GROWING IN
diversity

XIII INTERNATIONAL PEAR SYMPOSIUM

MONTEVIDEO - URUGUAY
DECEMBER 4TH - 7TH 2018

Municipal Palace,
Montevideo, Uruguay

www.pear2018.uy

Presentation

The XIII International Pear Symposium will be an ideal environment for discussion and exchange of the latest information generated on pear. Scientists, researchers, students, technicians, consultants, industry people, nurserymen, growers, and other interested persons will be able to share their knowledge and experience to improve together in the challenging and amazing culture of pear.

Uruguay will be hosting the symposium and has its doors opened to show what pear production means in the country, since its beginning with the first European immigrants until today. Evolution of pear culture and the technological changes have managed to keep it as one of the main fruits produced and with good perspective for the future.

The main activities will take place in the city of Montevideo, capital of the República Oriental del Uruguay. Due to its proximity to one of the main fruit growing areas, it will be possible to visit many plantations together with the scenic touristic landscapes.

It will be an honor for us to have you participate of the symposium.

Roberto Zoppolo, Ing. Agr. PhD
Convener

Danilo Cabrera, Ing. Agr. MSc
Co - Convener

Scientific committee

Argentina

M. C. Dussi
Universidad Nacional de Comahue
Gabriela Calvo
María Dolores Raffo
INTA

China

Yuanwen Teng
Zhejiang University

South Africa

Karen I Theron
University of Stellenbosch

United States of America

Amit Dhingra
Stefano Musacchi
Washington State University
Todd Einhorn
Michigan State University
Rachel Elkins
University of California Cooperative Extension
Terence Robinson
Cornell Univesity

Belgium

Serge Remy
Jeff Vercammen
PC Fruits

Germany

Michael Blanke
University of Bonn

Portugal

Cristina Oliveira
Instituto Superior de Agronomía

Spain

Luis Asin
IRTA

Uruguay

Danilo Cabrera
Alicia Castillo
Carolina Leoni
Diego Maeso
Valentina Mujica
Jorge Soria
Roberto Zoppolo
INIA
Pedro Mondino
Vivian Severino
Ana Cecilia Silveira
Facultad de Agronomía

Organizing committee

Conveners
Roberto Zoppolo
Danilo Cabrera

Support group
Maximiliano Dini
Carolina Fasiolo
Valentina Mujica
Julio Pisano
Pablo Rodríguez
Yésica Bernaschina

Financial administration
Esteban Cisneros

Communication
Mónica Trujillo

Web
María Emilia Guinovart

Contact Information
Website: **www.pear2018.uy**
E-mail: **info@pear2018.uy**
ISBN: **978-9974-38-421-7**

Declarations of interest and sponsorship

The XIII International Pear Symposium has been declared as an event of public interest by:

MINISTERIO DE GANADERÍA AGRICULTURA Y PESCA

UruguayNatural
Ministerio de Turismo

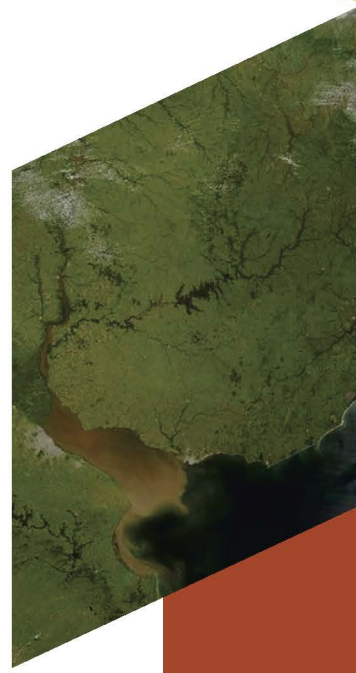
mec
MINISTERIO DE EDUCACIÓN Y CULTURA

Sponsored by:

Intendencia de Montevideo

Host country

Uruguay is a country in Southern South America, bordering the South Atlantic Ocean, between Argentina and Brazil.
With an area of approximately 176,000 km², Uruguay is geographically the second-smallest nation in South America, after Suriname.
According to FAOSTAT, Uruguay is one of the world's largest producers of soybeans (9th), greasy wool (12th), horse meat (14), beeswax (14th), and quinces (17th). Most farms (25,500 out of 39,120) are family-managed; beef and wool represent the main activities and main source of income for 65% of them, followed by vegetable farming at 12%, dairy farming at 11%, hogs at 2%, and poultry also at 2%. Beef is the main export commodity of the country.
Uruguay has a population of 3.25 million inhabitants (2011 census) of whom 1.3 million live in the capital and largest Montevideo. A very high percentage of the population has European ancestries.
The official language is Spanish.



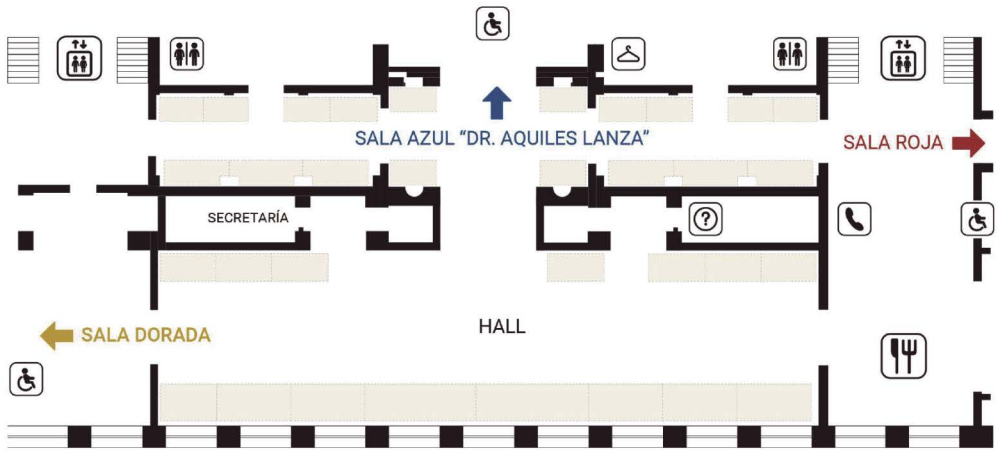
The host city

Montevideo is the capital city of the República Oriental del Uruguay, the political and economic center of the country, and the MERCOSUR administrative headquarters. It was founded between 1724 and 1730 as a fortified town next to a port on the Río de la Plata, in the big bay which holds the Cerro de Montevideo. During this period, Spanish families arrived from Buenos Aires and the Canary Islands to populate the new city.
Montevideo is a key destination in Latin America. All over the year, the city offers visitors a diverse cultural and recreational agenda, quality services, and beautiful landscapes, along with security and the typical hospitality of Uruguayans. Montevideo is also known as the seat for international congresses and events.

The Symposium venue

The Municipal Palace headquarters of the Intendencia de Montevideo, executive organ of the departamental Government of Montevideo, was designed by the Uruguayan Architect Mauricio Cravotto.

It is located on the main avenue of the city, 18 de Julio, were you will find some of the most important and historic buildings in the city, and shops of various types.
It has a Conference Center located on the 1 ½ floor. It is accessed through the main entrance (18 de Julio Av.) to the main Hall of the Municipal Palace, then go to the left where you will find the elevator that will take you to the Conference Center.



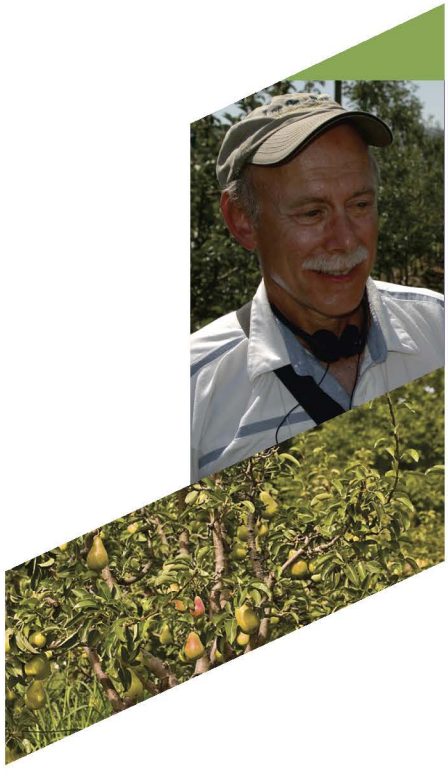
Speaker

Todd Einhorn

Michigan State University

Todd Einhorn is Associate Professor and Tree Fruits Specialist with Michigan State University (MSU). He directs a pragmatic research and outreach program focused on production efficiency of tree fruit orchards with emphases on regulation of plant growth and development, rootstock/scion interactions, flowering and fruit set biology, cold hardiness and modification of canopy architecture. Prior to joining the faculty at MSU, Einhorn led a European pear and sweet cherry research program at Oregon State University (Mid-Columbia Agricultural Research and Extension Center). Einhorn is an active member of the USDA Pyrus Clonal Germplasm Committee, secretary of the American Pomological Society and chair of the Pear committee of the USDA Multistate Research Project, NC140 (Improving economic and environmental sustainability in tree-fruit production through changes in rootstock use). He was the recent recipient of the Washington State Horticulture Association's 2016 Silver Pear Award and the Oregon, Columbia Gorge Fruit Growers 2017 Dr. Tim Facteau Award for his contributions to the Pacific Northwest tree fruit industries, most notably pear.

Speaker



David Michael Granatstein

Washington University

David Granatstein is Professor Emeritus with Washington State University, having spent the past 30 years in Wenatchee, Washington, USA, doing extension and applied research on sustainable agriculture and organic farming. Areas of focus have included orchard floor management, soil quality, organic sector trends, cover crops, ecolabeling, and Climate Friendly Farming. He organized the 2012 ISHS organic fruit symposium in Washington State and has spoken at many state, national, and international conferences. He has also participated in agricultural development projects in a number of countries.

Speaker

Stefano Musacchi

Washington State University

Stefano Musacchi is a Professor and Endowed Chair of Tree Fruit Physiology and Management at WSU. Dr. Musacchi's academic training is in Pomology (MS and PhD). He taught for 13 years at University of Bologna Italy and 6 years at the University of Bolzano. He joined Washington State University 5 years ago and he has established a broad research program that covers orchard management and fruit quality. He is the PD of several projects. A special mention is for the "Identifying and Managing Sources of Quarantine-Significant Post Harvest Diseases in Pacific Northwest Apple and Pear Orchards" project funded by the USDA Foreign Agricultural Service's Technical Assistance for Specialty Crops (TASC). This project has been funded for 5 years (2014-2019) with a total budget of $1.9 million. In his brief time at WSU he has already attracted in total over $8.78M. In Italy he was the National coordinator of the "Management and Crop Innovations for High-Quality Pear Production" project (€3.5 million). He is currently supervising the "Pear Breeding Rootstocks and Cultivars" project based in Bologna (€350,000).

In 2014, Dr. Musacchi patented 4 new pear cultivars. He has 63 English-language publications and 86 publications in Italian. He serves in the editorial board of several Journal: Agronomy, eJHS (European Journal of Horticultural Science), AIMS Agriculture Journal and Asian Journal of Life Sciences.

Speaker

Yuanwen Teng

Zhejiang University

Dr. Yuanwen Teng is Professor at the College of Agriculture and Biotechnology of Zhejiang University. He obtained his Ph.D. in agricultural science in 1998 at Tottori University, Japan, after finishing his studies at the Northwestern Agricultural University, China. After some years of research at Tottori University including a postdoctoral fellowship by the Japanese Society for the Promotion of Science, he moved back to China. He has published numerous papers in international journals about his research on: molecular phylogeny, evolution, and genetic diversity of horticultural plants with emphasis on Pyrus genera; molecular mechanisms underlying fruit quality; fruit trees dormancy. He was awarded in 2015 the First prize of Natural Sciences given by the Ministry of Education of China.

Speaker

Karen Theron

University of Stellenbosch

Karen Theron has been associated with Stellenbosch University, starting as a lecturer since 1985 and later became Full Professor and Chair of the Department of Horticultural Science.

She is currently the first incumbent in the HORTGRO Chair in Applied Pre-harvest Deciduous Fruit Research at the Dept. of Horticultural Science, Stellenbosch University. As the name implies she busies herself in more applied aspects of deciduous fruit production and enjoys doing research on plant growth regulators, fruit thinning etc. She is however also still active in undergraduate teaching and post graduate supervision and has published 70 peer-reviewed scientific papers, and graduated 68 Masters- and 10 PhD-students.

Program

Monday 3rd

5:30 pm	Registration
7:00 pm	Welcome Roberto Zoppolo and Danilo Cabrera Convener XIII International Pear Symposium
7:15 pm	International Society for Horticultural Science Luca Corelli Grapadelli Division Temperate Tree Fruits
7:30 pm	International Horticultural Congress 2022 Francois Laurens President IHC 2022
	Welcome cocktail

Tuesday 4th

8:00 am	Registration
	PEAR GENETICS – ROOTSTOCKS AND CULTIVAR EVALUATION
Chair:	Jorge Soria – Jef Vercammen
8:30 am	KEYNOTE – PEAR GENETICS – **Yuanwen Teng** - DNA sequences and markers yield insights into the phylogeny of Pyrus species and genetic relationships of Asian pear cultivars
9:10 am	*Breeding French INRA-CEP Innovation scion-pear breeding program: strategies to select and release new high quality and resistant cultivars* Francois Laurens

Update of pear breeding program at CREA – Research Center of Olive, Citrus and Tree Fruit
Giuseppina Caracciolo

New Zealand Interspecific Pear Breeding program: progress on fruit quality targets
Lester Brewer

10:10 am Fruit break

Chair: Maximiliano Dini – Lester Brewer

10:50 am *Variety testing of pears in Belgium*
Jef Vercammen

Newly bred pear cultivars in integrated fruit production system in the Czech Republic
Frantisek Paprstein

Agro-morphological diversity of local and international accessions of the Spanish Pear Germplasm Bank in Zaragoza
María Teresa Espiau

Functional genomics of 'D´Anjou' pear fruit quality and maturity
Loren Honaas

12:30 am Free lunch time

ORCHARD SYSTEMS AND MANAGEMENT

Chair: Danilo Cabrera – Leo Rufato

02:00 pm KEYNOTE – ROOTSTOCKS – **Todd Einhorn** - A Rootstocks overview – Cold hardy Amelanchier hybrid rootstocks confer dwarfing, precocity, and productivity to 'd´Anjou' and 'Comice' scions

02:40 pm *Characterization of the first and second bloom of European pear cultivars in South of Brazil*
Biane de Castro

Productivity and fruit quality of Japanese pear in `Joint V-shaped trellis´
Tatsuya Seki

Early induction of pear drop using ethephon
Serge Remy

03:40 pm Fruit break

03:50 pm POSTER SESSION 1

PLANT PROTECTION, PESTS AND DISEASES

Chair: Diego Maeso – Cristina Oliveira

04:40 pm *Three pesticide spray technology for pest control annually in northern pear orchards of China*
Qi-zhi Liu

Optimizing a protocol for the high-throughput phenotyping of Armillaria resistance in pear
Sara Montanari

The morpho-anatomy of nectaries and chemical analysis of nectar of selected pear cultivars with different susceptibility to Erwinia amylovora
Milica Fotiric Aksic

Important post-harvest pathogens of pear and their dynamics in plant residues in Dutch pear orchards
Marcel Wenneker

Evening free

Wednesday 5th

08:00 am Registration

Chair: Roberto Zoppolo - Luis Asin

08:50 am KEYNOTE – ORCHARD MANAGEMENT – **Stefano Musacchi** - Physiological basis of pear pruning and light effects on fruit quality

09:30 am *Effects of tree density, tree shape, and rootstock on Bosc pear tree performance*
Terence Robinson

Return bloom and yield of ´Packham´s Triumph´ and ´D´Anjou´ pears are increased by ethephon
Mateus Pasa

Productive behavior of Williams pear (Pyrus communis L.) grafted onto different rootstocks
Danilo Cabrera

10:30 am Fruit break

10.40 am POSTER SESSION 2

Chair: Claudio García – Sara Serra

11:30 am *Quantification of capillary water input to the root zone form shallow water table and determination of the associated Bartlett pear water status*
María Dolores Raffo

Training system alternatives for Rocha and Santa Maria pear tree cultivars
Leo Rufato

Etiology of pear flower bud necrosis in Uruguay
Carolina Leoni

Fruit size and yield efficiency of European pear varieties in Central Chile
Gabino Reginato

12:50 pm Free lunch time

Chair: Vivian Severino – Terence Robinson

02:30 pm KEYNOTE – PLANT GROWTH – **Karen Theron** - The use of plant growth regulators to manipulate crop load

Plant growth regulators to increase fruit set and yield of ´Rocha´ pear trees in Southern Brazil
Bruno Carra

Dormancy release of pear trees cv. Hosui with the use of vegetable and mineral oils
Renato Vasconcelos Botelho

Yield maps in tree fruit production: Automatic system for precision agriculture implementation
Edgardo Benitez

03:50 pm Fruit break

04:00 pm POSTER SESSION 3

Chair: Valentina Mujica – Gabino Reginato

04:50 pm KEYNOTE – CULTURAL PRACTICES – **Luis Asin** - Training system, rootstocks and innovation in the orchard design

Efficient irrigation management as a tool to optimize quality and storability in 'Abbé Fétel' pear
Luca Corelli

Pollination mix: are honeybees and bumblebees good pollinators for Pyrus communis var. ´Conference´?
Jolien Smessaert

Pollinizer efficacy of several 'Celina' pollinizers in Norway, examined using microsatellite markers
Mekjell Meland

