Recent advances on peach-brown rot interactions: searching solutions to fight in a sustainable manner

Bénédicte Quilot-Turion

«ISHS Peach webinar
Current trends and challenges
on peach fruit production»

1 - 4 June, 2021

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Cyprus University of Technology

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ISHS Peach Webinar program

Central European Time (CET)

Session 1

Tuesday
June 1, 2021
Moderator: **Theodore DeJong**

16:30 - 17:00 *Welcome Remarks*
George Manganaris - Convenor
Peter Vanderborght - ISHS Executive Director
Panayiotis Zaphiris - Rector of Cyprus University of Technology
Spilios Livanios - Minister of Rural Development & Food, Greece

17:00 - 17:30 **Maria Jose Aranzana**
"The impact of somatic mutations in peach breeding"

17:30 - 18:00 **Ksenija Gasic**
"Advances in cultivar and rootstock breeding: A case study in peach"

18:00 - 18:30 **Davide Neri**
"Current trends in training systems"

18:30 - 19:00 **Ioannis S. Minas**
"Revealing the true impact of preharvest factors on peach fruit quality development and metabolism"

19:00 - 19:30 **Questions & Answers**

Session 2

Wednesday
June 2, 2021
Moderator: **Gregory Reighard**

17:00 - 17:30 **María Fabiana Drincovich**
"The metabolic diversity of peach fruit and its usage as phytochemicals resources with roles in human nutrition and health "

17:30 - 18:00 **Juan Carlos Melgar**
"Leading the peach industry to sustainable orchard fertilization"

18:00 - 18:30 **Bo Zhang**
"Regulation of peach fruit flavor-related volatiles"

18:30 - 19:00 **Ignasi Iglesias**
"Towards enhanced peach fruit quality and reduction of production cost: a proposal of efficient training systems for future orchards"

19:00 - 19:30 **"Questions & Answers"**

ASEPOP NAOUSSA

Vermina

Session 3

Thursday
June 3, 2021
Moderator: **Jim Adaskaveg**

17:00 - 17:30 **Benedicte Quilot-Turion**
"Recent advances on peach-brown rot interactions: searching solutions to fight in a sustainable manner"

17:30 - 18:00 **Jordi Giné-Bordonaba**
"Ethylene and ROS-scavengers in peach: are these key players determining the fruit resistance to biotic stress?"

18:00 - 18:30 **Carla Casals**
"Brown rot on stone fruits: from epidemiology studies to the development of effective control strategies"

18:30 - 19:00 **Guido Schnabel**
"Biology, epidemiology and management of diseases of peach driving the spray program in the southeastern United States"

19:00 - 19:30 **"Questions & Answers"**

Session 4

Friday
June 4, 2021
Moderator: **Florin Stanica**

16:45 - 17:00 **Francois Laurens**
"XXXI International Horticultural Congress: IHC2022"

17:00 - 17:30 **Laura Rossini**
"Design and realization of the multi-site PeachRefPop collection: an international research and breeding tool for fruit trees "

17:30 - 18:00 **Nikos Papadopoulos**
"Invasive pest threatens the sustainable peach production"

18:00 - 18:30 **Thomas M. Gradziel**
"Breeding peaches for processing: challenges and opportunities"

18:30 - 19:00 **Guglielmo Costa**
"Peach chemical fruit thinning: where we are, where we can go"

19:00 - 19:30 **"Questions & Answers"**

Maria Jose Aranzana

IRTA, Centre de Recerca en Agrigenòmica CSIC-IRTA-UAB-UB, Campus UAB, Edifici CRAG, Cerdanyola del Vallès (Bellaterra), Barcelona, 08193, Spain

"The impact of somatic mutations in peach breeding"

Genetic variability is essential for breeding. Peach varieties are characterized by low levels of variability with moderate heterozygosity. This is particularly acute in varieties developed in European and American breeding programs due to two main reasons: the strong genetic bottleneck produced by the intense use of a reduced number of varieties in North American pioneer breeding programs that are currently the basis of breeding in Western countries and the self-compatibility that leads to autogamy, usually associated with a global loss of variability and. Besides the intraspecific variability, which is the major source used for commercial breeding and the interspecific variability, somatic mutations constitute an important mechanism for generating variability in peach. For commercialization, successive clones are propagated over a period of years, generating millions of new plants for farmer production. Such successive clones may accumulate somatic mutations which will be propagated to next generation clones. When somatic mutations occur in meristems, the new organs (shoots, inflorescence of single flowers) may exhibit a different phenotype from the rest of the plant. These are named bud sports. In some cases, sports producing favorable traits are selected by breeders or farmers and maintained by grafting. Genetic studies have revealed that a large number of agronomic traits in peach are monogenic or controlled by major QTLs which may explain the large number of sports commercialized as new cultivars.

