the food supply chain to enhance the quality and extend the shelf life of fresh produce. The AgroFresh organization has 40 years of post-harvest experience across a broad range of crops, including revolutionizing the apple industry with the SmartFresh™ Quality System for more than 20 years. This is powered by a comprehensive portfolio that includes plant-based coatings, equipment and proprietary solutions that help improve the freshness supply chain from harvest to the home. Visit agrofresh.com to learn more.

Valent BioSciences LLC is a worldwide leader in the research, development and commercialization of biorational products for the agricultural, public health and forest health markets. With sales in an estimated 100 countries, the company is renowned for its innovation, best-in-class quality in manufacturing, product performance and consistency, and fully developed portfolio of sustainable solutions. The product family includes bioinsecticides, biofungicides, bionematicides, mycorrhizal fungi and plant growth regulators used in sustainable systems. Valent BioSciences' products are manufactured using proprietary fermentation processes and post-fermentation product recovery techniques rooted in pharmaceutical manufacturing, techniques the company has been perfecting for more than 50 years.

Bayer Crop Science is part of the quest to contribute to a better world, a world in which biodiversity thrives in harmony with humankind, hunger and climate change are effectively tackled by joint global actions, farms are more sustainable with plants that are more adaptive and resilient and where agriculture increases economic prosperity for all farming families and their communities. With innovative chemical & biological crop protection, seeds & traits and digital technologies & services, we strive to discover and promote farming practices that help our planet thrive and become a better place for generations to come. Megatrends such as a growing world population, climate change and changing consumer preferences drive the need for innovation in agriculture. These efforts are backed by the passion of over 33,000 employees, activities in more than 140 countries and R&D investments that are unmatched in the industry.

Agricultural Cooperative of Episkopi annually distributes 12.000.000 kg of products, 6.000.000 kg peaches, 2.000.000 kg nectarines, 3.000.000 kg kiwis and the rest 1.000.000 consists of cherries, plums and apricots. The Cooperative is certified from 2003 for both facilities and products. The facilities are in a proprietary area of 23000m² in Episkopi. The building is 7000 m² and the cool stores are able to store about 4.000.000 kg of fresh fruits. Peaches and nectarines are mainly exported in Poland, Italy, Cyprus, Ukrane, Serbia, etc., while kiwifruits are being exported in Poland, Italy, Spain, France, Saudi Arabia, UAE, USA, India, Hong Kong, etc.

Papakonstantinou Fruits was established in 1969 by Mr Nikolaos Papakonstantinou. The business has been running in a small rented warehouse until 2000. In 2000, the company moved to new private premises, while Mr Konstantinos Papakonstantinou became the general director. Mr Konstantinos Papakonstantinou gained his degree in Agriculture from the Aristotle University of Thessaloniki. In 2012, the premises were expanded and modernized. New state of the art freezing chambers were built while a new electronic fruit classifier was installed. The packing equipment was updated too and modern logo and designs were created. The business specialization together with the experience gained all these years on fruit trading, made Papakonstantinou Fruits capable to export fruit to central and eastern Europe, North Africa and western Asia. Today, the company exports fruit to more than 15 countries. Our premises are located at Monospita in Central Macedonia (9 km east of Naoussa), straight into the heart of the Greek peaches and nectarine. The company is certified by Eurocert with ISO 22000/ 2005 and Global Gap.

Q-CERT is the largest certification body based on North Greece, established in 1998. It is present in Europe, North Africa, Middle East and Asia. Our auditors are experienced industry experts in all sectors including agriculture, food industry, non-food industry, service and public sector. We stand by the fact that audits are conducted only by sector specific experienced and professional auditors. QMSCERT is a founding member of HELLASCERT, the official association of Certification Bodies in Greece. It is an EU Notified Body with number 1617. Q-CERT is the 7th largest Certification Body in Greece and one of the largest in the Balkans. It has 55 members at a permanent base and has more than 250 auditors on a contract base. We have audited more than 30.000 customers in Greece and abroad.

Bronze Sponsors

Emphyton activities in the field of agricultural crops and products are since 1964 having a unique and innovative role. It combines three related business units: The Fruit nursery tree production, the Distribution of nutritional products and bio stimulants and the Fruit Trade. Emphyton through its group of specialized technicians is providing quality service to its partners and always stand by them with cultivating suggestions and solutions that can help to develop their production techniques. Innovation, respect to partnerships, investments for low CO2 foot print are the selected steps for the next day in agriculture of Greece. GreenValue+ is the new brand name of Emphyton products with a list of "smart pesticides" harmonized with the strategy of EU for the program of Farm to Fork. GreenValue+ products are friendly to environment, to the user and of course to consumer with one powerful role to fulfil "the adaptation of plant protection to new climatic changes challenges".

Milis Nurseries has been a reference point in the production and marketing of fruit seedlings for over 60 years. Investing in human resources, it is staffed with a team of agronomists, able to meet the ever-increasing needs of its partners. Many years of experience and constant search make the company the recipient of an ever-increasing volume of information and new innovative technologies. This combination leads her to undertake and implement large projects abroad, which include all work from planting to harvest.

Agrology is a fast-growing company with long experience both in Specialty Plant Nutrition and Plant Protection Sector. Agrology's strategy is based on Science-Driven Product Development and a Customer-Centric Approach. By understanding crop and cropping requirements, creates solutions that can optimize customers' Plant Nutrition Investments. With a focus on long-term collaborations with strong local partners and research institutes in each country, Agrology's aim is to expand the local agronomic expertise by empowering its partners.