Evening free

Thursday 6th

07:45 am Depart from Montevideo to field trip

08:30 am Welcome to INIA Las Brujas – Regional Director, Dr. Santiago Cayota

08:45 am INIA Las Brujas presentation

09:00 am Uruguayan fruit industry – Fruit Research Program Director Dr. Roberto Zoppolo

09:30 am Visit field experiments

12:30 pm Lunch

02:30 pm Visit to commercial orchards

06:00 pm Wine tasting and snacks

Friday 7th

AGROECOLOGY AND SYSTEM DESIGN / TICs AND ROBOTIC

Chair: Carolina Leoni – Todd Einhorn

08:30 am KEYNOTE – AGROECOLOGY AND SYSTEM DESIGN
- **David Granatstein** - Agroecology: a strategy for greater orchard sustainability

09:10 am *Energy efficiency in a pear agroecosystem*
María Claudia Dussi

Effectiveness of conventional and portable wind machines on temperature control under different frost conditions: a spatial analysis approach
Victor Beyá

FRUIT QUALITY

Chair: Gabriela Calvo – James Mattheis

09:50 am *Cross-fertilization, self-fertilization, and gibberellin treatments in European pear and their effect on fruit quality*
Hanne Claessen

Developmental variations of different pear cultivars, early ripening and late ripening pear, in relation to stone cell development in the flesh
Li Yang

10:30 am Fruit break

10:40 am POSTER SESSION 4

11.30 am *D'Anjou pear sorting by predicted dry matter and its effect on consumer preference*
Sara Serra

A comprehensive analysis of the interplay between ethylene and other hormones during growth and development of Conference pears
Violeta Lindo García

12:10 pm *The effects of light exposure on red colour development in European pear*
Madeleine Peavey

12:30 pm Free lunch time

POSTHARVEST

Chair: Ana Cecilia Silveira – Serge Remy

02.30 pm *Utilizing the IAD index to predict ´Rocha´ pear quality and physiological disorders after storage*
Cristina Oliveira

Transcriptional differences associated with sugar metabolism between ´Nanguo´ and its mutant ´Nanhong´ pears in different post-harvest ripening stages using RNA-seq
Wang Wenhui

Maturation and ripening biology of interspecific pears
Jason W. Johnston

Optimization of the alternatives to control superficial scald in ´Beurré d´Anjou´ pear avoiding detrimental effects on fruit quality
Gabriela Calvo

IAD value at harvest as a predictor for ´Anjou´ fruit storage performance
Jim Mattheis

04:30 pm ISHS Meeting

08:00 pm Closing dinner

Abstracts of oral presentations

O1- DNA sequences and markers yield insights into the phylogeny of *Pyrus* species and genetic relationships of Asian pear cultivars

Prof. Dr. Yuanwen Teng, Dept. Of Hort., College of Agric.& Biotech., Zhejiang University, Zijingang Campus, Hangzhou 310058, China; ywteng@zju.edu.cn

The genus *Pyrus* species are widely spread through the Euro-Asian continent including North Africa. More than 35 species have been extensively recognized, of which about 20 have been treated as primary species. The *Pyrus* species are geographically divided into two native groups: occidental pears and oriental pears. However, the establishment of phylogenetic relationships in *Pyrus* has proven challenging due to lack of distinguishing characters among species and frequent hybridization in the genus. Recent studies on *Pyrus* phylogeny based on multiple DNA sequences supported the point of view of independent evolution of occidental pears and oriental pears. Phylogenetic trees inferred from nuclear LFY2int2-N (LN) data showed that reticulation evolution caused by hybridization is one of the major evolutionary modes for *Pyrus* species. Four occidental species *P. mamorensis, P. gharbiana, P. cossonii* and *P. regelii*, and one oriental species *P. betulaefolia* were shown to be monophyletic in the LN tree. *Pyrus calleryana* once treated as descendent of primitive stock *Pyrus* was found to be polyphyletic. Further study using retrotransposon-based SSAP makers found that *P. calleryana* was putative hybrid involving *P. betulaefolia* and *P. pashia*. On the other hand, pear is one of the most important temperate fruit trees. *Pyrus communis* is widely cultivated in the world except for East Asia. In East Asia, different cultivated species or types have been recognized. However, their origin is still controversial. Using different DNA markers, such as RFLPs, RAPDs, SSRs and cpDNA haplotypes, and different pear accessions, different research groups revealed that cultivars of Chinese white pears (CWP) and Chinese sand pears (CSP) have a close genetic relationship, although they are traditionally assigned to different species. Japanese pears (JP) and Chinese sand pears belong to the same species *P. pyrifolia*. However they are usually not clustered together in the dendrogram. Further analysis of genetic structure of Asian pear cultivars showed that there were no significant levels of differentiation among CWP, CSP and JP. The newest researches proved that Ussurian pear cultivars are of hybrid origin involving wild *P. ussuriensis* and cultivated *P. pyrifolia*. Much more samples from wild *Pyrus* species and new research strategies will be needed for the reconstruction of *Pyrus* phylogeny and clarification of the origin of Asian pear cultivar groups.

Keywords: *Pyrus*, phylogeny, Asian pear, DNA markers, cultivar origin

O2- French INRA-CEP Innovation scion-pear breeding program: strategies to select and release new high quality and resistant cultivars

Dr. François Laurens, IRHS -INRA, UMR 1345, INRA, SFR 4207 QUASAV, 49070 Beaucouzé , France; francois.laurens@inra.fr

Philippe Guerif, IRHS, UMR 1345, INRA, SFR 4207 QUASAV, Beaucouzé, France; philippeguerif@inra.fr

Arnaud Guyader, IRHS-INRA, UMR 1345, INRA, SFR 4207 QUASAV, 49070 Beaucouzé, France; arnaud.guyader@inra.fr

Mehdi AlRifai, IRHS-INRA, UMR 1345, INRA, SFR 4207 QUASAV, 49070 Beaucouzé, France; mehdi.al-rifai@inra.fr

Christelle Pitiot, CEP INNOVATION, 23 rue Jean Baldassini, 69364 lyon, France; cep.christel@wanadoo.fr

Scion-pear breeding programs started in 1960 at Angers France. At this time, main objectives were fruit quality, fruit maturity (both late and early) and late flowering. From the 80's, following the outbreaks of fire blight and pear scab in Europe, disease resistance breeding goals were introduced in the programs: Tens of thousands seeds and seedling were produced which combined scab (*Venturia pyrina*) and fire blight (*Erwinia amylovora*) resistance from various genetic and geographical sources. In parallel, methodologies to test susceptibility/resistance for these two diseases have been set up in greenhouse on seedlings and in orchards on adult trees. Since 2004, based on former experiences, a new breeding program is going on in partnership with CEP Innovation, a group of French nurserymen. It follows two main goals : 1) releasing new pear cultivars which combine regular and high yield, attractiveness and long storage ability for the European market and 2) building new plant material (pre-breeding) which pyramide various sources of resistance for different pathogens : scab, fire blight and *Psylla* (*Psylla pyri*). This plant material will be at the basis of the next generation of pear breeding. In the last years, genetic studies have been performed to decipher the mechanisms behind these resistances and to provide molecular tools for breeding. In this paper we will present the scion pear breeding program performed in collaboration with CEP-Innovation, provide the last main results on molecular studies and draw the perspective for Molecular Assisted Breeding on pear.

Keywords: pear breeding, disease resistance, fruit quality, molecular assisted breeding

O3- Update of pear breeding program at CREA-Research Center of Olive, Citrus and Tree Fruits

Dr. Giuseppina Caracciolo, CREA, via La Canapona 1bis, 47122 Forlì (FC), Italy; giuseppina.caracciolo@crea.gov.it

Sandro Sirri, via La Canapona 1 bis, 47122 Forlì (FORLÌ-CESENA), Italy; sandro.sirri@crea.gov.it

Dr. Gianluca Baruzzi, via La canapona 1 bis, 47122 Forlì (FORLÌ-CESENA), Italy; gianluca.baruzzi@crea.gov.it

Pear breeding activity at CREA -Research Center of Olive, Citrus and Tree Fruits of Forlì (FC) started fifty years ago. The first controlled crossings were made in 1968 and, since then, the activity has continued releasing seven varieties: Tosca (1993), Carmen, Norma and Turandot (2000), Aida and Bohème (2003) and Falstaff (2012). In the past, the breeding program has been funded with several public and private research projects. In the last decade, it has been co-funded by New Plant Consortium of Forlì which brings together the growers'associations Apofruit Italia, Orogel Fresco and Apoconerpo. Falstaff is the first variety released with New Plant co-funding. In Emilia-Romagna areas, the harvest starts in early September (25-30 days after Williams and at the same period as Abate Fétel). The skin is yellow colored, with red over-color on about 80% of the surface becoming very attractive during cold-storage. Fruit taste increases during cold-storage reaching excellent levels in winter, when it often presents a peculiar spicy aftertaste. For its commercial exploitation a "club" managed by New Plant has been set up. The main objectives of the program are: extension of the harvest time; high fruit quality and shelf life; tree resistance and/or tolerance to diseases, as fire blight (*Erwinia amylovora*) and brown spot (*Stemphylium vesicarium*) and insects (*Psilla pyri*); high nutraceutical fruit characteristics; red skin and flesh. In recent years, the European trend has been focused on red-skin pears or red-blushed ones to diversify the market. There is the need for new varieties able to diversify the product and to ensure the maintenance of high market shares. Interspecific hybrids (P. *communis* x P. *pyrifolia*) have become an interesting goal thanks to their organoleptic characteristics (very crispy, juicy and aromatic flesh). Some of the most interesting selections at an advanced stage of evaluation will be described.

Keywords: variety, hybrids, tolerance, resistance, red skin, quality

O4- New Zealand Interspecific Pear Breeding programme: progress on fruit quality targets

Lester Brewer, Plant and Food Research, Nelson Research Centre, Old Mill Road - R.D.3, 7198 Motueka, New Zealand; lester.brewer@plantandfood.co.nz

Marlene Aldsworth, Nelson Research Centre, Old Mill Road - R.D.3, 7198 Motueka, New Zealand; marlene.aldsworth@plantandfood.co.nz

Biff Kitson, Nelson Research Centre, Old Mill Road - R.D.3, 7198 Motueka, New Zealand; biff.kitson@plantandfood.co.nz

Natalie Proffit, Hawkes Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; Natalie.proffit@plantandfood.co.nz

Dr. Richard Volz, Hawkes Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; richard.volz@plantandfood.co.nz

The Plant & Food Research interspecific pear breeding programme began in 1983 when a range of European, Asian and interspecific families were created. Since 2001 the programme has focused on interspecific hybrids to create a convenient product acceptable to consumers. Strong focus has been placed on fruit quality, with up to 50 traits monitored. Progress towards achieving major breeding targets will be discussed, with emphasis on crisp firm texture, flavour development, fruit size, fruit shape, scuffing tolerance and reduction of fruit skin bitterness. We will also outline the range and sources of red skin coverage and the combinations of European and Asian pears used in the breeding programme.

Keywords: breeding, interspecific, fruit quality, *Pyrus*

O5- Variety Testing of Pears in Belgium

Jef Vercammen, pcfruit vzw, Experim. Garden Pome & Stone Fruits, Fruittuinweg 1, 3800 Sint Truiden, Belgium; jef.vercammen@pcfruit.be

Ann Gomand, Fruittuinweg 1, 3800 Sint-Truiden, Belgium; ann.gomand@pcfruit.be

Prof. Dr. Dany Bylemans, Fruittuinweg 1, 3800 Sint-Truiden, Belgium; dany.bylemans@pcfruit.be

In Belgium, with almost 90 %, 'Conference' remains the main pear variety. One main variety has as a disadvantage that a low yield (spring night frost, off-years ...) or low prices have a much larger impact on the earnings of the fruit grower and on our market position than when the risk is spread over more varieties. Variety testing is one of the most important research topics for pears in the "Experimental Garden for pome and stone fruit". Every year several new pear varieties are planted in the first screening. From each variety we plant 10 trees on Quince C or Adams (if possible with an interstem of 'Beurré Hardy' or 'Doyenné du Comice'). As reference 'Conference' is planted. For the observations we use a Descriptor list based on the IBPGR Descriptor list. A report is annually sent to the breeders/licensors. We are looking for a pear that is productive and delicious and that has a good fruit size, a good appearance, a good storability and a good shelf life. The new variety must also be optimally to grow in our climate and it must preferably be less susceptible for pests and diseases (e.g. fire blight). It is also very important that parthenocarpic fruit set is possible through sprayings with gibberellins and that the new variety can be grown in addition to 'Conference'. After 4 to 5 production years a first selection is made. From the best varieties in the first screening more trees are planted. Depending on the variety we do trials on improving the fruit set, chemical thinning, fertilisation, fruit quality, training and pruning. To test the (ideal) storage conditions we work together with VCBT (KULeuven). The eventual goal is to make a technical guide for the fruit growers. During the symposium the results of 3 varieties will be shown namely Celina/QTee®, Cepuna/Migo® and CH201/Fred®.

Keywords: Celina/QTee®, Cepuna/Migo®, CH201/Fred®

O6- Newly bred pear cultivars in integrated fruit production system in the Czech Republic

Dr. Frantisek Paprstein, Research and Breeding Institute of Pomology, Holovousy 129, 508 01, Horice, Czech Republic; fp@vsuo.cz

Dr. Jiri Sedlak, Research and Breeding Institute of Pomology, Holovousy , Holovousy 129, 50801 Horice, Czech Republic; sedlak@vsuo.cz

Pear belongs to traditional fruit crops in the territory of the Czech Republic. The acreage of commercial pear plantations moves around 750 ha in the Czech Republic in recent years. From this amount, 580 ha are included in integrated fruit production systems (SISPO). Integrated fruit production means the economic production of commercial quality crops, while giving priority to methods that are relatively safe to human health and environment friendly. Long term breeding programme of pear was finalized at the end of the 20th century. Twenty five newly bred Czech pear cultivars were the result. These cultivars were included into the national Listing of Plant Varieties. ´Bohemica´ (63 ha), ´Erika´ (35 ha) and ´Dicolor´ (25 ha) established the most successfully in commercial integrated fruit production systems. In the case of remaining newly bred pear cultivars, the acreage of production plantations is less than 5 ha. Although pear has not been commercially grown on a big scale in the Czech Republic, there is potential for a larger commercial fruit production due to favourable climatic and soil conditions. Important fruit and vegetative characters of pear cultivars recommended for commercial plantations are described in the presented paper.

Keywords: *Pyrus*, variety, breeding, plantation, description

O7- Agro-morphological diversity of local and international accessions of the Spanish Pear Germplasm Bank in Zaragoza

María Teresa Espiau, CITA, Avda. Montañana, 930, 50059 Zaragoza, Spain; mespiau@cita-aragon.es

José Manuel Alonso Segura, Unidad de Hortofruticultura, CITA de Aragon, Avda Montañana 930, 50059 Zaragoza, Spain; jmalonsos@aragon.es

A set of 34 landraces and local accessions and 39 international reference varieties from the Spanish Pear Germplasm Bank in Zaragoza (Spain) was agro-morphologically characterized based on 50 Bioversity International and UPOV descriptors (24 quantitative and 26 qualitative) in order to evaluate the agro-morphological variability of the Spanish germplasm, identify the most relevant differences with the reference cultivars and group the varieties according to their agro-morphological distances. The correlation analysis between the 24 quantitative descriptors revealed few significant correlations, four positive ('leaf blade length'-'leaf blade width', 'season of ripening'-'fruit size', 'russet around eye basin'-'russet on cheeks' and 'russet on cheeks'-'russet around stalk') and one negative ('leaf blade width'-'ratio length/with'). The traits showing the highest phenotypic variability were 'fruit size', 'fruit firmness', 'fruit acidity', 'leaf distance from the stipules to the petiole base', and 'length of leaf pointed tip'. As a whole, the Spanish accessions were more precocious in flowering and ripening time than the international reference group, showed a bigger flower petal size, a smaller fruit size, a more rounded fruit shape, less incidence of skin russet amount and more 'spreading' fruit attitude of sepals. The dendrogram obtained from the agro-morphological distances does not group the accessions according to their geographical origin; nevertheless a small group of Spanish cultivars ('Don Guindo', 'L-3.2.10' 'Duquesa Barreda', 'Limón de Verano', 'Malacara', 'Tocinera' y 'Magallón') showed a higher distance to the rest of accessions included in the study.

Keywords: *Pyrus communis*, genetic resources, agro-morphological characterization, descriptors

O8- Functional genomics of 'D´Anjou' pear fruit quality and maturity

Dr. Loren Honaas, ARS, 1104 North Western Ave, Wenatchee WA 98801, United States of America; loren.honaas@ars.usda.gov

Eric Wafula, 101 Life Sciences, University Park 16802 PA, United States of America; ekw10@psu.edu

Prof. Dr. Claude de Pamphilis, 405B Life Sciences, University Park PA 16802, United States of America; cwd3@psu.edu

Prof. Dr. Sara Serra, 1100 N. Western Ave., Wenatchee WA 98801, United States of America; sara.serra@wsu.edu

Prof. Dr. Stefano Musacchi, 1100 N. Western Ave., Wenatchee WA 98801, United States of America; stefano.musacchi@wsu.edu

Functional genomics is an emerging technological frontier in postharvest crop management. This is driven in part by exponential growth of genomics resources for specialty crops, which include genomes and transcriptomes. These global scale technologies are allowing insights into responses of Rosaceous tree fruit to modified atmospheres, various storage temperature regimes, and crop protectants in the postharvest period. These insights will allow researchers and producers to maximize favorable outcomes, especially with regard to differential at-harvest fruit status that can influence postharvest outcomes. Previous work on the samples we sequenced showed, as a function of on-tree fruit position, that pear fruit had distinct fruit quality attributes and metabolite profiles at harvest and throughout the storage period. To discover the gene activities associated with these differences, we sequenced the transcriptome of these D'Anjou pear fruit samples. A primary hurdle to analyzing European pear transcriptome data is the utility of the reference Bartlett genome; we therefore also discuss this important prerequisite and how it impacts RNA-Seq analysis.