Ksenija Gasic

Clemson University, Department of Plant and Environmental Sciences, 105 Collings St., Clemson, SC 29634, USA

"Advances in cultivar and rootstock breeding: A case study in peach"

Environmental challenges, changes in production systems, and human preferences are driving the need for delivery of new scion and rootstock cultivars for sustainable production. The latest innovations in science and technology are integrated in plant breeding to provide sustained solutions to production challenges and market demands. Understanding the genetics of the key traits of importance for fruit tree production and sustainability is the main generator of advances in breeding of new cultivars that can address changing needs of the fruit industry. Characterization and utilization of genetic diversity, and application of genomic technologies are needed to improve breeding efficiency in both scion and rootstock cultivar development. Functional and comparative genomics studies utilizing synteny and collinearity among species and genera are often applied in development of new cultivars with desirable traits via marker-assisted s election in breeding programs. Routine DNA-informed breeding has become reality via translation of the new discoveries into practical breeding-friendly tools and knowledge. A multidisciplinary approach that incorporates the application of modern technological tools in peach scion and rootstock cultivar development in the Clemson University peach breeding program will be presented.

Davide Neri

Università Politecnica delle Marche, Dipartimento di Scienze Agrarie, Alimentari e Ambiental i60131 Ancona, Italy

"Current trends in training systems"

Peach plants are characterized by a high morphological plasticity and adaptability. "Compensatory-adaptive" growth require the continuous control of the equilibrium between the vegetative and productive organs as well as between these organs and the root system. Traditional low density training systems were three dimensional (3D, vase systems) made up of massive and long-lived trees, with high level of autonomy and the need for labor to be properly managed. Modern intensive orchards are very specialized with a strong reduction in plant-size, consistently pursued in small open vase-bush. As well as small two-dimensional trees (2D, hedgerow systems) are becoming more popular. They are managed to begin production as early as possible, to facilitate mechanization (summer and winter pruning, fruit thinning) and to limit the use of labor per unit of product. The canopy architecture is modified by acting on the distribution of the sylleptic branches and free limbs along the stem. Pruning is dramatically reduced by limiting the interventions made to obtain preordained geometric shapes in favor of more functional shapes. Thus, the essential goal of modern pruning is the attainment of an early canopy development and a balanced and independent (natural) growth of the tree, in the context of specific planting designs and training shapes. For this reason, planting density has progressively increased up to the limits compatible with the desired production quality and quantity. Agronomic (especially fertigation), and pruning tools are primarily used to govern the "compensatory-adaptive" growth of the tree and to obtain an equilibrium between the vegetative and productive organs as well as between these organs and the root system. As a result, the tree's functioning in modern peach orchards, based on the interaction of the combination of genetic (rootstock - variety) and environmental (soil and climate) conditions, is managed with very raw pruning (eventually mechanized) acting as a powerful tool to control tree shape and size during summer and by more precise winter pruning, helped with mechanical fruit thinning in spring, to regulate the quantity and quality of its fruiting bodies.