COMPO EXPERT GmbH with headquarters in Münster/Westphalia is an international company with 21 sales offices in Europe, North and South America, as well as in Asia and Africa. The company produces high-quality specialty fertilizers and biostimulants in its four fertilizer plants in Krefeld (Germany), La Vall d 'Uixó (Spain), Deinze (Belgium) and Patras (Greece), thus offering professional users safe solutions for the segments of fruits, vegetables, field crops, turf and public green as well as nursery and ornamentals. Our innovative product range includes specialty mineral and stabilized

fertilizers, slow and controlled release fertilizers, water soluble and liquid fertilizers as well as biostimulants, trace elements and soil conditioners. The high quality and innovative technology of its products, in combination with the expertise of its agronomists, ensure top quality results.

ASPIS is one of the largest processors of fruits and vegetables in Greece and among the leading in the world, for technological products from fruits and vegetables. The company produces fruit juices and pulps from a wide variety of fruits, fruit aromas and oils, fruit preparations and canned products. The high quality and innovative products of ASPIS support a large number of well-known and recognized private brands and supermarkets. In our 50 years history, with hard work and commitment, the company serves more than 70 countries around the world. Our goal is to expand our product portfolio and reach every attractive new market that we didn't have the chance to be a part of until today. ASPIS has processing units in two different areas of Greece, in Argos in Southern Greece and in Irinoupoli in Northern Greece.

FITOTECHNIKI specializes in tissue culture propagation of fruit tree rootstocks. Facilities include a micropropagation laboratory, 4 hectares of greenhousing for acclimatization and micrografting, and a nursery covering approximately 10 hectares. The company collaborates with Universities and other research institutions at Greek and European level. The laboratory produces rootstocks for stone and pome fruit species and varieties of kiwifruit, supplying Greek nurseries and exporting to several other countries. All plant material sold by FITOTECHNIKI is certified virus-free according to Greek and European regulations.

VITAPLANT is a nursery of fruit plants since 1970 with headquarters at Monospita-Naoussa, Greece. Our facilities are covering 30 hectares of nurseries, 5.000 square meters of warehouses as well as cold storages and a greenhouse under construction. Our annual production is almost 1 million plants of all kind of species such as peaches, nectarines, almonds, apples, apricots, chestnuts, cherries, lotus, pears, plums, walnuts etc. Apart our role as national market leader in Greece, we export to countries such as Algeria, Jordan, Lebanon, India, Bulgaria, Poland etc. Our goal is to produce healthy & high-quality plants as a result of our responsibility and hard work, in order to support our clients to their investments and efforts.

Agromillora Group is a worldwide leader company in the nursery sector and a benchmark in production and marketing of fruit trees and olive trees with the highest genetic and health standards. This leadership is the result of two factors: an innovative and high-tech productive system and a presence in five continents. Thanks to these factors, we have become the number one supplier of propagation for woody species in the agricultural industry. We are strongly committed to the development of global agriculture to which we contribute value through productivity enhancements. We promote the creation of more productive, healthy and resistant plants and work to implement new agronomic solutions, such as the Super High-Density techniques, new pruning systems and plant conduction systems. All these systems are much more efficient and profitable for the grower.

ASEPOP VELVENTOS is an agricultural cooperative which was founded in 1917 and consists of 400 producers with main activity the produce of fresh fruits with a total production that exceeds 15.000 tones. ASEPOP VELVENTOS is certified by ISO 9001:2000, ISO 22000:2005 Globalgap, Grasp and applies system of integrated management in agricultural production. The products of the cooperative are recognizable in international markets so much so the demand is high and in some cases the availability of products is not enough for the entire demand.

Agrohellas SA is a Greek company based in Kastanies Evros with modern facilities located in Aghialos, Thessaloniki. The company founded in 1991 from people passionate with the agricultural industry who have strong will to serve the agri-food sector with consistency and vigor. Agrohellas supports producers and breeders not only by offering them a complete plant and livestock management solution but also with the production, process and trade of unique agricultural products, aiming to modernize their agricultural holdings and businesses. Covering a wide range of activities, Agrohellas envision is to contribute to the sustainable modernization of the Greek agricultural production.

DELCOF SA was founded in 1999 and derived from the need of wider cooperation and mutual support of the biggest processed fruit industries in Greece. In the frame of this network ANALYSIS-DELCOF SA. began the same year its operation as a food, water and environmental specialized Laboratory. ANALYSIS-DELCOF's facilities are located in Naoussa which is a geographical center of intense agricultural and industrial activity. Since 2006 the laboratory is accredited by Greek Accreditation Board (ESYD) under the ISO 17025 standard. The laboratory's purpose is to provide quality analysis to all food and water industry, municipal water companies, agricultural cooperatives, trade organizations, governmental departments, as well as private individuals. The laboratories personnel expertise and the cutting-edge technology equipment offer high quality and reliable chemical and microbiological analysis.

Anadiag Hellas is an independent CRO, specialized in agrosciences services, on the European market. For over 30 years, we have been specialized in plant product registrations (plant protection products, seeds, fertilizers, biocompounds, biostimulants and biocides, etc). The head office in northern Greece is located in the city of Veria, Imathia, which is one of the most important agricultural areas in Greece. The Branch station in Crete is located in the city of Heraklion.

STORY BEHIND THE LOGO

ACADEMIC
RESEARCH

10
DECEM

CLOCK HOUSE
NAOUSSA

BLOSSOMS
AGAIN

PEACH
FRUIT

X INTERNATIONAL PEACH SYMPOSIUM

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