Keywords: RNA-Seq, transcriptome, de novo assembly, postharvest

O9- Cold hardy Amelanchier hybrid rootstocks confer dwarfing, precocity, and productivity to 'd'Anjou' and 'Comice' scions

Todd Einhorn, Michigan State University, Horticulture, 1066 Bogue Street, Plant & Soil Sciences Building A338, East Lansing, MI 48824, United States of America; todd.einhorn@oregonstate.edu

Felicitas Dittrich, Bayerisches Obstzentrum BayOZ, Am Süssbach , 85399 Hallbergmoos, Germany; df@bayoz.de

Prof. Dieter Treutter, Technische Universität München TUM, Fachgeb, 85354 Freising, Germany; dieter.treutter@wzw.tum.de

Michael Neumüller, Bayerisches Obstzentrum BayOZ, Am Süssbach , 85399 Hallbergmoos, Germany; nm@bayoz.de

The principal pear production regions of the world depend on rootstock clones from *Pyrus* sp. (pear) or *Cydonia oblonga* (quince). *Pyrus* rootstocks are vigorous and confer insufficient precocity to scions to facilitate high-density orchards. Alternatively, quince rootstocks lack adequate cold hardiness for northern regions and are susceptible to fire blight and iron chlorosis. A breeding program with selection pressure toward dwarfing, cold hardiness, productivity, and sensitivity to iron-chlorosis was developed at the Bavarian Centre of Pomology and Fruit Breeding (BCPFB), Hallbergmoos, Germany. Selections of *Amelanchier* sp. were developed from intra- and interspecific hybridization. Graft compatibility was evaluated with 'Doyenné du Comice'. Compatible selections were screened for resistance to key pathogens including inoculation with *Candidatus Phytoplasma pyri* (pear decline phytoplasma). Amelanchier were non-hosts for pear decline and tolerated -40°C during dormancy. Field performance trials were established at the BCPFB ('Doyenné du Comice' and 'Beurré Hardy') and Hood River, Oregon, USA ('Beurré 'd'Anjou'). In Germany, Amelanchier rootstocks conferred greater dwarfing than Pyrodwarf (*Pyrus communis*), Quince A or Quince C. Yield efficiency (YE) of 'Comice' and 'Hardy' was more than twofold 'Pyrodwarf' and similar to 'Quince C'. In the USA, Amelanchier clones were compared to Old Home × Farmingdale 87 (OH×F 87) in a 1 × 3 m (2,989 trees/ha) high-density planting. Amelanchier markedly increased precocity in the 3rd leaf (~50 flower clusters/tree) compared to OH×F 87 (5 flower clusters/tree). Tree yield on Amelanchier increased between the 3rd leaf (6.3 tons/ha) and 6th leaf (36.4 tons/ha). Tree yields on OH×F 87 did not begin until the 4th leaf and were insignificant until the 6th leaf when yield was twofold that of Amelanchier (71.7 tons/ha), resulting in similar cumulative yields between rootstocks. However, Amelanchier trees were ~half the size of those on OH×F 87, thus cumulative YE of Amelanchier was double OH×F 87.

Keywords: *Pyrus* sp., *Cydonia oblonga*, production, Amelanchier, yield efficiency

O10- Characterization of the first and second bloom of European pear cultivars in South of Brazil

Dr. Biane de Castro, Av. Bento Gonçalves 7712, 91540-000 Porto Alegre-RS, UFRGS - Faculdade de Agronomia, Departamento de Fitotecnia, Brazil; bianedecastro@gmail.com

Prof. Dr. Gilmar Arduino Bettio Marodin, Av. Bento Gonçalves 7712, UFRGS - Faculdade de Agronomia, Departamento de Fitotecnia, 91540-000 Porto Alegre-RS, Brazil; marodin@ufrgs.br

Pedro Henrique Guardiola Ferreira, Av. Bento Gonçalves 7712, UFRGS - Faculdade de Agronomia, Departamento de Fitotecnia, 91540-000 Porto Alegre-RS, Brazil; pedro_hgf@yahoo.com.br

The aim of this study was to characterize the first and second bloom of 'Abate Fetel', 'Clapp's Favourite', 'Packham's Triumph', 'Rocha', 'Santa Maria' and 'Williams' pears cultivated in South of Brazil. The experiment was carried out in São Francisco de Paula city (29°05'50"S; 50°50'14"W, altitude 892 m), Rio Grande do Sul State, Brazil, a city which presents around 395 chilling hours (below 7,2° C) per season. Types of blooming sequence of flowers in the inflorescence, mass of inflorescences and flowers, number of flowers, floral components and anomalies were characterized of the first and second bloom. Production, morphology, size and viability of pollen grains parameters of first and second bloom were also evaluated. Centripetal blooming sequence of 'Abate Fetel' and 'Clapp's Favourite' and centripetal variant opening order of 'Williams' produced more flowers than divergent type 'Santa Maria', default changed by alternate bud differentiation. The sequence of blooming in 'Rocha' and 'Santa Maria' was divergent. 'Abate Fetel', 'Clapp's Favourite' and 'Santa Maria' emitted second spring bloom from the shoots of the year. Second bloom was the main source of anthers and pollen grains in 'Santa Maria' which can lead to higher rate of pollen germination than in the first bloom. 'Clapp's Favourite' and 'Williams' showed great pollen viability, rate of pollen germination, anthers differentiation and production of pollen grains per flower and per anther. Floral abnormalities were observed in all cultivars, being more frequent in secondary bloom. Changes were observed in the development and quantity of stamens and pistils, as well as the inversion and fusion of floral whorls. Petal-shaped stamens were the main change.

Keywords: inflorescences, floral components, floral anomalies, viability of pollen grains, rate of pollen germination

O11- Productivity and fruit quality of Japanese pear in `Joint V-shaped trellis´

Tatsuya Seki, 1617 Kamikisawa, Hiratsuka 2591204, Japan; seki.h908@pref.kanagawa.jp

Kenichiro Shibata, 1617 Kamikisawa, Hiratsuka Kanagawa 2591204, Japan;
shibata.z0m6@pref.kanagawa.jp

Kyosuke Hirose, 1617 Kamikisawa, Hiratsuka Kanagawa 2591204, Japan;
hirose.bsb@pref.kanagawa.jp

In Japanese pear production, unique cultivation system by using flat trellis has been established in order to protect from climate disaster such as tropical storm and to maintain stable production. In this flat trellis cultivation, fruit production with high quality is reached through even sunlight reception and intensive management. But there are several disadvantages such as high initial cost of flat trellis, needs of highly trained technique and a lot of labor for pruning, etc. On the other hand, tree joint training system is now spreading in the fruit tree production areas as effective replanting technology, because it enables earlier establishment of orchard and labor saving management. For future, to cope with expanding orchard scale for stability of orchard management is necessary. We have invented and studied a new system called 'Joint V-shaped trellis' which is focused on earlier establishment of orchard, higher productivity and labor saving than flat trellis tree joint training system. In this study, we examined the effect of change of the angle of lateral branches from conventional flat position of flat joint training system into Joint V-shaped slanting angle on yield, fruit quality, and tree growth. In conclusion, productivity of joint V-shaped trellis is higher than conventional flat trellis tree joint training system. Using 6 year old trees of 'Korei' and 'Natsumizu', yield was around 20 t・ha-1 and there was little difference of Brix % between both systems, though there was slight decrease of fruit size in 'Korei'. Furthermore, there seemed not to be a concerned quality decline in the basal part of lateral branch because difference of Brix % in height of fruit setting position was small.

Keywords: Japanese pear, Joint V-shaped trellis, replanting, labor saving

O12- Early induction of pear drop using ethephon

Wim Verjans, Pcfruit Research Station , Fruittuinweg 1, 3800 Sint-Truiden Kerkom, Belgium; wim.verjans@pcfruit.be

Hilde Schoofs, Pcfruit Research Station, Fruittuinweg 1, 3800 Sint-Truiden Kerkom, Belgium; hilde.schoofs@pcfruit.be

Prof. Dr. Dany Bylemans, Pcfruit Research Station, Fruittuinweg 1, 3800 Sint-Truiden Kerkom, Belgium; dany.bylemans@pcfruit.be

Dr. Serge Remy, Pcfruit Research Station, Fruittuinweg 1, 3800 Sint-Truiden Kerkom, Belgium; serge.remy@pcfruit.be

In recent years the acreage of 'Conference' pear has been steadily increasing in Belgium reaching above 10.000 ha and rendering it the most important fruit in terms of production and economic value. However, this strong growth can have sometimes unfavourable effects. In 2014 the climatological conditions during pear bloom as well as during the rest of the season were excellent. Consequently, there was a risk of overproduction and the prices of pears were decreasing rapidly. The Russian embargo in August 2014 on Belgian pears worsened the situation and the European non-harvest regulation or intervention became effective to avoid destabilization of the European fruit market. The question arose how the non-harvested pears can be forced to drop early because the growers want to economize on the harvest cost and avoid further energy investment by the trees in fruit development. Trials were initiated at Pcfruit on several cultivars using ethephon, which yields the plant hormone ethylene that enhances fruit abscission. Variable doses (0.5 to 2.0 L/ha) and number (1 to 2) of applications at harvest to induce early pear drop were tested. One application of 1.0 L/ha ethephon fastened fruit drop by 2 weeks in 'Conference' and 'Doyenné' to 4 weeks in 'Durondeau' compared to their respective natural fruit drop. The most clear dose response in pear drop enhancement was observed in 'Durondeau' followed by 'Conference', and finally 'Doyenné' in which no difference in pear drop was seen between 2.0 L/ha and 1.0 L/ha ethephon. A strong storm in June 2016 and several subsequent hail storms caused severe damage on pears necessitating fast removal of the pears from the trees. However, trials at Pcfruit in that year clearly demonstrated that with applications two and even one month before harvest ethephon (up to 2.0 L/ha) cannot induce a significant pear drop.

Keywords: abscission, Conference, Doyenné du Comice, Durondeau, ethylene, fruit fall

O13- `Three pesticide spray´ technology for pest control annually in northern pear orchards of China

Prof. Dr. Qi-zhi Liu, China Agricultural University, Yuan Mingyuan West Road 2, Haidian distric, Beijing, 100193, China; lqzzyx163@163.com

Xiao-min Zhao, China Agricultural University, Yuan Mingyuan West Road 2, Haidian distric, Beijing, 86, 100193, China; 206761886@qq.com

Chemical pesticides seriously affect ecological environment and fruit safety. Currently about ten pesticide sprayings are done every year in most pear orchards for pest and disease control in Northern China.Based on more than ten years of our investigation data on main pear pest and disease occurrence characteristics, "three pesticide spray" technology and techniques were figured out, combined with the roles of natural enemies and the techniques of paper bag cover on pear fruits after fruit bearing and corrugated paper tied on tree trunks or main branches. Each spray time was defined by phenological period and/or the average air temperature of past ten days. The pest and disease population were controlled down to economic threshold level. The "three pesticide spray" technique is the following: First spray: Pear flower bud finished dormant phase and just started sprouting phase, 5° lime sulfur (Calcium polysulfides) was recommended to control the population of *Psylla chinensis, Grapholitha molesta, Tetranychus urticae, Cladosporium cucumerinum, Phyllactinia pyri* and *Physalospora piricola*, even though some insect pests and pathogens haven't or just finished their hibernation. Second spray: Petal fall about 80-90%, most insect pests were in the phase of post-hibernation. A*abamectin* , *acetamiprid, chlorpyrifos, captan, difenoconazole* , or other commercially available pesticides and fungicides with the same function could be used for control of *P. chinensis, G. molesta, T. urticae, Panonychus ulmi, Aphanostigma jakusuiense, Janus piri, Hoplocampa pyricola, C. cucumerinum, P. pyri* and *P. piricola, Gymnosporangium haraeanum* during this period. Third spray: Just before paper bags are put to cover pear fruits (thumb finger size), available pesticides include: imidacloprid, abamectin, thiophanate-methyl or mancozeb or any other commercial products of the same function. The main pest objects were P. *chinensis, G. molesta, T. urticae, T. urticae, P. ulmi, Pseudococcus comstocki, Schizaphis piricola, C. cucumerinum, P. pyri, P. piricola, Gymnosporangium haraeanum.*

Keywords: pear orchards, pest control, chemical pesticide spray time reduction

O14- Optimizing a protocol for the high-throughput phenotyping of Armillaria resistance in pear

Dr. Sara Montanari, UC Davis, Dept. Plant Sciences, MS4, One Shields avenue, Davis CA 95616, United States of America; smontanari@ucdavis.edu

Sugae Wada, Oregon State University, Horticulture Department, Corvallis OR, United States of America; sugae.wada@oregonstate.edu

Charles Leslie, UC Davis, Dept. Plant Sciences, One Shields avenue, Davis CA 95616, United States of America; caleslie@ucdavis.edu

Rachel Elkins, UC Cooperative Extension, Lakeport CA, United States of America; rbelkins@ucanr.edu

Kendra Baumgartner, USDA-Agricultural Research Service, Crops Pathology and Genetics Research Unit, Davis CA 95616, United States of America; kbaumgartner@ucdavis.edu

David Neale, UC Davis, Dept. Plant Sciences, MS4, One Shields avenue, Davis CA 95616, United States of America; dbneale@ucdavis.edu

Armillaria root disease is a serious threat to pear and other economically important tree crops throughout the United States. In California, the species of root pathogen, *Armillaria mellea*, kills and decomposes woody roots, limiting vigor and yield and, eventually, killing trees. There are neither practices to eradicate the pathogen from infected trees nor therapeutic methods that counteract the reduced productivity and tree death. No pear rootstock is currently known to be resistant, which limits options for replanting infected trees. In order to identify sources of resistance to be implemented in pear rootstock breeding programs, a phenotyping assay for the screening of large numbers of pear accessions is necessary. The objective of this work is to optimize a protocol for high-throughput phenotyping, which we would then use to screen the *Pyrus* core collection (~200 genotypes) of the USDA National Clonal Germplasm Repository in Corvallis, OR. High-quality phenotypic data from such a large and genetically diverse collection could then be used for association studies. Currently, the only phenotyping protocol is an in vitro assay developed for grape and, subsequently, adapted to almond, peach, and walnut. We tested this protocol on a small number of pear rootstock genotypes, including three different species, and evaluated its suitability for high-throughput phenotyping in pear.

Keywords: Rootstock breeding, *Pyrus, Armillaria mellea*, in vitro assay

O15- The morpho-anatomy of nectaries and chemical analysis of nectar of selected pear cultivars with different susceptibility to *Erwinia amylovora*

Assoc. Prof. Milica Fotiric Aksic, Faculty of Agriculture, University of Belgrade, 11080 Beograd – Zemun, Serbia; fotiric@agrif.bg.ac.rs
Prof. Dr. Marina Macukanovic-Jocic, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; marmajo@agrif.bg.ac.rs
Radenko Radosevic, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; botany@agrif.bg.ac.rs
Dr. Radosav Cerovic, Faculty of Tecnology and Metalurgy, University of Belgrade, 11000 Belgrade, Serbia; radosav.cerovic@gmail.com
Dr. Uros Gasic, Faculty of Chemistry, University of Belgrade, 11000 Belgrade, Serbia; urosgasic@chem.bg.ac.rs
Dr. Tomislav Tosti, Faculty of Chemistry, University of Belgrade, 11000 Belgrade, Serbia; tosti@chem.bg.ac.rs
Prof. Dr. Zivoslav Tesic, Faculty of Chemistry, University of Belgrade, 11000 Belgrade, Serbia; ztesic@chem.bg.ac.rs
Prof. Dr. Mekjell Meland, Norwegian Institute of Bioeconomy Research, NIBIO, Ullensvang, Norway; mekjell.meland@nibio.no

Erwinia amylovora is the causative agent of fire blight, a bacterial disease existing as an unsolved problem in most countries where pear (*Pyrus communis*) is grown. The primary site of colonization is the open flower. As for the establishment of the disease, the importance of various organs within the flowers is considerably different. The usual place for developing a large epiphytic population is the stigma, while actual infection is attained by the external washing (rain, heavy dew) of bacteria from the stigma to the hypanthium. It is assumed that the bacteria penetrate the tissue through the stomata, so, these openings are the main entrance sites for them, while nectar is an excellent medium for growth of fire blight bacteria. The aim of the present investigation was to study the morphology, anatomy, and histology of the nectaries and do chemical analysis of nectar of some European pears (`Bella di Giugno`, 'Williams Bartlett', ` Poire de Cure` and ` Alexander Lucas`), Asian pear cultivars (`Nijisseiki` and `Chojuro`), and interspecies hybrid ('Kieffer Seedling') with different susceptibility to fire blight. Morpho-anatomical characteristics of floral nectaries have been analyzed by light and scanning electron microscopy. Sugar profile was determined by ion chromatography, while polyphenolic profile of the nectar was elaborated by ultra-high-performance liquid chromatography (UHPLC) coupled with hybrid mass spectrometry, which combines the Linear Trap Quadrupole (LTQ) and OrbiTrap MS/MS mass analyzer. The nectar cells were located on the inner surface of the plate-like hypanthium, below the stamen filaments and the apical part of the ovary. Large differences in size and structure of the nectarines, and number of stomata, were observed in seven pear cultivars. Regarding polyphenolics, p-hydroxybenzoic acid was present in all nectar samples, while caffeic acid, p-coumaric acid and apigenin 7-O-glucoside were found only in `Chojuro`. Some of the studied traits helped clear separation of susceptible cultivars from resistant cultivars to fire blight.