Ioannis S. Minas

Department of Horticulture and Landscape Architecture, Colorado State University, Fort Collins, CO 80523, United States

"Revealing the true impact of preharvest factors on peach fruit quality development and metabolism"

Improvement of peach fruit quality is impossible postharvest. Hence, optimum peach quality at harvest and during postharvest and subsequent, consumer satisfaction, is achievable through understanding the influence of preharvest and orchard factors. Crop load management, fruit position in the canopy, cultivar and rootstock are important preharvest factors to balance yield, quality, and maturation in peach. However, few studies have addressed how preharvest factors impact quality and metabolism on fruit of equal maturity. Traditional methodology for fruit quality and maturity assessment is destructive and hard to adopt for field measurements. The development of precise and reliable non-destructive tools to assess physicochemical properties of fleshy fruit has been challenging. Accurate 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 true impact of preharvest factors such as crop load, canopy position, cultivar and rootstock on peach internal quality. Large-scale field evaluation showed that heavier crop loads reduced peach quality and delayed maturity, upper canopy position advanced both, while extensive tree vigor as affected by cultivar or rootstock might be detrimental for peach internal quality. Extensive and non-targeted profiling of primary and secondary metabolites was carried out using gas chromatography mass spectrometry (GC-MS) on the mesocarp and skin of equally mature peach fruit samples from various preharvest conditions. Overall, this combined physiological and metabolomic analysis provides insights into the real impact of major preharvest factors and underscores that distinct carbon sufficiency/competition or light environments may facilitate specific regulations in peach fruit quality development.

María Fabiana Drincovich

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

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

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 perfomance, 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.

Juan Carlos Melgar

Clemson University, Department of Plant and Environmental Sciences, Clemson, SC 29634, USA

"Leading the peach industry to sustainable orchard fertilization"

Current fertilization practices in commercial orchards often lead to excessive applications due to an overestimation of tree needs and the relative low cost of fertilizers. Excessive fertilizer applications can increase leaching and runoff of nutrients, and cause soil and underground water pollution, as well as nutrient imbalances that can lead to nutrient deficiencies, excessive vegetative growth and undesirable fruit quality. As fruit professional workers we often advise growers on orchard management and should consider a holistic and rational approach that recognizes the results of annual tissue and soil analyses within the framework of the specific orchard characteristics, including soil type and management, irrigation, annual climatic conditions, and plant material (age, cultivar, rootstock). This rational approach should also acknowledge the importance of nutrient reserves in perennial trees, and the impact of other orchard management practices at different tree phenological stages on nutrient mobilization to reserves, storage, and remobilization of nutrients. Furthermore, the incorporation of new technologies such as unmanned aerial vehicles, GIS mapping, and intelligent or variable rate sprayers are current valuable tools that can help us improve the efficiency and sustainability of fertilization programs of peach orchards.

Bo Zhang

Department of Horticulture, Zhejiang University, Hangzhou 310058, China

"Regulation of peach fruit flavor-related volatiles"

A perceived lack of flavor is a major source of consumer dissatisfaction with fresh market fruits. Flavor-related volatiles are major contributors to consumer liking of peach fruit. Although great progress has been made in identifying volatile chemicals, much less is known about regulation of those pathways. We have developed a comprehensive understanding of the biosynthetic pathways for flavor-related volatiles. Genome-wide association analysis was performed to expand our understanding of volatile regulation. Moreover, transcription factors associated with volatile synthesis were identified in peach fruit. In parallel, epigenetic regulation of transcription factors, volatile synthesis genes were investigated during fruit ripening and in response to postharvest handling and retail systems. Our results would greatly facilitate efforts to regulate volatile production and thus improve aroma and flavor of peach fruit.

Ignasi Iglesias

Agromillora Catalana Group, Plaça Manuel Raventós, 3. 08770 Sant Sadurní d'Anoia, Spain

"Towards enhanced peach fruit quality and reduction of production cost: a proposal of efficient training systems for future orchards"

In Spain the total surface occupied by peach in 2020 accounted for 81.530 ha, with a production of 1,340 and 1,550 t for 2019 and 2020, respectively. Around 70% of total production is exported, mainly to European countries. Prices perceived by growers from 2014, Russian veto, to 2020 are in most of the cases close to production costs, a situation not sustainable in a short or midterm for growers' profit. During this period, production costs (labour, energy, fertilizers) are increasing faster much more than peach prices perceived by the growers. In this scenario the main challenge for future European peach industry is to stablish productive models more efficient in the use of inputs, in particular labour, water, fertilizers and pest and diseases control, to reduce de cost of production compared with the traditional gobelet. Economically sustainable production requires early and high-quality yields in order to recover as soon as possible the initial investment. Intensification is required to achieve these objectives. We propose productive models based in controlling vigour rootstocks associated with planar canopies. This will result in a better sunlight distribution into the canopy improving fruit quality, providing better accessibility to labour, allowing partial or total mechanization, resulting also in a better efficiency of treatments in terms of coverage and drift reduction. Intensification in peach is possible thanks to the use of dwarfing and semi-dwarfing rootstocks as the ones from Rootpac series (Rootpac-20, Rooppac-40, Rootpac-R) from Agromillora used for training systems as central axis or biaxis. The combination of intensification with planar canopies allowed us to get in the 3rd year from 60 to 90 t/ha cumulative yield, depending on the variety, with a reduction of production cost of around 30%, compared to traditional open vase and, improving fruit size and fruit colour.