Keywords: P*yrus communis L., Pyrus pyrifolia (Burm. f.) Nakai], P. pyrifolia x P. communis*, fire blight, polyphenolics, sugar

O16- Important post-harvest pathogens of pear and their dynamics in plant residues in Dutch pear orchards

Marcel Wenneker, Wageningen University and Research, Field Crops, P.O. Box 200, 6670 AE Zetten, Netherlands; marcel.wenneker@wur.nl Khanh Pham, P.O. Box 200, 6670 AE Zetten, Netherlands; khanh.pham@wur.nl

Dr. Jürgen Köhl, P.O. Box 16, 6700 AA Wageningen, Netherlands; jurgen.kohl@wur.nl

Post-harvest diseases of pear cause significant losses. Packinghouse surveys of postharvest diseases on stored pear fruit were conducted from 2012 to 2017. The most important pathogens in terms of incidence and severity were *Cadophora* spp., causing side rot on pears, and *Fibulorhizoctonia psychrophila,* causing lenticel spot on apples and pears. These pathogens, including *Neofabraea* spp., infect fruits during the growing season and remain quiescent until disease symptoms occur after several months in storage. Epidemiological knowledge of these diseases is limited. TaqMan PCR assays were developed for quantification of *N. alba* and *C. luteo-olivacea* in environmental samples. Various host tissues, dead weeds and grasses, soil and applied composts were collected in 10 pear orchards. *Neofabraea alba* was detected in 48% of samples from pear orchards. *Cadophora luteo-olivacea* was detected in 93% of samples from pear orchards. In pear orchards, *N. alba* and C. *luteo-olivacea* were found in highest concentrations in pear leaf litter and in dead weeds. Substrate colonization varied considerably between orchards. The temporal dynamics of pathogens was followed in four pear orchards. Knowledge on population dynamics is essential for the development of preventative measures to reduce risks of fruit infections during the growing season.

Keywords: epidemiology, fungal pathogens, inoculum sources, post-harvest losses, qPCR

O17- Physiological basis of pear pruning and light effects on fruit quality

Assoc. Prof. Stefano Musacchi, Washington State University, TFREC, 1100 N. Western Ave., Wenatchee, WA 98801-1230, United States of America; stefano.musacchi@wsu.edu

Today, the main trend in European orchard design is to increase planting density. High density planting (HDP) in pear is expanding due to the widespread use of quince rootstocks to reduce tree size and induce early bearing. These factors have enabled growers to develop orchard training systems for planting densities ranging from 1,000 up to 12,000 trees/ha. For densities ranging from 2,000 and 3,000 trees/ha, the main quince stocks are BA29, which has become less popular today, and the new Sydo. New quince stocks with vigor similar to Quince C are the East Malling selection QR193-16, marketed as MH, and Adams. The latter is characterised by a vigour intermediate between Quince C and Quince A; the former 10-15% higher vigour than Quince C. The most important stocks for LDPs are seedlings and clonal pear rootstocks. The clonal pear rootstock from the OHxF series include some interesting genotypes like OHxF40 (Farold® 40) in Europe and OHxF87 (Farold® 87) and OHxF97 (Farold® 97) in USA. Many training systems are suitable to increase planting density, especially the V and vertical axis systems. The big advantage of V system is a double cropping hedgewall and maximum canopy light interception. The drawbacks include higher trellis outlays and more laborious pruning due to the complicated trellis structure. New ideas regarding tree shape include plants with 2 or 4 axes so as to divide the vigor over more branches. Nurseries can provide pre-formed trees with two axes (Bi-axis) ready to be planted or, knip the trees for spindle. Fruit set is still a big problem in some environmental conditions and for some cultivars. In pear, a very intensive pruning can enhance fruit set of such cultivars as “Abbé Fétel”, “Doyenne du Comice” and “Passe Crassane”. Other cultivars like “Beurre Bosc” and “d’Anjou” require a long pruning. HDP requires an intensive management program with drip irrigation and localized applications of nutrients. Quince presents some problems like iron chlorosis that occurs when they are planted in soil with a high level of active lime. BA29 is one of the most tolerant to chlorosis. Root pruning to control vigor has become a frequent management tool in HDP and VHDP orchards. The use of protecting nets to reduce hail damage is increasingly widespread in HDP orchards to minimize the risk of fire-blight attacks.

Keywords: *Pyrus communis*, quince, rootstocks, training system, pruning

O18- Effects of tree density, tree shape, and rootstock on bosc pear tree performance

Dr. Terence L. Robinson, Dept. Horticultural Science, 630 W. North Street, Geneva, NY 14456, United States of America; tlr1@cornell.edu

Dr. Jaume Lordan, Dept. of Horticulture, Cornell University, 630 W North Street, Geneva New York 14456, United States of America; jl3325@cornell.edu

Dr. Poliana Francescatto, Dept. of Horticulture, Cornell University, 630 W. North Street, Geneva New York 14456, United States of America; pf246@cornell.edu

Leo Dominguez, Dept. of Horticulture, Cornell University, 630 W. North Street, Geneva New York 14456, United States of America; lid6@cornell.edu

The adoption of high-density pear plantings in the USA has been slow due to the lack of fully dwarfing rootstocks. Most new orchards use *Pyrus* rootstocks which lack precocity. A field trial was planted in 2013 at Cornell University in Geneva, New York, This trial compares 3 systems (Tall Spindle, V-trellis and Bi-Axis) using 3 rootstocks (OHxF69, OHxF87 and Pyro2-33), and three spacings (0.9 ´ 3.7 m, 1.4 ´ 3.7 m, 1.8 ´ 3.7 m,) with 'Bosc' as the scion cultivar. After 5 years, smaller trees were observed at 0.9 m spacing, compared to 1.4 and 1.8 m. The highest yields were observed at 0.9 m spacing (26 t/ha), followed by 1.4 m (18 t/ha), and 1.8 m (13 t/ha). Fruit was smaller for the narrowest spacing; yet, pear size was still good at 221 g on average. No significant differences regarding cumulative crop load and yield efficiency have been observed. Regarding rootstock, bigger trees were on OHxF69, followed by OHxF87, and then Pyro2-33. No differences regarding suckers and survival were observed. Fruit size was smaller on OHxF87. While no significant differences for yield were observed, crop load and yield efficiency were higher on Pyro-2-33. Bigger trees were observed for Tall Spindle and V-trellis, which is as expected as the Bi-axis system spreads the tree vigor over the two axes. Yield was highest on the V-trellis, followed by the Tall Spindle, with no difference between them. Bi-axis had the lowest yield, with significant differences compared to the V-trellis. There were no differences in fruit size and quality. Higher yield efficiencies were observed on the Bi-axis compared to either V-trellis or Tall Spindle. There was a significant interaction among spacing, rootstock, and training system in 2017 and cumulative yield per hectare. The highest cumulative yields were observed with Tall Spindle on OHxF69 and OHxF87 at 0.9 m (42 t/ha), followed by Bi-axis on Pyro2-33 at 0.9 m (41 t/ha), and V-trellis on OHxF87 at 0.9 m (39 t/ha). The lowest cumulative yields were observed with the V-trellis on Pyro-2-33 at 1.8 m (13 t/ha), and Bi-axis on OHxF87 at either 1.4 m or 1.8 m (15 t/ha).

Keywords: *Pyrus* rootstocks, Tall Spindle, V-trellis, Bi-axis, Yield efficiency, Fruit size

O19- Return bloom and yield of 'Packham's Triumph' and 'D'Anjou' pears are increased by ethephon

Dr. Mateus Pasa, 3005 Experiment Station Drive, Hood river Oregon 97031, United States of America; mateus.pasa@oregonstate.edu

Dr. Todd Einhorn, 1066 Bogue St, Room A338-C, East Lansing Michigan 48824, United States of America; einhornt@msu.edu

Dr. Alberto Brighenti, Rua João Araújo Lima, 88600000 São Joaquim-Santa Catarina, Brazil; albertobrighenti@epagri.sc.gov.br

MSc.Bruno Carra, Campus Universitário, sn, Capão do Leão, Brazil; brunocarra@hotmail.com

The objective of this study was to evaluate different rates and timings of ethephon (ETH) on return bloom and yield components of pear trees grown in two markedly different climates. In 2014 and 2015, 30-year old, low-density 'Packham's Triumph' (4 x 6 m; 417 trees ha-1) pear trees in São Joaquim, SC (Southern Brazil) were sprayed with ETH (150 and 300 mg L-1) at different timings [40, 60, 80, and/or 100 days after full bloom (DAFB)]. In 2014 and 2016, 13-year-old 'd'Anjou' pear trees in Oregon (Northern U.S.) (3.1 x 4.9 m; 672 trees/ha) were treated with ETH (150, 300 and 450 mg L-1) between 45 and 55 DAFB alone or in addition to 250 mg L-1 prohexadione-calcium [P-Ca]. P-Ca was applied when new shoots were ~5 cm and again ~90 DAFB. Experiments were arranged in randomized block designs, with four to six single-tree replications. A nonionic surfactant [0.05% (v:v)] was used in all studies. Return bloom and yield components were assessed. Yield components were not affected the year of application in any experiment. However, return bloom, number of fruit per tree and yield of all experiments were consistently and significantly increased by ETH 300 mg L-1 the year following application. In 2014, 'Packham's Triumph' return bloom and yield were increased by ETH irrespective of the time of application. This result raises questions regarding the timing and interaction of ETH and floral initiation and whether repeat applications would have cumulative effects on bloom and yield processes. In 2015, no benefits to return bloom or yield were observed from multiple applications compared to single applications. In U.S. trials, ETH 300 mg L-1 overcame significant reductions in return bloom associated with P-Ca. Results suggest that pear tree vigor on *Pyrus* sp. rootstocks may be managed without compromising production.

Keywords: *Pyrus communis*, plant growth regulators, flower bud induction, ethylene.

O20- Productive behavior of Williams pear (*Pyrus communis* L.) grafted onto different rootstocks

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones, Uruguay; dcabrera@inia.org.uy

Pablo Rodríguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; prodriguez@inia.org.uy

Alison Uberti, Federal University of Fronteira Sul - UFFS, Chapecó, Brazil; alisonuberti@hotmail.com

Dr. Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; rzoppolo@inia.org.uy

Andrés Coniberti, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; aconiberti@inia.org.uy

Edgardo Disegna, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; edisegna@inia.org.uy

Mostly used rootstocks for pears are of the genus *Pyrus and Cydonia*. The objective of this study was to evaluate production and quality of fruits of Williams cultivar on different rootstocks. Work was conducted at the National Institute of Agricultural Research - INIA Las Brujas. Williams trees were planted in 2003, being evaluated during cycles 2014/15, 2015/16, 2016/17 and 2017/18. Rootstocks were OH×F40 and OH×F69 (*Pyrus communis*), BA29, EMC and Adams quince (*Cydonia oblonga*). For quinces, Beurre Hardy (*Pyrus communis*) cultivar was used as an interestem. Spacing was 4.5m between rows, varying the space between plants, according to the expected vigor of each rootstock. For OH×F40, OH×F69 and BA29 plants were spaced 1.70m (1307 plants.ha-1), Adams 1.50m (1481 plants.ha-1) and EMC 1.30m (1709 plants.ha -1). The experimental design was a randomized block with five treatments (rootstocks), and four replications. Diameter, average fruit weight and firmness, soluble solids, number of fruits and productivity were analyzed. The data was submitted to analysis of variance by the F test and, when significant, the means were compared through Tukey's test at 5%. In the 2015/16 and 2017/2018 cycles there were no high productions due mainly to low chilling units. Fruit diameter and soluble solids did not present differences among the rootstocks tested. Quince BA29 presented greater fruit weight in relation to OH×F69 and higher firmness in relation to OH×F69 and OH×F40, in cycle 2016/17. For productivity, it was observed that OH×F40 was superior in the 2014/15 cycle. For the 2016/17 cycle all *Pyrus* rootstocks were substantially superior, and in the 2017/18 cycle they were slightly inferior to those of Cydonia. Results showed that *Pyrus* rootstocks had a much higher performance under optimal conditions, being slightly more affected when climatic conditions (chill units and precipitation) were not good for pear cultivation.

Keywords: quince, interstem, climatic conditions, Uruguay

O21- Quantification of capillary water input to the root zone from shallow water table and determination of the associated Bartlett pear water status

Maria Lucia Mañueco, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km 1190, General Roca 8303, Argentina; manueco.lucia@inta.gob.ar
Andrea Rodriguez, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km 1190, General Roca, Argentina; rodriguez.andrea@inta.gob.ar
Ayelen Montenegro, Instituto Nacional de Tecnología Agropecuaria Ruta Nacional 22 km 1190, General Roca 8332, Argentina; montenegro.ayelen@inta.gob.ar
Juan Galeazzi, Instituto Nacional de Tecnología Agropecuaria, Ruta 151 km 12.5, 8303 Cinco Saltos, Choose a country; juan.galeazzi@faca.uncoma.edu.ar
Dolores Del Brio, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km 1190, General Roca 8332, Argentina; delbrio.dolores@inta.gob.ar
Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km 1190, General Roca 8332, Argentina; curetti.mariela@inta.gob.ar
Angel Muñoz, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km 1190, General Roca 8332, Argentina; munoz.angel@inta.gob.ar
Maria Cristina Aruani, Ruta 151 km 12.5, Cinco Saltos 8303, Argentina; mcaruani@gmail.com
Dr. Maria Dolores Raffo Benegas, Instituto Nacional de Tecnología Agropecuaria, Fleming 534, General Roca 8332, Argentina; raffo.dolores@inta.gob.ar

The Alto Valle of Rio Negro and Neuquén is an intensive irrigated fruit producing area. The existence of a shallow water table modifies the water content in the soil profile. It is important to understand and quantify the capillary rise in order to enhance the irrigation management and allow the crop to achieve its maximum yield and development. The aim of this trial was to quantify and associate water content of soil profile with water status of pear trees, using different methods. In a Bartlett pear orchard planted on 2003, surface irrigated, the following variables were measured during the 2017-2018 growing season: soil water content at three depths (20 – 40 – 60 cm), water table level and electrical conductivity of the water table. Additionally, soil profile was described. Evapotranspiration (ETc) and vapor pressure deficit (VPD) were calculated with data of the automatic weather station. Stomatal conductance (Gs) was measured with a leaf porometer in three different moments of the growing season. At the same time, moisture stress index (MSI) was calculated from all Sentinel 2A images available for the season. The capillary water input into the root zone from a shallow water table is evident in the sensors continuous records. This phenomenon keeps soil water content above the water threshold proposed for those particular conditions of crop and soil. The Gs measures showed that the crop water status was appropriate and that values were high compared to those referred to deciduous trees. The MSI values obtained at the beginning of the irrigation season were the highest, but decreased as the water requirement was accomplished with a homogenous spatial distribution in the plot. These results match with the non-stressed condition observed in field condition, according to high Gs values and moisture standard in leaves structure.

Keywords: soil water balance, stomatal conductance, moisture stress index

O22- Training systems alternatives to Rocha and Santa Maria pear tree cultivars

Dr. Leo Rufato, Rua Cel Pedro Pacheco 186, 85550-000 Coronel Vivida-Parana, Brazil; leoruffato@yahoo.com.br

Prof. Dr. Aike Anneliese Kretzschmar, Av Luiz de Cames 2090, Lages-88520000, Brazil; aike.kretzschmar@udesc.br

Mariana Mendes Fagherazzi, Av Luiz de Cames 2090, Lages, Brazil; marianaargentamendes@gmail.com

Augusto José Posser, Av Luiz de Cames 2090, Lages, Brazil; augusto.posser@hotmail.com

Prof. Dr. Antonio Felippe Fagherazzi, Av Luiz de Cames 2090, Lages, Brazil; antonio.fagherazzi@gmail.com

Bruna Bernardes de Castro, Av Luiz de Cames 2090, Lages, Brazil; bbernardes.castro@gmail.com

Prof. Dr. Francine Regianini Nerbass, Av Luiz de Cames 2090, Lages, Brazil; fnerbass@hotmail.com

Vegetative and reproductive development of different training systems on European pear cultivars were analyzed in a commercial orchard in São Joaquim city, southern region of Brazil in seasons 2015/16, 2016/17 and 2017 /18 in order to determine the best combination for production in this region. Tall Spindle training systems in 45º (TS 45º) and 90º (TS 90º) and BI-AXIS at 90º were evaluated in cultivars Rocha and Santa Maria grafted on “BA 29” quince (*Cydonia oblonga*) rootstock. Plant height, stem section diameter, fresh pruning weight, branches of the year (number and length), bud fertility index, productive efficiency and productivity, were evaluated. The experiment had a randomized blocks design, in four replications, with subdivided plots. Variance analysis was performed by the F test and, when this was significant, data were submitted to Tukey test, at a 5% level of significance. No difference was observed for fresh pruning weight and bud fertility index for both evaluated cultivars and training systems. In Tall Spindle system, regardless of the arching angle used, plants reached maximum recommended height, which is approximately 90% distance between planting lines in both cultivars. Stem section diameter was higher in the TS 45 ° training systems for both cultivars, TS 90 ° and BI-AXIS in 'Santa Maria'. Hence, therefore, For São Joaquim-SC region, commercial planting of 'Santa Maria' is recommended in Tall Spindle system, due to a productivity of approximately 21 tons per hectare and productive efficiency of 60% more than 'Rocha'.

Keywords: Tall Spindle, Bi-axis, *Pyrus* spp.

O23- Etiology of Pear Flower Bud Necrosis in Uruguay

Dr. Carolina Leoni, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Rincón del Colorado 90200, Uruguay; cleoni@inia.org.uy

Felicia Duarte, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Rincón del Colorado 90200, Uruguay; delaflia@hotmail.com

Gabriela SperoniFacultad de Agronomía, Universidad de la República, Garzón 780, Montevideo 12900, Uruguay; speronig@fagro.edu.uy

Mariana Silvera, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Rincón del Colorado 90200, Uruguay; msilvera@inia.org.uy

Wanda Iriarte, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Rincón del Colorado 90200, Uruguay; wiriarte@inia.org.uy

Victoria Bonnecarrere, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Rincón del Colorado 90200, Uruguay; vbonecarrere@inia.org.uy

Pear Flower Bud Necrosis (PFBN) has been observed in Uruguayan orchards affecting fruit trees productivity. Severity of the problem is highly variable among years and despite observed in several countries, the etiology of the disease is not clear. In order to elucidate it, different activities were implemented along several years: surveys of pear orchards to quantify PFBN severity, morphological and histological studies of diseased buds, and isolation of potential pathogenic microorganisms from affected tissues. From the orchard surveys no clear association between climatic conditions (mean temperatures, precipitation, chilling hours) and PFBN were detected for the 5 years evaluated, using a 5-grade disease severity scale. Flower buds collected one month before flowering and fixed in formalin-ethanol-acetic acid solution showed necrosis associated with tumor development in bud primordia, and histological preparations from those tumors showed cell hypertropia and hyperplasia. Finally, from the diseased buds we consistently isolate bacteria and no fungi. The bacteria were gram negative, oxidase positive, fluorescent on KingB media, produced indole-3-acetic acid (measured by colorimetric analysis -absorbance at 530 nm- after addition of Salkowsky´s reagent to culture filtrates), amplified the iaaL gene from genomic DNA, and were positive for tobacco hypersensitivity test. We conclude that PFBN in Uruguay is caused by bacteria, belonging to Pseudomonas group.

Keywords: Pear flower bud necrosis; *Pseudomonas* sp.; *Pyrus communis*, Uruguay

O24- Fruit size and yield efficiency of European pear varieties in Central Chile

Prof. Gabino Reginato, Universidad de Chile, Casilla 1004, Santiago, Chile; greginat@uchile.cl

During the 2013-2014 and 2014-2015 seasons, several thinning trials were carried out in Central Chile, in 'Forelle' (4), 'Coscia' (4) and 'Abate Fetel' (1) pear orchards. In order to determine yield capacity for different cultivars and locations, the response of fruit weight and yield efficiency to crop load was established for each trial; crop load was standardized as fruits per ha intercepting 70% of the incident PAR. Thus the range of crop load varied from around 100,000 to around 500,000 fruits/ha in 'Forelle' and 'Coscia' and from 240,000 to 550,000 in 'Abate Fetel'. The response of fruit weight and yield efficiency was described by a linear equation in all cases, being the value of the constant inverse to the slope for fruit size, which means that as greater the potential size of the fruit, the greater the fruit size reduction by the effect of crop load. The production of 'Forelle' varies from 18 to 82 t/ha while the weight of the fruit falls from 205 to 162 g; 'Coscia' varies from 12.8 to 54 t / ha while decreasing from 112 to 92 g, and 'Abate Fetel' varies from 51 to 95 t / ha while the fruit size falls from 208 to 171 g.

Keywords: Crop load, PAR interception, Coscia, Forelle, Abate Fetel

O25- The use of plant growth regulators to manipulate European pear crop load

Prof. Karen I. Theron, Department of Horticulture, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa; kit@sun.ac.za

Commercial pear production requires a large, regular crop load of fruit of the right size to be economical. In commercial production, it is often found that European pear cultivars (*Pyrus communis* L.) differ in their ability to set fruit. Some cultivars naturally set too few fruit while others set too many fruit. This results in situations that either need input to increase set, while in others set needs to be reduced. In order to improve set one needs to know the reason(s) for flower or fruit drop, i.e. inadequate pollination and fertilisation, shoot growth competition or weak set potential of flowers. Various management practices can be used to improve fruit set, e.g., pruning and the use of plant growth regulators (PGRs). PGRs can be used to reduce shoot growth competition, improve flower bud quality or directly enhance fruit set. The PGRs used include such that inhibit gibberellin biosynthesis e.g., prohexadione-calcium or gibberellins that can be used to directly stimulate fruit set. Quite often fruit set is enhanced to such an extent that thinning is needed to reduce excess fruit load. Reducing the crop load by using PGRs as chemical thinning agents is widely applied in commercial pear production. The chemicals used include the following: 6-benzyladenine (6-BA), naphtylacetamide (NAD), naphthalene acetic acid (NAA), S-abscisic acid (S-ABA), metamitron, Ethephon, and abscisic acid (ABA). The concentration and timing of applications vary with the chemical used and the pear cultivar it is applied to. The chemicals can also be combined in a programme to increase efficacy. In this paper the most recent research on the use of PGRs in fruit set enhancement and fruit thinning will be discussed.

Keywords: pear production, fruit set, fruit thinning, *Pyrus communis*

O26- Plant growth regulators to increase fruit set and yield of `Rocha´ pear trees in Southern Brazil

MSc. Bruno Carra, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; brunocarra@hotmail.com

MSc. Everton Sozo de Abreu, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; sozodeabreu@hotmail.com

MSc. Maximiliano Dini, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; maxidini@hotmail.com

Dr. Mateus Pasa, 3005 Experiment Station Drive, Hood River Oregon 97031, United States of America; mateus.pasa@oregonstate.edu

Dr. Carina Pereira Pasa, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; carpers.rs@gmail.com

Dr. Poliana Francescatto, 630 W. North Street, Geneva New York 14456, United States of America; pf246@cornell.edu

Prof. Dr. Flávio Gilberto Herter, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; flavioherter@gmail.com

Prof. Dr. Paulo Celso Mello-Farias, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; mellofarias@yahoo.com.br

Low fruit set is one of the main factors leading to pear orchards poor yield in Brazil. Exogenous application of plant growth regulators (PGRs) shows great potential to overcome this problem. Recent studies report promising results of aminoethoxyvinilglycine (AVG) to increase fruit set and yield in some pear cultivars, as well as other PGRs. The objective of this study was to evaluate the effect of several PGRs, sprayed in different timings, on fruit set, yield, and fruit quality of 'Rocha' pear trees in Southern Brazil. The study was performed during the 2016/2017 growing season, in a five-year-old 'Rocha' pear orchard grafted onto quince rootstock 'BA29'. Treatments consisted of control, AVG 60 mg L-1 sprayed at 1 + 2 weeks after full bloom (WAFB); cobalt (Co) 25.6 mg L-1 + molybdenum (Mo) 38.4 mg L-1 sprayed at full bloom (FB), 1 WAFB, 2 WAFB, 1 + 2 WAFB and FB + 1 + 2 WAFB; and Kinetin (K) 0.18 mg L-1 + Gibberellic acid (GA) 0.1 mg L-1 + Indolebutyric acid (IA) 0.1 mg L-1 sprayed at FB and FB + 1 WAFB. The fruit set, total of fruits, thinned fruits, fruits per tree, yield, average fruit weight, projected yield, fruit length (L), fruit diameter (D), L/D ratio, seed number, flesh firmness and soluble solids content were assessed. Fruit set and yield are consistently increased by all treatments except K + GA + IA sprayed at FB to total of fruits, thinned fruits, yield and projected yield compared to control trees. The greatest increase in yield components was observed with AVG. Fruit weight of all treatments, but Co + Mo (FB), was reduced compared to control trees, likely as a crop load effect.

Keywords: *Pyrus communis*; fruitlet drop, fruit quality; seed number; aminoethoxyvinilglycine

O27- Dormancy release of pear trees cv. Hosui with the use of vegetable and mineral oils

Prof. Dr. Renato Vasconcelos Botelho, Dpt. de Agronomia - UNICENTRO, R. Simeão Varella de Sá, 03, Bairro Cascavel, 85040-080 Guarapuava-Paraná, Brazil; rbotelho@unicentro.br

Dr. Aline José Maia, UNICENTRO, Rua Simeão Camargo Varela de Sá 03, 85040 080 Guarapuava-Paraná, Brazil; alymaia2005@yahoo.com.br

Dr. Luis Antonio Biasi, Setor de Ciências Agrárias - UFPR, Rua dos Funcionários 1540, 80035050 Curitiba-Paraná, Brazil; biasi@ufpr.br

Thiago Marchi, UNICENTRO, Rua Simeão Camargo Varela de Sá 03, 85040 080 Guarapuava -Paraná, Brazil; marchithiago@yahoo.com.br

Cultivars of pear tree planted in regions with mild winter have deficiency of sprouting and, consequently, low productivity. Several are the compounds tested in the dormancy release in pear, however, they can be toxic, causing great environmental impact. In this sense, the objective of this work was to evaluate the effect of different oils (vegetable and mineral) on sprouting, production and catalase activity on 'Housui' pears. The following treatments were applied: 1) Control (without application), 2) vegetable oil 4% (Natur'oleo®, Stoller Co.), 3) 4% sunflower oil + mineral oil 4%, 4) mineral oil 4% + vegetable oil 4%, 5) Vegetable oil 2% + mineral oil 2%, 6) mineral oil 4% + 4% sunflower oil, 7) hydrogen cyanamide at 20 mL L-1. The following traits were evaluated: sprouting percentage of lateral buds and apical buds, number of fruits, fruit weight, yield and activity of the catalase enzyme. The highest percentage of sprouting of the lateral buds was verified for the treatment with mineral oil 4% + vegetable oil 2%, with results similar to the standard treatment with hydrogen cyanamide. For the apical buds, all treatments increased the sprouting percentage when compared to the control. All treatments increased the number and weight of fruits and yield, except the treatment with vegetable oil at 4%. There was also a reduction in the activity of the catalase enzymes in the buds for the plants treated with the different mineral or vegetable oils, evidencing their mode of action through oxidative stress, similarly to the effect of conventional treatment with hydrogen cyanamide. Based on the results it was verified that the application of mineral oil 4% + vegetable oil 2% may be a more sustainable alternative for the dormancy release of pear trees.

Keywords: *Pyrus pyrifolia*, budbreak, catalase, bud sprouting, organic system

O28- Yield maps in tree fruit production: Automatic system for precision agriculture implementation

Edgardo Benitez Piccini, Instituto Nacional de Tecnología Agropecuaria, Esteban Echeverría 164, Neuquén 8300, Argentina; benitez.edgardo@inta.gob.ar
Mauricio Romitelli, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; romitelli.mauricio@inta.gob.ar
Angel Muñoz, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; munoz.angel@inta.gob.ar
Marcelo Muñoz, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; munoz.marcelo@inta.gob.ar
Dr. Darío Fernández, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; fernandez.dario@inta.gob.ar
Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; curetti.mariela@inta.gob.ar
Pablo Fonovich, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; pablo7fonovich@gmail.com
Fredis Cabezas, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; cabezas.fredis@inta.gob.ar
Dr. Carlos Magdalena, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; magdalena.carlos@inta.gob.ar

Precision agriculture (PA) has been in continue development in the last thirty years, reaching to high levels of technological advance and information management. Differential application of supplies according to spatial and temporal variability is a common practice in extensive crops in order to optimize resources. This practice allows to obtain a better production and to reduce environmental impact and costs. However PA is not a practice adopted by growers in intensive production. Mainly because there is no technological development that allows it, beyond the studies conducted on this subject. This paper presents a simple and patented method and system that allows the automatic generation of yield maps with high resolution, in real time for intensive crops. This could be the key to give impulse to the technological development that allows adopting the PA. Besides, this system incorporates an automatic traceability and system of operation registers. This technology could be incorporated into platforms for manual harvest or into harvests trolley without affecting the work of harvesters. The system was developed and improvements were incorporated while field tests were carried out. This is composed of load cells, a GPS-RTK, RFID (radio frequency identification) systems, a panel-PC for concentration and visualization of the information and a wireless communication system. During five seasons, yield maps were generated in a `Bartlett` pear crop. Site-specific management zones were proposed through the analysis of these maps and measurements of other variables such as soil parameters and productive efficiency.

Keywords: Load cells, site-specific management, hand-harvested fruit, traceability

029 - Evolution of training systems in pear orchards

Luis Asín. IRTA-Fruitcentre. Parc Científic i Tecnològic Agroalimentari de Lleida. Parc de Gardeny, Edifici Fruitcentre. 25003 Lleida.

In the last decades there has been a tendency to increase planting density and to reduce tree height in pear orchards, this new scenario is similar in other fruit crops. The aim of this tendency is to reduce production costs and to raise faster full production. In some countries, it is based in the use of dwarfing rootstocks. There are other factors which are present like increase in land and labor costs, mechanization of some tasks, although pear tree performance is not favorable in comparison with other fruit crops. In this situation, a new plantation has more key elements, in comparison with some decades ago, and its economic profitability is defined by some factors that are to be considered.

O30- Efficient irrigation management as a tool to optimize quality and storability in Abbé Fetél pear

Prof. Luca Corelli Grappadelli, Dept. of Agricultural and Food Sciences, Università di Bologna, Via Fanin 46, 40127 Bologna, Italy; luca.corelli@unibo.it

Assist. Prof. Brunella Morandi, Dept. of Agricultural and Food Sciences, University of Bologna, Viale Fanin 46, 40127 Bologna(BO), Italy; brunella.morandi@unibo.it

Melissa Venturi, Dept. of Agricultural and Food Sciences, University of Bologna, Viale Fanin 46, 40127 Bologna(BO), Italy; melissa.venturi@studio.unibo.it.

Dr. Flavia Succi, Agrofresh Italia, Via Di Vittorio 18, 40013 Castel Maggiore (BO), Italy; fsucci@agrofresh.com

Assist. Prof. Luigi Manfrini, Dept. of Agricultural and Food Sciences, University of Bologna, Viale Fanin 46, 40127 Bologna(BO), Italy; luigi.manfrini@unibo.it

Due to climate change, evapotranspiration requirements and prolonged periods of water scarcity are increasing, while water availability for agriculture is decreasing. Irrigation intensity can be used to optimize fruit quality at harvest and after storage. This could have an important impact in pear fruit quality, due to the potential problems of this species to resume maturation after storage with 1-MCP. The aim of this study was to investigate the relations among water supply, rootstock vigour, fruit quality and storability so as to define the optimal irrigation volume to maximize plant yields and quality, while allowing water saving. A total of 36 “Abbè Fetèl” trees, half grafted on “BA29” and half on “SYDO” quince was chosen. Each group received three different irrigation volumes: 100%, 70% and 50% of commercial irrigation, respectively. After harvest, fruit were treated with 2 different dosages of 1-MCP and stored in cold rooms. During the season, shoot and fruit growth, midday water potentials, gas exchanges and dry matter content were monitored at 65, 80,103, 129, 159 days after full bloom. Fruit firmness, soluble sugar content, and ethylene production were evaluated at harvest and at 4 and 6 months after harvest. The main results of this study are that: i) fruit size was not significantly reduced by decreased irrigation, while fruit dry matter percentage and post-harvest soluble solid content increased; ii) rootstock plays a significant role in fruit quality determination as the more dwarfing rootstock allocated more resources to reproductive sinks thus leading to improved fruit quality features; iii) pre-harvest RDI led to fruit that, once treated with 1-MCP, were less subjected to external and internal disorders as well as pathogen attacks. From these results new irrigation protocols can be developed, aiming to reduce water consumption while increasing fruit quality.

Keywords: Pear, Rootstock, Irrigation, 1-MCP, Fruit Dry Matter

O31- Pollination mix: Are honeybees and bumblebees good pollinators for *Pyrus communis* var. 'Conference'?

Jolien Smessaert, KU Leuven - Crop Biotechnics, Lab of Fruit Breeding and Biotechnology, Willem de Croylaan 42, box 2427, 3001 Heverlee, Belgium; jolien.smessaert@kuleuven.be

Jef Torfs, Willem de Croylaan 42, box 2427, 3001 Heverlee, Belgium; imkertorfs@gmail.com

Prof. Dr. Olivier Honnay, Kasteelpark Arenberg 31 - bus 2435, 3001 Heverlee, Belgium; olivier.honnay@kuleuven.be

Prof. Dr. Wannes Keulemans, Willem de Croylaan 42, box 2427, 3001 Heverlee, Belgium; wannes.keulemans@kuleuven.be

Fruits crops such as apples and pears are often supplemented with honeybee colonies in the orchards to fulfil the pollination requirements. More recently some growers intend to add bumblebees to the orchards to increase the pollinator diversity and enhance the pollination process. In this study, the influence of bumblebees and honeybees on the fruit set and fruit quality of *Pyrus communis* var. 'Conference' was investigated using a cage experiment. Five different treatments were established of which four in cages: bumblebee treatment (BB), honeybee treatment (HB), a combination treatment of both bumblebees and honeybees (Combi), a control without any pollinators (Control) and an open air treatment (Open air). Each treatment contained six trees and was repeated three times. The activity of the pollinators and the pollination intensity was recorded on a daily basis. During the growing season, fruit set was monitored and at harvest fruit quality parameters such as width, length, fruit shape, weight, brix, firmness, seeds and acid content of the fruits were assessed. The bumblebees flew very intensively from flower to flower and visited half open and even closed flowers, unlike the honeybees. This behaviour resulted in damaged flowers and a reduced fruit set in the cages where bumblebees were placed. Fruit set at harvest was significantly higher in the HB treatment compared to the other treatments, whereas for seed set both the combination treatment and the HB treatment had the highest seed set. Pears from the HB treatment had the lowest length/width ratio and firmness compared to the other treatments. The Control treatment had significantly less normal shaped pears in comparison with the other treatments. Overall, bumblebees were too active on the trees in the cages, damaging the flowers and negatively impacting the fruit set. Honeybees on the other hand improved the fruit and seed set of 'Conference'.