Benedicte Quilot-Turion

INRA, Génétique et Amélioration des Fruits et Légumes, INRA, Montfavet, 84143, France

"Recent advances on peach-brown rot interactions: searching solutions to fight in a sustainable manner"

Brown rot caused by Monilinia spp. provokes dramatic losses of peach in all production regions. Thus, we search solutions to fight in sustainable ways against this disease. Compounds produced by fruit, through constitutive synthesis or de novo response to stress, may play a role in controlling the infection. In the past years, we explored different ways to gain in knowledge on fruit defense against brown rot and progress towards the definition of fruit that could be more tolerant to this disease. First, we explored phenolic and triterpenoid diversity of fruit skin together with brown rot resistance. A Brazilian peach collection and an interspecific cross between P. davidiana and P. persica, each of 120 genotyped individuals, have been screened for 3 years, for susceptibility to M. fructicola and to M. laxa respectively. Some genotypes of the two populations showed low or null infection the 3 years. Correlations between compounds and infection traits led us to hypothesize that some compounds from peach skin could play a role in the brown rot control. Second, we tested the fungicide activity of different compounds in vitro. The effect of chlorogenic acid (ACQ) on M. fructicola pathogenic capacities was tested in liquid culture and HPLC, proteome and RT-qPCR analyses were conducted. The observations indicated that ACQ or its derivates can modify pathogenetic factors by modulating gene expression resulting in a modification of enzyme secretion. In addition, the impacts of triterpenoid and peel extracts on growth, sporulation and germination were tested on Petri dishes and the expression of virulence genes examined. At last, we investigated the effect of wounding the fruit on a subsequent infection, suspecting that the synthesis of new compounds after an injury can impede the fungi attack. We performed a series of experiments to study the composition of the skin after injury and in case of inoculation immediately after wounding and seven hours after wounding. Phenolic and terpenoid compounds were identified in the skin by HPLC analysis and volatile compounds were detected by GC-MS analysis. In addition, RNAseq analyses highlighted pathways activated after injury. Some of the compounds produced after injury may play an active role in plant-pathogen relations and/or activation of metabolic pathways involved in the susceptibility/resistance of peach to M. laxa. All together, these experimentations underlined the impacts of some compounds on different factors of Monilinia spp. involved in pathogenicity, paving the way for breeding strategies.

Jordi Giné-Bordonaba

IRTA, Postharvest Programme, Edifici Fruitcentre, Parc Científic i Tecnològic Agroalimentari de Lleida, Parc de Gardeny, 25003 Lleida, Catalonia, Spain

"Ethylene and ROS-scavengers in peach: are these key players determining the fruit resistance to biotic stress?"

It is already well known that ethylene plays a crucial role in peach fruit growth and ripening, by triggering an array of biochemical and physiological changes that finally make the fruit attractive for consumption. This said, ethylene is not only responsible for fruit ripening but, in conjunction with other hormones, is involved in the plant response to numerous abiotic stresses (drought, salt and heat tolerance) as well as the plant/fruit response against necrotrophic pathogens. Likewise, ROS homeostasis within the fruit controls a broad range of fruit physiological processes, including also biotic stress responses, by activating, for instance, ethylene transcription factors and the autocatalytic ethylene production. Accordingly, in this presentation we detail the role that the ethylene biosynthetic and ROS-scavenging pathways may play in the peach resistance/susceptibility to Monilinia spp. To do so, we combine multiple studies investigating (1) the changes of the ethylene and ROS-scavenging pathwaysand other metabolites along fruit growth and ripening in parallel to the fruit susceptibility to different Monilinia spp but also (2) the changes at the ethylene biosynthetic and signalling level during the peach-Monilinia interaction. Our results show that changes in the concentration of specific primary (citrate) and secondary metabolites (carotenoids and phenolic compounds) together with the fruit ethylene production capacity and/or signalling seem to determine the peach fruit resistance to Monilinia spp. infection at various fruit phenological stages, ranging from flowering to fully ripe fruit. Some of the observed pathogen induced host-responses are conserved along the different fruit phenological stages and regardless of their climacteric or non-climacteric nature. The results from these studies are discussed trying to unravel the complex regulatory networks that may led to fruit with enhanced resistance to biotic stress.