Keywords: A*pis mellifera, Bombus terrestris*, fruit quality, fruit set, pear fruits

O32- Pollinizer efficacy of several 'Celina' pollinizers in Norway, examined using microsatellite markers

Prof. Dr. Mekjell Meland, Nibio Ullensvang , Norwegian Institute of Bioeconomy Research, N-5781 Lofthus, Norway; mekjell.meland@nibio.no

Oddmund Froynes, NIBIO Ullensvang, Lofthus, Norway; oddmund.froynes@nibio.no

Dr. Belma Kalamujic-Stroi, University of Sarajevo, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina; belma.kalamujic@ingeb.ba

Dr. Lejla Lasic, University of Sarajevo, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina; lejla.lasic@ingeb.ba

Assoc. Prof. Fuad Gasi, University of Sarajevo, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina; fudo01@yahoo.com

The Norwegian newly bred pear cultivar, Celina/QTee®, which was launched in 2010, has been released from the Norwegian breeding program that was initiated in 1983. It derived from a crossing 'Colorée de Juillet' x 'Williams'. In Norway the flowering is medium to late and it ripens in the beginning of September. It has large attractive fruits with red blush and good fruit quality, storability and shelf life. Significant areas of the ‘Celina’ cultivars are planted in other countries, mainly Europe. Generally unfavorable environmental conditions for pear pollination, during the Nordic spring, can have a very negative effect on yield quantity in Norwegian pear orchards. Therefore, it is of considerable importance to interplant multiple suitable pollinizer genotypes together with the main cultivar. In order to find the right pollinizers besides following biology of fertilization, pollinizing efficacy using microsatellites was studied at NIBIO Ullensvang. In this study, during 2017, seeds were extracted from fruits of the pear cultivar ‘Celine’. The fruits, were randomly harvested from five different orchards located in Ullensvang included NIBIO, Norway. Alongside the seeds, leaves were taken from the mother cultivar (‘Celina’) and five pear pollinizer cultivars present in the orchards (‘Fritjof’, ‘Kristina’, ‘Clara Frijs’, ‘Herzogine Elsa’ and ‘Anna’). Using eleven microsatellite markers, a genetic characterization was conducted on both the seeds and the leaves. The obtained SSR profiles were used for gene assignment analyses. The results of the genetic analyses indicate a very heterogeneous situation regarding pollination. In all cases, ‘Fritjof’, ‘Kristina’, ‘Clara Frijs’, ‘Herzogine Elsa’, and ‘Anna’ had different pollen contribution depending on the investigated orchard. Considering the mentioned conclusion, genetic analyses should be repeated in the same orchards, during an additional season, after which more conclusive results will be available.

Keywords: *Pyrus communis* L., pear seeds, paternity analyses, DNA markers

033 - Agroecology: A Strategy for Greater Orchard Sustainability

David Granatstein. Professor Emeritus. Tree Fruit Research and Extension Center

Washington State University, Wenatchee, WA USA.

Sustainability is a widely accepted agricultural goal, encompassing the optimization of economic, environmental, and social dimensions of the farming system. Agroecology – an approach to sustainability focusing on reintegrating ecology with agriculture – is receiving more attention as a possible strategy. The 'science' and the 'practice' definitions of agroecology (in contrast to the 'movement' definition) have relevance to modern pear systems, particularly for pest and disease management, and for evaluating a system's impact (e.g. Life Cycle Assessment or footprint). As researchers uncover new ecological relationships in farming systems, growers then can contemplate how they might be deployed as part of a system to improve sustainability. New findings about rhizosphere and phyllosphere communities, communication within a species and between trees and fauna, plant defense systems, light manipulation, and landscape diversity provide potential mechanisms and practices for altering agroecosystem design. Most findings come from studies in crops other than pear, but they will be useful for consideration in designing pear production systems to be more productive and profitable while leaving a smaller environmental footprint. Examples from pear include acoustic disruption of psyllid communication, blossom microbial ecology and fire blight (*Erwinia amylovora*) control, and the effect of landscape diversity on insect fauna. The increasing level of complexity in this type of agroecosystem redesign will require appropriate research methods and funding cycles to properly test and evaluate the changes.

O34- Energy efficiency in a pear agroecosystem

Prof. Dr. Maria Claudia Dussi, Universidad Nacional del Comahue, Facultad de Ciencias Agrarias, CC 85 (8303) Cinco Saltos, Rio Negro, Argentina; mcdussi@yahoo.com

Liliana Flores, Facultad de Ciencias Agrarias, Universidad Nacional del Comahue, cc 85, 8303 Cinco Saltos Patagonia, Argentina; shlilianaflores@gmail.com

Cristina Fernandez, Facultad de Ciencias Agrarias, Universidad Nacional del Comahue, cc 85, Cinco Saltos, Patagonia, Argentina; cristinaf.faca@gmail.com

Yesica Machuca, Facultad de Ciencias Agrarias, Universidad Nacional del Comahue, cc 85, Cinco Saltos, Patagonia, Argentina; yesinoe@gmail.com

The use of energy subsidies accelerates the flow of energy and the circulation of matter in agroecosystems which leads to an increase in entropy reflected in pollution and loss of biological-cultural diversity, among other aspects. In this context, energy evaluation of these systems could generate valuable information related to the energy balance used and extracted in the production process. The objective of the present work was to carry out an energy balance through the use of indicators in an organic and biodynamic pear agroecosystem. We analyzed the labor practices carried out during the productive season between August 2017 and February 2018 of a pear agroecosystem with organic and biodynamic management located in Patagonia, Argentina. A balance was made to assess the energy inputs and outputs expressed in megajoul (MJ) / hectare (ha) and MJ / kilogram (kg), allowing to calculate the total amount of energy needed to obtain the product. The energy indicators calculated were energy efficiency, specific energy and net energy. In this production system, 232.08 MJ / ha of cultural biological energy and 16469.59 MJ / ha of industrial energy were used, equivalent to 1.39% and 98.61% respectively. With respect to the entry of indirect industrial cultural energy, a value of 68.12MJ / ha was observed, which implies a total energy income of 16769.79 MJ / ha. The values of energy efficiency, specific energy and net energy obtained by the evaluated agroecosystem were 3.08, 0.79 MJ / kg and 34538.33 MJ / ha respectively. Results reflect a high dependence on subsidies. Analyzing systems through the energy flow is a relevant aspect to promote sustainable agroecosystems.

Keywords: agroecology, energy flux, organic and biodynamic production, *Pyrus communis,* sustainability

O35- Effectiveness of conventional and portable wind machines on temperature control under different frost conditions: a spatial analysis approach

Victor Beyá, Universidad de Chile, Santa Rosa 11.315, La Pintana, Santiago, Chile; vbeya@uchile.cl

Julio Herrera, Universidad de Chile, Santa Rosa 11.315, La Pintana, Santiago, Chile; jules@ug.uchile.cl

Dr. Fernando Santibáñez, Universidad de Chile, Santa Rosa 11.315, La Pintana, Santiago, Chile; fersantiba@gmail.com

Dr. Thomas Fichet, Universidad de Chile, Santa Rosa 11.315, La Pintana, Santiago, Chile; tfichet@uchile.cl

Frosts are one of the most damaging meteorological events in agriculture making active control methods, such as wind machines, essential to reduce the impact on crops. A new portable wind machine (PM), Tow and Blow®, has been commercialized for frost control. Although commercial information claims large benefits, neither its effectiveness nor its performance relative to conventional wind machine (CM), has been scientifically studied. Thus, the aim of this work was to measure the effectiveness on temperature spatial modification between CM and PM for different operational configurations and thermal inversion conditions. Measurements were undertaken during 12 frosty winter and spring nights along two seasons in a pear orchard located in Central Chile. Temperature measurements were simultaneous and at regular spacing around the machines. All frost events were characterized by clear sky, low wind and moderated to strong thermal inversion; thus, optimal frost control performance was expected. PM showed lower effectiveness in frost control on stability, area and temperature increase. CM best performance configuration produced a temperature increase in 5.3 ha in contrast to 3.0 ha for PM, considering a temperature increase of 30% thermal inversion strength. These figures change to 2.7 ha and 0.6 ha for a 50% temperature increase of thermal inversion strength respectively. The low coverage angle of PM (~26°) is an important limiting factor in frost control effectiveness. Thus, it must be operated with the minimum rotation time. The microclimatic conditions, intra and inter frost, were highly variable, being difficult to make recommendations about the optimal operational configuration (position and rotational speed mainly) for the PM without a previous site-specific study.

Keywords: Frost control, active frost protection, thermal inversion strength, *Pyrus communis.*

O36- Cross-fertilisation, self-fertilisation, and gibberellin treatments in European pear and their effect on fruit quality

Hanne Claessen, Willem de Croylaan 42, 3001 Leuven, Belgium; hanne.claessen@kuleuven.be

Fruit set in many European pear cultivars is poor, on the one hand because of limited cross-fertilization caused by incompatible or even no pollinator trees, on the other hand due to the self-incompatibility system that prevents self-fertilisation in many Rosaceae species. Gibberellin treatments that are used in pear varieties like Conference have significant drawbacks such as the increased costs of thinning and the larger occurrence of misshapen pears that must be sold at a suboptimal price. The goal of our research project is therefore to obtain a better understanding of the mechanisms behind cross-pollination, self-pollination and the gibberellin treatments and how they differ in their effect on fruit development and quality. This knowledge is essential for achieving an optimal fruit set in all commercial pear varieties, while avoiding alternate bearing and low fruit quality. In this study, a large pollination experiment is set up using Conference and Doyenné du Comice pear trees. During bloom, flowers are either cross-pollinated, self-pollinated or treated with gibberellin (GA3 or GA47). Size and shape of the fruitlets are recorded during development and fruit quality is measured after harvest. In addition, fruitlet samples are taken at critical time points during development for RNA sequencing. The results of this study will allow us to identify differences in the effect of cross-pollination, self-pollination and gibberellin treatment on fruit set, development and quality, but also on the expression of key genes in fruit development pathways, like genes involved in cell division or cell expansion. Comparing the varieties Conference and Doyenné du Comice can help elucidate why gibberellin treatments have large effects in some varieties (like Conference) but not in others (like Doyenné du Comice).

Keywords: *Pyrus communis*, self-fertilisation, cross-fertilisation, GA-treatments, fruit set, fruit quality

O37- Developmental variations of different pear cultivars, early ripening and late ripening pear, in related to stone cell development in the flesh

Dr. Li Yang, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, Wuhan, China; kelizi@126.com
Zhongqi Qin, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, Wuhan, China; zhongqiqin@163.com
Dr. Tao Wu, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; 562935899@qq.com
Xianming Li, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; 1879006235@qq.com
Junfan Ms. Tu, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; tujunfan2005@126.com
Hongyan Zhu, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; 176058909@qq.com
Fuchen Yang, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; 275091558@qq.com
Dr. Zheng Liu, Institute of Fruit and Tea, Hubei Academy of Agricultural Sciences, China, Wuhan, China; 496874148@qq.com

This study was conducted to microscopically verify the distribution and morphological changes occurring in stone cells during fruit growth in order to determine physiological changes occurring in pear fruits. Early ripening and late ripening pear, *Pyrus pyrifolia* Nakai cv. 'Eli 1' and *Pyrus pyrifolia* Nakai cv. 'Xiangnan' fruits were harvested at development stages of 3,7,14,40,70,95, and 140 days after full bloom (DAFB). Stone cells were observed via light microscopy. The results showed that the initial differentiation of *P. pyrifolia* Nakai cv. 'Eli 1' stone cells in parenchyma cells formed primordial cells on the seventh day after flowering, and about five days earlier than that in *P. pyrifolia* Nakai cv. 'Xiangnan'. The stone cells clustered less profoundly in the 'Eli 1' than in 'Xiangnan' pears, and the sizes of the clusters were smaller. Also, the peak of content of stone cells in the two cultivars appeared during 40-60 days, and 'Xiangnan' pear had higher content than 'Eli 1'. The relative decrease in the quantity of stone cell clusters in the flesh was attributed to the fact that stone cells were no longer being generated, and the flesh cells increased dramatically in size. The results indicate that the total amount of stone cells in pear mainly depends on the occurrence of stone cells in early fruit development, all of which provides direct clues for establishing new methods to evaluate fruit texture of pear in the early developmental stages.

Keywords: Fruit texture, *P. pyrifolia* Nakai cv. 'Eli 1', *P. pyrifolia* Nakai cv. 'Xiangnan', Flesh cells

O38- d'Anjou pear sorting by predicted dry matter and its effect on consumer preference

Sara Serra, Washington State University, Department of Horticulture, Pullman, WA 99164, United States of America; sara.serra@wsu.edu

Alex Goke, 1100 N Western Ave, 1100 N Western Ave, wenatchee, United States of America; alex.goke@wsu.edu

Angela Knerl, 1100 N Western Ave, Wenatchee WA 98801, United States of America; angela.knerl@wsu.edu

Prof. Dr. Carolyn Ross, school food science, Pullman, United States of America; cfross@wsu.edu

Beata Vixie, school food science, Pullman, United States of America; bvixie@wsu.edu

Ryan Sheick, 1100 N Western Ave, 1100 N Western Ave, 1100 N Western Ave, Wenatchee WA 98801, United States of America; ryan.sheick@wsu.edu

Prof. Dr. Stefano Musacchi, 1100 N Western Ave, 1100 N Western Ave, 1100 N Western Ave, Wenatchee WA 98801, United States of America; stefano.musacchi@wsu.edu

Dry matter (DM) is gaining importance in the horticultural sector as a new index related to fruit quality, maturity, and ultimately to consumer preference. Some commodities like avocado, mango, and kiwifruit have adopted dry matter to determine the picking time and/or assess quality. In apples, DM was reported as a good predictor of total soluble solids content after 3 months in storage. In general, consumer acceptability is higher when fruit has higher dry matter at harvest. The trial was located in a commercial orchard of 'd'Anjou' pear trees grafted on OHF87 (1998, WA, U.S.A.) with 957 trees/ha. Fruit were harvested in 2016 from four different pruning treatments (winter, winter and summer, fall, and fall and summer pruning). Pears at harvest were non-destructively measured by a handheld near-infrared spectrometer (Felix F-750 Fruit Quality Meter, Camas, WA, U.S.A.) to obtain a dry matter % prediction. This parameter was used to sort fruit in to six classes (from 11 to 18%) and then divided in to two storage periods - quality analysis at harvest, September 2016 and quality analysis after five months of storage at 0.5°C, February 2017 with a paired consumer test. Comparison between DM classes, regardless of pruning treatment, revealed significant differences in fruit quality at harvest and after storage. Pears in the lower DM classes had significantly higher IAD index immediately after storage and the smallest decrease in IAD index in seven days of ripening at room temperature. They also presented lower SSC (°Brix) than all other classes, indicating lower maturity. Sensory analysis revealed that perceived juiciness, sweetness, and pear flavor increased with increasing dry matter classes. Higher dry matter pears were significantly more favored overall, supporting fruit sorting by non-destructive DM prediction to anticipate the final eating quality and consumer acceptance.

Keywords: *Pyrus communis*, non-destructive assessment, NIR spectroscopy, sensory analysis

O39- A comprehensive analysis of the interplay between ethylene and other hormones during growth and development of Conference pears

Dr. Jordi Giné Bordonaba , Postharvest. IRTA, Ed. Fruitcentre, PCiTAL, 25003 Lleida, Spain; jordi.gine@irta.cat

Violeta Lindo-García, Postharvest, IRTA, Edifici Fruitcentre, PCiTAL, 25003 Lleida, Spain; violeta.lindo@irta.cat

Paula Muñoz-Roldán, Department of Plant Biology, Faculty of Biology, University of Barcelona, 08028 Barcelona, Spain; paulamuro30@gmail.com

Prof. Dr. Sergi Munné-Bosch, Department of Plant Biology, Faculty of Biology, University of Barcelona, 08028 Barcelona, Spain; smunne@ub.edu

Dr. Christian Larrigaudière, Postharvest, IRTA, Edifici Fruitcentre, PCiTAL, 25003 lleida, Spain; christian.larrigaudiere@irta.cat

Involvement of ethylene on postharvest pear fruit ripening has been extensively described and numerous physiological processes leading to the final fruit appearance, texture, flavor, and aroma are directly related to this hormone. However, scarce information is available on the role of other hormones or its interplay with ethylene in the regulation of pear development. Accordingly, we investigated the involvement of ethylene biosynthesis (ethylene, 1-aminocyclopropane-1-carboxylic acid (ACC), ACC oxidase (ACO) and ACC synthase activity), in relation to other hormones such as abscisic acid (ABA), indole-3-acetic acid (IAA), jasmonic acid (JA), salicylic acid (SA), gibberellins, and cytokinins on the main physiological and quality modifications occurring during on-tree development of Conference pears. Our results show that ethylene production and respiration rates were higher at early stages of fruit development (10 days after full bloom; DAFB) and steadily declined thereafter with a transitory ethylene peak occurring prior to the fruit expansion growth phase (50 DAFB). The decline in ethylene production was associated with lower ACO activity rather than limited ACC availability. ABA was maximum at 30 DAFB and also declined during pear development preceding the observed changes in ethylene production. Hormonal changes were especially significant when considering the results on a fruit basis (µg·fruit-1). In this sense, changes in ABA, JA and SA, which increased at advanced developmental stages (from 70 DAFB onwards) were paralleled with most quality changes including fruit softening, starch degradation, decline on the fruit acidity and increase in the total soluble solid content. Higher levels of gibberellins (GA1) at the time of commercial harvest may act as ripening inhibitors of Conference pears and hence partially explain the chilling requirements of this pear variety to achieve normal ripening.

Keywords: ABA, gibberellins, *Pyrus communis,* salicylic acid

O40- Harvest maturity influence on postharvest performance of new blush pear cultivars from Australia

Dr. Dario Stefanelli, Agriculture Victoria Research - DEDJTR, AgriBio Centre, 5 Ring Road, Bundoora, Vic, 3083, Australia; dario.stefanelli@ecodev.vic.gov.au

John Lopresti, Agriculture Victoria Research - DEDJTR, AgriBio Centre 5 Ring Road, Bundoora Victoria 3083, Australia; john.lopresti@ecodev.vic.gov.au

Dr. Rodney Jones, Agriculture Victoria Research - DEDJTR, AgriBio Centre, 5 Ring Road, Bundoora Victoria 3083, Australia; rod.jones@ecodev.vic.gov.au

Glenn Hale, Agriculture Victoria Research - DEDJTR, AgriBio Centre, 5 Ring Road, Bundoora Victoria 3083, Australia; glenn.hale@ecodev.vic.gov.au

Dr. Ian Goodwin, Agriculture Victoria Research - DEDJTR, Tatura Centre, 255 Ferguson Road, Tatura Victoria 3616, Australia; ian.goodwin@ecodev.vic.goc.au

Australian pear exports have been declining in recent years due to a lack of high quality cultivars that meet consumer expectations for quality including visual appearance, texture, and flavour. Maturity stage at harvest influences fruit postharvest behaviour, storability, and final quality. This project aimed to develop harvest maturity guidelines and postharvest storage protocols for new blush pear cultivars 'ANP-0118' (marketed as Lanya®) and 'ANP-0131' (marketed as Deliza®). Consumers prefer 'ANP-0118' to be eaten as a crisp pear rather than ripened to a melting flesh whereas 'ANP-0131' is preferred as a melting flesh cultivar. The effect of maturity at harvest on storage life and eating quality were investigated. Fruits were harvested at three maturities determined by flesh firmness (kg/cm2) measured destructively with a penetrometer, and skin chlorophyll a concentration measured non-destructively using a DA-meter (IAD). Pear storage performance was assessed over 28 weeks at −0.5°C in air. 'ANP-0118' remained firm during cool storage when harvested at 4.3 to 5.0 kg/cm2 and 1.3 to 1.5 IAD with a 10% decline in firmness over 20 weeks at −0.5°C in air. 'ANP-0131' stored well for up to 32 weeks in air at −0.5°C. Fruit remained firm during storage when harvested at 4.7 to 5.7 kg/cm2 and 1.5 to 1.6 IAD with a 9% decline in firmness over 28 weeks at −0.5°C in air. No signs of superficial scald were observed in 'ANP-0131' fruit during storage for up to 40 weeks. In contrast 'ANP-0118' suffered from superficial scald when stored for 16 weeks or longer. Maturity at harvest affected fruit storability by reducing or increasing rate of ripening during cold storage when fruits were harvested at a more immature or mature stage respectively. Harvest maturity and storage protocols have been developed for each cultivar.

Keywords: IAD, Fruit quality, cold storage, superficial scald, storability

O41- Maturation and ripening biology of interspecific pears

Dr. Jason W. Johnston, Plant and Food Research, Private Bag 1401, Havelock North 4157, New Zealand; jason.johnston@plantandfood.co.nz
Miriam Hall, Plant and Food Research, Private Bag 92169, Auckland Mail Centre, Auckland, New Zealand; Miriam.Hall@plantandfood.co.nz
Bridie Carr, Plant and Food Research, Private Bag 1401, Havelock North, New Zealand; Bridie.Carr@daf.qld.gov.au
Matt Punter, Plant and Food Research, Private Bag 1401, Havelock North, New Zealand; Matt.Punter@plantandfood.co.nz
Dr. Ken Marsh, Plant and Food Research, Private Bag 92169, Auckland Mail Centre, Auckland, New Zealand; Ken.Marsh@plantandfood.co.nz
Dr. Ian Hallett, Private Bag 92169, Auckland Mail Centre, Auckland, New Zealand; Ian.Hallett@plantandfood.co.nz
Natalie Proffit, Plant and Food Research, Private Bag 1401, Havelock North, New Zealand; Natalie.Proffit@plantandfood.co.nz
Shona Seymour, Plant and Food Research, 55 Old Mill Rd RD3, Motueka, New Zealand; Shona.Seymour@plantandfood.co.nz
Dr. Adam Friend, Plant and Food Research, 55 Old Mill Rd RD3, Motueka, New Zealand; Adam.Friend@plantandfood.co.nz
Dr. Robert Schaffer, Plant and Food Research, 55 Old Mill Rd RD3, Motueka, New Zealand; Robert.Schaffer@plantandfood.co.nz
Lester Brewer, Plant and Food Research, 55 Old Mill Rd RD3, Motueka, New Zealand; Lester.Brewer@plantandfood.co.nz
Dr. Richard Volz, Plant and Food Research, Private Bag 1401, Havelock North, New Zealand; Richard.Volz@plantandfood.co.nz

A new range of interspecific pear cultivars differentiated by appearance, flavour, and texture have been developed and will be globally sold under the Piqa® brand. The Piqa®Boo® brand PremP009 cultivar is the first commercial release from this programme with fruit that develop a bright red skin colour and 'William Bon Chretien'-like aroma once ripe. The interspecific genetics of these cultivars mean that pre-existing information from traditional Asian and European pear cultivars may not be directly transferable to optimise timing of harvest and subsequent performance in storage. This presentation focuses on the biology of maturation and ripening of 'PremP009' and three other interspecific genotypes with different flavour profiles and skin colours. Change in skin colour was the best indicator of harvest timing for maintenance of quality in storage and flavour development after harvest. Chlorophyll breakdown seemed to be the most important aspect associated with change in colour, and was accompanied by darkening seed colour and increased ethylene production. Genotypes producing more flavour tended to have elevated ethylene production, although there was one genotype with no detectable flavour despite having elevated ethylene production. Treatment with ethylene action inhibitors (1-methylcyclopropene) delayed flavour development in all genotypes tested. These results suggest that ethylene was required for flavour development, but there were additional unknown limiting factors. All genotypes maintained a crisp-juicy texture during storage, despite having elevated ethylene production, which meant that long periods of storage and shelf-life were possible without significant loss of quality. There was an indication that genotypes with the highest ethylene production may lose a little crispness during ripening, a response that was reversed when treated with ethylene inhibitors. A more detailed understanding of ripening regulation in interspecific pears could contribute more broadly to our understanding of maturation and ripening processes across all pear species.

Keywords: Ethylene, texture, flavour, colour

O42- Utilizing the IAD index to predict ´Rocha' pear quality and physiological disorders after storage

Assoc. Prof. Cristina Oliveira, LEAF - Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1399- 017 Lisboa , Portugal; crismoniz@isa.ulisboa.pt

Rafael Gomes, CPF, Estrada Nacional 8, Km 69 - Sobreiral, 2540-170 Bombarral, Portugal; rafaelblancgomes@gmail.com

Filipe Silva, CPF, Estrada Nacional 8, Km 69 - Sobreiral, 2540-170 Bombarral, Portugal; filipe.silva@cpf.com.pt

In order to use the index of absorbance difference (IAD), as a fruit maturity evaluator and to assess the correlation of fruit maturation and post-harvest physiological disorders, fruits from three 'Rocha' pear orchards (A, B, C orchards) were harvested on eight dates during seven weeks. At harvest, the fruits were separated into three classes of IAD (1.4-1.6, 1.6-1.8 and 1.8-2.0, class I, II and III, respectively). The fruits were stored in a normal atmosphere storage (NA) for 23 weeks and in a dynamic controlled atmosphere (DCA) for 31 weeks. Standard quality parameters of the fruits were evaluated at harvest, and after 0 and 5 days of shelf life at 20 °C. At 7 days of shelf life superficial scald and internal browning fruit incidence were evaluated. At harvest, the IAD was correlated with firmness and ethylene production rate (r2= 0.74 and 0.76, respectively) but poorly correlated with total sugar content and fruit size (r2= 0.10 and 0.45, respectively). Regarding NA storage, with the exception of orchard C, the fruits of IAD class I, for orchards A and B, 13.1% of the fruits showed superficial scald and 11.1% internal browning and the best results were from fruit of the orchard C of the IAD class III, that had 0.8% and 9.2% of superficial scald and internal browning, respectively. Considering the fruits of DCA, fruits from orchard B and of the IAD class III, showed the lowest incidence of internal browning (6.15%). These results show that the orchard has a strong influence on physiological disorders and the IAD may be insufficient to be used as the only criterion to set the harvest date and predict the level of incidence of physiological disorders.

Keywords: ethylene, internal browning, non-destructive analysis, ripening, superficial scald, VIS/NIR measurement

O43- Transcriptional differences associated with sugar metabolism between `Nanguo´ and its mutant `Nanhong´ pears in different post-harvest ripening stages using RNA-seq

Prof. Dr. Wang Wenhui, Inst. of Pomology, Chinese Academy of Agric. Science, No. 98 Xinghai South Street , Xingcheng, Liaoning 125100, China; wenhuiw@263.net

Assist. Prof. Yanmin DU, Research Institute of Pomology, CAAS, Xingcheng, China; duyanmin@caas.cn

'Nanguo' pear, a variety of *Pyrus ussuriensis* Maxim that is one of the main cultivated species of pear in China, is widely planted in northern parts of China (Liaoning province) for its attractive color, exquisite flesh, and pleasant flavor. 'Nanguo' fruit is very hard when harvested at commercial harvest; however, after a post-harvest ripening process at 20℃, the fruit flesh becomes soft and the soluble sugar content increases significantly, and the fruit has an intense aroma production improving final fruit quality. 'Nanhong' pear is a bud mutation of the 'Nanguo' pear and has been released as a new pear cultivar. The pericarp of the 'Nanhong' pear fruits turns red at the late development stage, as a mutant of 'Nanguo' pear, most of the main characteristics of the 'Nanhong' pear are similar to the 'Nanguo' pear, however the tasted flavor showed totally different from each other, especially for the sweet taste. In order to better understand the difference in sugar metabolism between them, for one aspect, we measured the soluble sugar content by utilizing HPLC (High Performance Liquid Chromatography). The preliminary results showed that the contents of fructose and sucrose were higher in 'Nanhong' pear than those in 'Nanguo' pear, while the glucose and sorbitol contents were lower. For another aspect, we sequenced and annotated the transcriptome for the 'Nanguo' pear and 'Nanhong' pear at four stages of post-harvest ripening process using illumina RNA-seq technology. At the best eating stage (fruit firmness: 15N), compared with the 'Nanguo' pear, a total of 751 differentially expressed genes (DEGs) were identified in 'Nanhong' pear, 448 genes were up-regulated, and 303 genes were down-regulated. Six DEGs were involved in glycolysis/gluconeogenesis, five DEGs were involved in starch and sucrose metabolism, and three DEGs related to fructose and mannose metabolism.

Keywords: 'Nanguo' pear；Bud mutant；sugar metabolism；transcriptome

O44- The effects of light exposure on red colour development in European pear

Madeleine Peavey, Research Scientist, Agriculture Victoria, 255 Ferguson Rd, Tatura, VIC 3616, Australia; peaveymadeleine@gmail.com

Iris Visscher, Wageningen University, 6708 PB Gelderland Wageningen, Netherlands; iris.visscher@wur.nl

Dr. Ian Goodwin, Agriculture Victoria, Tatura Victoria 3616, Australia; ian.goodwin@ecodev.vic.gov.au

Dr. Lexie McClymont, Agriculture Victoria, Tatura Victoria 3616, Australia; lexie.mcclymont@ecodev.vic.gov.au

Pear breeding programs throughout the world have released new fresh market cultivars that are premium quality and aim to increase world consumption of pears. Red colour of the fruit peel is a key quality requirement of many of the new cultivars. The degree of red coloration is determined by the content and composition of anthocyanins in the peel of pears. Biosynthesis of anthocyanins in plant tissues either requires or is enhanced by light. During this experiment the effect of artificial shading on the red colour development of newly bred 'ANP-0534' pear was investigated. Six different treatments were applied which consisted of a control treatment and five artificial shading periods which differed in duration and timing. Red colour was measured several times during the experiment. Quality measurements, which included weight, firmness and soluble solids concentration, were measured at the end of the experiment. Red colour in the control treatment increased substantially between 21 and 42 days after full bloom (DAFB) thereafter gradual increasing in red colour until harvest (124 DAFB). No red colour was observed when fruit were artificially shaded from 21 DAFB until start of harvest. Artificial shading did not affect the maximum red colour when applied for 3 weeks from 21 – 84 DAFB. Later shading and longer periods of shading resulted in lower red colour at harvest. Maximum red colour occurred at the end of the season which is favourable and can make 'ANP-0534' a novel cultivar compared to other red-blushed or fully red cultivars. The implications of these results in terms of managing fruit exposure to light will be discussed.

Keywords: artificial shading, blush, anthocyanins

O45- Optimization of the alternatives to control superficial scald in 'Beurré d'Anjou' pear avoiding detrimental effects on fruit quality

Dr. Gabriela Calvo, Instituto Nacional de Tecnología Agopecuaria, Ruta Nacional 22 km. 1190, General Roca 8332, Argentina; calvo.gabriela@inta.gob.ar

Dr. Ana Paula Candan, Instituto Nacional de Tecnología Agopecuaria, Ruta Nacional 22 km. 1190, General Roca 8332, Argentina; candan.ana@inta.gob.ar

Dr. Christian Larrigaudière, IRTA Postharvest, PCiTAL, Parc de Gardeny, Edifici Fruitcentre, 25003 Lleida, Spain; Christian.Larrigaudiere@irta.cat

In a previous work we evaluated the effectiveness of different alternatives to control superficial scald in 'Beurré d'Anjou' pear. Dynamic controlled atmosphere (DCA) and 1- methylcyclopropene applied at a 0.3 mL L-1 dose were efficient, but with detrimental effects on quality because of the development of internal cavities (DCA) and ripening impairment (1-MCP). In this work, these strategies were optimized using higher O2 and lower CO2 concentrations for DCA storage and lowering the 1-MCP dose to 0.15 mL L-1. Pears were harvested at optimal maturity, treated with 0 (Control) or 0.15 mL L-1 1-MCP (1-MCP) and stored for 240 days in regular air or at 0,7% O2 and <0,4%.CO2 (DCA). Combined strategies were also tested (DCA+1-MCP). Changes in fruit maturity, ethylene, α-farnesene, conjugated trienols levels, and physiological disorders were monitored monthly. All the storage strategies reduced ethylene production and in consequence scald incidence compared to Control. In relation to ripening all the strategies, except the combined DCA+1-MCP, allowed fruit ripening after 180 + 7d of storage. DCA applied alone or combined to 1-MCP led to high incidence of cavities already after 2 months of storage. At the view of these results the 0.15 mL L-1 1-MCP treatment appeared to be the best strategy to control superficial scald in 'Beurré d'Anjou' pear without detrimental effects on fruit quality.

Keywords: ripening, cavities, 1- methylcyclopropene, controlled atmosphere, ethylene

O46- Ethylene antagonists influence cold storage life and fruit quality of Packham's Triumph and Beurre Bosc pears

Prof. Dr. Zora Singh, Curtin University , Curtin Horticulture Research Laboratory, School of Molecular and Life Sciences, Perth 6845 - Western Australia, Australia; zora.horti@hotmail.com

Mehwish Yaseen, Curtin University, Curtin Horticulture Research Laboratory, School of Molecular and Life Sciences, Perth WA 6845, Australia; mehwish.yaseen@postgrad.curtin.edu.au

Dr. Alan Payne, Curtin University, School of Molecular and Life Sciences, Perth WA 6845, Australia; Alan.Payne@curtin.edu.au

Management of ethylene in postharvest phase of pear fruit is a major challenge. The effects of potential ethylene antagonists to extend cold storage life and maintain pear fruit quality were investigated. 'Packham's Triumph' and 'Beurre Bosc' pear fruit were fumigated with 1-methylcyclopropene (1-MCP), 1-hexylcyclopropene (1-HCP), (S)-(-)-limonene or trans-cinnamaldehyde (TCA) in two independent experiments. Following the fumigation, the fruit were stored at 0-1°C and > 85 % RH for 4 and 6 months. After each cold storage period, the fruit were transferred to simulated shelf conditions (21 ± 1 °C) for 10 days and assessed for ethylene production and respiration rate. Various fruit quality parameters were determined at 10th day of simulated shelf conditions. Climacteric ethylene production peak was highly suppressed in both cultivars with 1-MCP (20.9 and 71.6 pmol kg-1 s-1respectively) followed by (S)-(-)-limonene in 'Beurre Bosc' (307.7 pmol kg-1 s-1) as compared to all other treatments. All fumigation treatments delayed onset of climacteric ethylene peaks (1.83-3 days) in both pear cultivars as compared to the control. The rate of climacteric respiration peak was highly reduced by 1-MCP in 'Packham's Triumph' and 'Beurre Bosc' (0.33 and 0.30 µmol kg-1 s-1respectively) as compared to all other fumigants and control. While, onset of respiratory peak was delayed by 1-MCP and 1-HCP treatments (2.83 and 2.33 days respectively) in 'Beurre Bosc' pear. Fruit firmness, total antioxidant capacity and ascorbic acid concentrations were significantly higher in 1-MCP fumigated fruit in both pear cultivars as compared to all other treatments. 1-HCP, (S)-(-)-limonene or TCA fumigation also maintained the firmness, ascorbic acid concentration and total antioxidants as compared to the control in both pear cultivars. In addition to 1- MCP, 1-HCP, (S)-(-)-limonene and TCA showed potential to act as an ethylene antagonist to supress climacteric ethylene production and maintain quality in cold stored pear fruit.