Carla Casals

IRTA, Postharvest Programme, Edifici Fruitcentre, Parc Científic i Tecnològic Agroalimentari de Lleida, Parc de Gardeny, 25003 Lleida, Catalonia, Spain

"Brown rot on stone fruits: from epidemiology studies to the development of effective control strategies"

In the last years research has been focused on the study of Monilinia spp. affecting stone fruit in 'Valle del Ebro'. The epidemiology of these fungus species was deeply investigated in the field and one of the main out comings was the development of a prediction model that indicates the risk of infection. Furthermore, the epidemiology was also studied at postharvest, providing a wide range of information regarding to the relevance of the main postharvest handling operations, the identification of fungal population in packinghouses, the fruit infection risks and the influence of temperature and humidity of conidia survival. Furthermore, many efforts have been oriented to the development of control strategies in both, pre and postharvest. Traditionally, chemical fungicides have been used to preserve the quality of fruit and vegetables over extended periods of storage or transportation. However, the growing public concern over the health and environmental hazards associated with high levels of pesticide use, have resulted in restrictions imposed by legislation and distribution companies. In this context, our main goal has been the development of environmental-friendly alternative strategies to synthetic fungicides to control Monilinia spp. in stone fruits. Although many studies have demonstrated the efficacy of these alternative treatments, only few of them are currently applied under commercial conditions. Biocontrol agents, natural compounds from different origins and physical means are the main studied approaches with different success level. There are several reasons for the limited success of these products, such as inconsistency of results, variability of the efficacy under commercial conditions, low persistence, a narrow spectrum range of activity, the difficulties in developing a shelf-stable formulated product that retains efficacy in the case of biocontrol agents and economical and regulatory limitations. Generally, it is accepted that the combination of different strategies is necessary to improve the control extent of postharvest diseases and that the real solution needs to integrate different tools to achieve the disease control. The aim of this talk is to review the main efforts conducted by our research group regarding the control of Monilinia spp. in stone fruit, from epidemiology studies to the development of effective control strategies.

Guido Schnabel,

Clemson University, South Carolina USA

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

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.

Laura Rossini

[1]Department of Agricultural and Environmental Sciences (DISAA), University of Milan, Via Celoria

"Design and realization of the multi-site PeachRefPop collection: an international research and breeding tool for fruit trees"

Exploiting the allelic diversity within available germplasm and understanding the mechanisms regulating plant interactions with t he environment are crucial to address climatic challenges and assist breeding of novel cultivars with improved resilience. In particular, the development of multi-site collections is a primary objective for conservation and utilization of genetic materials and will greatly facilitate dissection of genotype-by-environment interactions. Such resources are still lacking for perennial trees. Here we report the concept, design and realization of the first multi-site peach reference collection (PeachRefPop: PRP) located across five locations in Italy, Spain and Greece and sharing the same experimental design. In order to build a resource harnessing peach diversity and breeding history represented in European collections, the starting point were 1,262 accessions together with 1,467 individuals from 18 progenies and their parents, characterized with the 9k SNP array in the framework of the FruitBreedomics EU project (http://fruitbreedomics.com/). The sampling strategy was designed to accommodate multiple purposes and the final panel included 150 accessions and 250 progenies for a total of 400 entries, assembled by the combination of two different subsets: the first ensuring the preservation of the total allele number with the minimum number of accessions; the second subset accommodating for other scopes was chosen by experts, with a robust knowledge of peach breeding history. Genetic analyses support that PRP composition is highly representative of the diversity of peach germplasm present in European collections, as it retains all the allelic variability present within the starting panel, specifically targets defined genetic clusters and includes the most relevant phenotypic traits. Other than an invaluable tool for multi-environment GWAS and genomic prediction studies in perennial species, the PRP is configuring as the first milestone of an international collaborative project for the conservation and exploitation of peach genetic resources and a legacy for future generations.

Nikos Papadopoulos

Laboratory of Entomology and Agricultural Zoology, Department of Agriculture Crop Production and Rural Environment, University of Thessaly, Fytokou St., 38446, Volos, Greece

"Invasive pest threaten the sustainable peach production"

Biological invasions are a major threat to biodiversity, ecosystem function, sustainable agricultural production, agricultural cropping patterns, pesticide use for 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 new 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 facing several challenges including management of endemic, emerging and alien invasive pests. Commercial peach orchards are intensively controlled 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 an alternative plant protection option, is expected to further expose the European peach production to the 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 invading the Middle East, and often arriving 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 facing because of emerging and invasive pests and introduces a strategic approach to manage biological invasions considering novel concepts and approaches.

Thomas M. Gradziel
Department of Plant Sciences, University of California, Davis, California, USA

"Breeding peaches for processing: challenges and opportunities"

A major difference between processing and fresh market cultivars is that processing peaches are largely handled as a bulk commodity requiring greater fruit durability during handling and processing. Processing peach cultivars also need to have greater yields and longer orchard life-expectancies to compensate for the generally lower price for the raw product. In addition, because most flavor volatiles are l ost during processing, breeding programmes must emphasize other components of peach eating quality. While some fresh market freestone cultivars are processed, their soft melting-flesh and typical high levels of water-soluble anthocyanin pigments result in poor processed quality unless processing is by rapid freezing or drying. Consequently, approximately 80% of all processed peach cultivars utilized the non-melting clingstone type fruit. The clingstone, or high stone-to-flesh adhesion, trait is generally undesirable as it can result in endocarp or pit fragments in processed products. The clingstone trait is tightly linked genetically with the desirable non-melting trait which produces firm fruit flesh that is more resistant to physical damage during bulk fruit harvest, transport, and processing. While presenting obstacles, these qualities also allow breeding opportunities not possible with fresh market cultivars.

Guglielmo Costa
University of Bologna, Italy

"Peach chemical fruit thinning: where we are, where we can go"

Fruit thinning is a cultural management operation that consists in reducing the number of flowers or fruits to increase fruit size, improve fruit appearance and intrinsic quality to fulfil market demand. In some fruit species, such as peach and apple, fruit thinning must be performed every year. Manual, chemical and mechanical methods are used, alone or in combination, depending upon species, climatic conditions and the reliability of the method. Pome-fruits are frequently thinned using chemical methods whereas stone-fruits are routinely thinned manually. The differences between apple and peach are depending on the fact that there are many formulates to thin apple while peaches can count only on bloom thinners or ethephon at fruitlet stage. Recently, mechanical thinning has been tested and could represent a potential viable option for both stone- and pome-fruits and new molecules have been released for apple and pear (metamitron), while two naturally occurring compounds, abscisic acid (ABA) and 1-aminocyclopropane-1-carboxylic acid (ACC) are under evaluation as new chemical thinners. Quite recently, the precision and predictability of thinners responses have been significantly improved using newly developed modeling systems that monitor fruit growth or consider climate at the application time to tune up the operation of the chemical thinning, whose efficacy is dependent upon a series of internal (cultivar, fruit load, plant reservoir, etc.) and external factors (climatic conditions, frost, etc.) able to affect the plant response. Recently different research groups developed modeling tools to support decision for improving thinning performance. However, fruit abscission is a complicate physiological process influenced by a series of internal and external factors that complicate the scenario making this research sector extremely challenging and complex. In addition, the climate changes are further increasing this complexity, thus requiring more intensive and dynamic efforts that need to be coordinated within an international R&D platform to exchange information on the new molecules and the new cultivars placed on the market to set up timely strategies in the different cultivation areas. All this should be supported by the availability of structural fund policy from both institutional agency and the whole productive chain.