Keywords: *Pyrus communis* L., fruit ripening,1-hexylcyclopropene, (S)-(-)-limonene, trans-cinnamaldehyde, 1-methylcyclopropene

O47- IAD value at harvest as a predictor for `Anjou´ fruit storage performance

Dr. Jim Mattheis, USDA ARS TFRL, 1104 N.Western Ave, Wenatchee, WA 98801, United States of America; james.mattheis@ars.usda.gov

Dr. Stefano Musacchi, Washington State University TFREC, 1100 N. Western Avenue, Wenatchee Wa 98801, United States of America; stefano.musacchi@wsu.edu

Dr. Sara Serra, Washington State University TFREC, 1100 N. Western Avenue, Wenatchee Wa 98801, United States of America; sara.serra@wsu.edu

'Anjou' pears produced in the Pacific Northwest USA can have considerable fruit maturity variability at harvest. Assessment of chlorophyll in and several mm below the peel using differential absorbance (IAD) is a means to identify populations of fruit of varying maturity. 'Anjou' is superficial scald-susceptible and while the disorder can be prevented by 1-MCP, treated fruit ripening can be unpredictable. As 1-MCP impacts ripening in part based on fruit stage of development when the treatment is applied, the project objective was to determine if IAD at harvest can provide an indication of postharvest performance of 1-MCP-treated fruit. Pears were harvested in a commercial orchard and three (2015) or four (2016) classes were assembled based on IAD. Fruit exposed to 0 (control) or 100 ηL L-1 1-MCP for 16h at 0.5 oC were stored in air for up to 8 months followed by 7 days at 20 oC. During and after removal from storage, decreases in fruit weight, IAD, and firmness were greater in controls compared with 1-MCP fruit. After storage, fruit with the highest IAD at harvest (less mature) had less IAD drop and green to yellow color change but more weight loss compared to fruit with lower IAD at harvest. 1-MCP fruit had less decrease in IAD and hue after storage regardless of IAD class compared with control fruit. Superficial scald (scald) developed only on control fruit in the first season. After 5 months, scald decreased with increased IAD at harvest. Scald development was reduced but not prevented by 1-MCP after 8 months in year two. Scald symptom intensity in control fruit after 8 months decreased with increased IAD values at harvest. The results indicate IAD at harvest can provide some level of prediction of storage performance related to 1-MCP use, storage duration, and production season.

Keywords: maturity, ripening, superficial scald, firmness, color

Abstracts of posters

P1- Clonal selection of `Williams´ pear in Uruguay

Maximiliano Dini, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones, Uruguay; maxidini@hotmail.com

Julio Pisano, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Uruguay; jpisano@inia.org.uy

Jorge Soria, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Uruguay; jsoriabaraibar@gmail.com

Fruit quality of 'Williams' European pear produced in different Uruguayan commercial orchards is heterogeneous. It's unknown if those differences are due to environmental factors or genetic factors linked to the source of plant material used for propagation. To know if there are genetic differences among them, this research focused on the evaluation of phenotypic characteristics of different sources of 'Williams' pear accessions under the same growing conditions. The experiment was installed in 2007 at INIA Las Brujas, Canelones, Uruguay. 'Adams' quince was used as rootstock jointly with an interstem of 'Beurré Hardy' pear. The treatments correspond to 'Williams' pear sources, totaling 17 treatments with four repetitions. At harvest, analyzed variables were yield and fruit number. Study of fruit variables included: equatorial diameter, length, length/diameter ratio, weight, and epidermis quality represented by lenticel notoriety, skin texture and presence of russet. Data were submitted to variance analysis and the means of treatments were grouped by the Scott-Knott test ($P \leq 0.05$). The Unweighted Pair-Group Method using Arithmetic averages (UPGMA), a multivariate technique, was used for cluster analysis. Yield and fruit number showed significant differences; with accesses 1, 3, and 13 presenting the best productions, during the last harvest seasons. This could be related to low chilling accumulation in recent years, indicating differences among the accessions in their adaptation to mild winter conditions. Significant differences among accessions were found for the following variables: equatorial fruit diameter, fruit length, as well as length/diameter ratio. Concerning the epidermis quality parameters, differences were also observed, highlighting accesses 8 and 13. This confirms that that the different behavior originally observed in the different locations was not due to site conditions. There are accessions achieving better behavior and fruit quality under the Uruguayan pear growing conditions, which show a potential for improvement in new plantings.

Keywords: *Pyrus communis* L.; pear breeding; fruit quality; phenotypic variability; climatic adaptation.

P2- Protocol for in vitro shoot multiplication of ancient pear cultivars and landraces

Dr. Jiri Sedlak, Research and Breeding Institute of Pomology, Holovousy, Holovousy 129, 508 01 Horice, Czech Republic; sedlak@vsuo.cz

Dr. Frantisek Paprstein, Research and Breeding Institute of Pomology, Holovousy, Holovousy 129, 508 01 Horice, Czech Republic; fp@vsuo.cz

In 2016, a project has been started to preserve the diversity of older pear cultivars grown on the territory of the Czech Republic. The purpose of this study is to develop an efficient in vitro system for rapid propagation of pear explants as an initial plant material for cryopreservation experiments. The donor shoots were obtained in March from mature trees grown at the Research and Breeding Institute of Pomology (RBIP) Holovousy Ltd., Department of Genebanks. Selected pear genotypes 'Avranches', 'Jakobibirne' 'Marillat', 'Flamandka' were successfully established in vitro using 0.15% mercuric chloride as a disinfection solution. Six MS-based media containing 1, 2, or 4 mg L-1 of zeatin or 1, 2, or 4 mg L-1 BAP (6-benzylaminopurine) were used for multiplication experiments. Multiplication rate was defined as the number of newly formed shoots (>10 mm) per initial shoot tip after four weeks of culture. Cultivars in the study differed in their proliferation and development potential in MS medium according to hormone level between 1.0 and 3.8. Generally, the highest proliferation rate (3.8) in our experiments was obtained for cultivar 'Marillat' on MS medium with the concentration of BAP 2 mg L-1. Concerning cytokinin zeatin, sufficient multiplication rate 3.1 was obtained only for 'Marillat' on medium with the highest concentration 4 mg L-1. Results obtained in our study confirmed preliminary findings that BAP was an important plant growth regulator for proliferation and growth in pear micropropagation. During in vitro multiplication phase, for all tested cultivars, any morphological abnormalities such as excessive callus formation, hyperhydricity or production of abnormally narrow leaves were not noted.

Keywords: explant, *Pyrus*, in vitro, growth regulation, shoot

P3- Micropropagation of different pear rootstocks

Dr. Alicia Castillo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km10, Canelones, CP 90200, Uruguay; aliciamariacastillo@gmail.com

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10 Canelones, Canelones 90200, Uruguay; dcabrera@inia.org.uy

Pablo Rodríguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10 Canelones, Canelones 90200, Uruguay; prodriguez@inia.org.uy

Pear (*Pyrus communis* L.) is one of the most important temperate fruit crops. Uruguay aims at producing pears of high quality to reach regional markets as well as those of the North Hemisphere. Nevertheless, local climate and soil conditions generate sanitary problems to the pear production, mainly in the South of the country, where the major pear producing area is located. Recently some rootstocks of the series of Old Home x Farmingdale (OHxF) were introduced from the pear germplasm collection of the US Department of Agriculture, National Clonal Germplasm Repository–Corvallis (NCGR) to the country with the aim of evaluating new materials and trying to identify those better adapted to local soil and weather conditions. To reach a reasonable number of plants for evaluation, in the shortest possible time, in vitro multiplication system was selected. This work was carried out to develop a protocol of in vitro propagation of different rootstocks, in order to generate faster plant availability to select the best material. A group of five rootstocks from the series OHxF was selected: OHxF 40, OHxF 333, OHxF 87, OHxF 69, OHxF 217 as well as a local plant identified as 11B4. All genotypes were cultured in the same culture medium. The base medium was composed of MS (Murashige and Skoog 1962) mineral salts. The rootstocks had different behaviour, with OHxF 217 and 11B4 exhibiting the lowest multiplication rate in the culture medium used, producing less than two shoots per explant. On the contrary, the rootstock OHxF 40 had the highest rate producing more than five shoots per explant. Rootstocks showed differences in percentage of rooting and the survival during the acclimation period.

Keywords: In vitro, shoot proliferation, tissue culture, rooting, *Pyrus communis* L.

P4- The role of different hormone combinations in root induction of micropropagated pear plants

Gitta Kocsisné Molnár, Pannon Egyetem, Egyetem U. 10, 8200 Veszprém, Hungary; kmg@georgikon.hu

Agnes Balazsy, Deak F. u. 16, 8360 Zala Keszthely, Hungary; balazsy.agnes@georgikon.hu

Gyongyi Nemeth, Deak F. u. 16, 8360 Zala Keszthely, Hungary; drnemeth.gyongyi@gmail.com

Laszlo Kocsis, Deak F. u. 16, 8360 Zala Keszthely, Hungary; kocsis-l@georgikon.hu

To save different varieties of plant species, the production of pathogen-free propagule and development of biotechnological, molecular genetic technologies, and micropropagation are very important in the case of woody fruiting plants. Propagation and root-induction of in vitro plants are regulated by different types and concentrations of phytohormones. The main objective of our study was to observe the effects of different hormone combinations in rooting with micropropagated in vitro pear plants. We used four treatments with different amounts of cytokinin (BAP) and auxin (2,4 D). Number of roots, total root-length, and average root-length were determined. All treatments resulted in succesful rooting for both pear varieties examined. Highest values were found in number of roots and total root-length at the treatment of higher concentration of auxin without cytokinin. However, best results of average root-length were obtained at lower concentration of auxin with lower rates of cytokinin. Considerable differences between pear varieties were not found in average root-length.

Keywords: micropropagation, in vitro, *Pyrus*, rooting, hormone combinations

P5- Genetic relationship among pear (*Pyrus communis* L.) varieties in Central Europe

Dr. Gitta Kocsisné Molnár, University of Pannonia, Egyetem U. 10, 8200 Veszprém, Georgikon Faculty, Hungary; kmg@georgikon.hu

David Bolla, Deak F. u. 16, 8360 Zala Keszthely, Hungary; bolla92@freemail.hu

Dr. Ulrike Anhalt C.M., Konrad Lorenz str. 24., 3430 Tulln, Universität für Bodenkultur Wien Department, für Nutzpflanzenwissenschaften Abteilung, Austria; ulrike.anhalt@boku.ac.at

Prof. Dr. Astrid Forneck, Konrad Lorenz str. 24., 3430 Tulln, University of Natural Resources and Life , Sciences Vienna, Austria; astrid.forneck@boku.ac.at

Prof. Dr. Janos Taller, Deak F. u. 16., 8360 Zala Keszthely, University of Pannonia, Georgikon Faculty, Department of Plant Science and Biotechnolo, Hungary; taller@georgikon.hu

Prof. Dr. Laszlo Kocsis, Deak F. u. 16., 8360 Zala Keszthely, University of Pannonia, Georgikon Faculty, Horticultural Department, Hungary;
kocsis-l@georgikon.hu

The Hungarian gene bank of pear, located in Keszthely was founded in 1981 and hosts 210 pear varieties including regional cultivars. Synonyms are presevered in multiple locations within the country in addition to the gene bank. There is place for the regional cultivars, with their versions, the already commercially grown and improved varieties, as well as wild varieties which are related to the domesticated ones. Our goal was to provide a survey on the genetic diversity present in the gene bank. Eighty-one genotypes from the Keszthely pear gene bank at the University of Pannonia, Georgikon Faculty, Department of Horticulture in Hungary were analysed covering autochtone varieties, foreign originated varieties, and commercial varieties. Seven varieties were obtained from BOKU University Vienna, AT, Department of Crop Sciences, Division of Viticulture and Pomology. Altogether 88 genotypes were analysed employing eight SSR primers resulting in 216 alleles. Seventy-seven genotypes were unambiguously analysed. In cases that only one fragment could be identified, the variety was considered homozygous for that locus. Because the null alleles cannot be excluded, heterozygous values may be underestimated. The average number of alleles counted were 27 / locus. The least alleles (11) were obtained with CH04e03 primer pair, while the most (44) appeared with CH03g07. Expected heterozygosity (He) was formed between 0.72 (CH04e03) and 0.95 (CH03g07), while the mean was 0.88. Observed heterozygosity (Ho) was formed between 0.01 (CHO 4 e03) and 1.00 (GD147), with an average of 0.80. The estimated frequency of null alleles gave positive results in three cases (CH04e03, CH03d12, CH3g07), but this only indicates the possibility of the presence.

Keywords: genetic diversity, genebank, pear varieties, simple sequence repeat SSR primers

P6- Genetic diversity of the Spanish Pear Germplasm Collection assessed by SSRs

Dr. Jose Manuel Alonso Segura, Unidad de Hortofruticultura. CITA de Aragón, Av. Montañana, 930, 50059 Zaragoza, Spain; jmalonsos@aragon.es
María Teresa Espiau, Unidad de Hortofruticultura, CITA de Aragón.
Av. Montañana 930, 50059 Zaragoza, Spain; mespiau@aragon.es
Dr. Ana Pina Sobrino, Unidad de Hortofruticultura, CITA de Aragón.
Av. Montañana 930, 50059 Zaragoza, Spain; apina@aragon.es
Dr. María José Rubio-Cabetas, Unidad de Hortofruticultura, CITA de Aragón.
Av. Montañana 930, 50059 Zaragoza, Spain; mjrubioc@aragon.es
Dr. Angel Fernández i Martí, Dept. of Environmental Science, Policy and Management. , University of California Berkeley, 145 Mulford Hall, Berkeley, United States of America; anfemar81@gmail.com

The Spanish Pear Germplasm Collection located at the CITA of Aragón (Zaragoza, Spain), holds 7 accessions of *Pyrus pyrifolia* and 340 accessions of *Pyrus communis*. It includes commercial and traditional cultivars, but also Spanish landraces. Although this collection has already been characterized morphologically, now is being genotyped with 17 SSRs for 170 accessions (144 diploid and 26 triploid). This study aims to estimate the genetic diversity by grouping the varieties according to their genetic closeness and to identify the genetic structure and relationships among its accessions. With the exception of GD96, all primers produced a successful amplification, varying the number of alleles from 6 (CH05a02) to 21 (CH04c07) with an average of 13.71, giving a total of 234 fragments and 743 different genotypes. Allele size ranged from 85 bp at locus CH05C06 to 300 bp at locus CH01D08. The mean expected and observed heterozygosities over the 17 SSRs averaged 0.77 and 0.69, respectively. Three Spanish varieties, 'Duquesa Barreda', 'Limón de Verano' and 'Limón Antiguo', showed heterozygosity in all loci analyzed. On the other hand, the genotypes showing heterozygosity lower than 0.45, were the P. pyrifolia cultivars 'Nijisseiki', 'Seigyoku', 'Shinseiki' and the Spanish 'F. de los Bosques'. UPGMA analysis was performed from the genetic distance matrix, allowing the arrangement of all genotypes according to their genetic closeness, establishing genealogical relationships. The unweighted pair group method classified the genotypes according to their geographical origin, confirming the particular evolution of different pear ecotypes. Structure analysis showed a strong subpopulation structure and, in overall, most of the Spanish genotypes analyzed in this study showed its genetic distinctness when compared to the reference ones. Therefore SSRs appear to be still excellent markers to provide genetic information and a viable approach for carrying out genetic diversity studies as well as to identify most of cultivars.

Keywords: heterozygosity, genetic closeness, structure analysis, cultivar identification

P7- Measuring absorption and reduced scattering coefficients by means of laser-induced backscattering imaging in European pear (*Pyrus communis* L.)

Nicole Brandes, Leibniz Institute for Agric. Engineering, Max-Eyth-Allee 100, 14469 Potsdam, Germany; nbrandes@atb-potsdam.de

Dr. Norhashila Hashim, University Putra Malaysia, 43400 Serdang, Malaysia; norhashila@upm.edu.my

Christian Regen, Leibniz Institute for Agric. Engineering, Max-Eyth-Allee 100, 14469 Brandenburg Potsdam, Germany; cregen@atb-potsdam.de

Dr. Manuela Zude-Sasse, Leibniz Institute for Agri. Engineering, Max-Eyth-Allee 100, 14469 Brandenburg Potsdam, Germany; mzude@atb-potsdam.de

Decouple of optical properties is of great challenge, but crucial to get better insight of the relationship between light and fruit attributes. In this study, the optical properties of European pear (*Pyrus communis* L.) were measured non-destructively using laser-induced backscattering imaging (LBI) and the yielded diffuse reflectance profiles were analysed by means of Farrel's diffusion theory after referencing with photon density wave (PDW) spectroscopy. The approach was validated with nine solid phantoms capturing the ranges of absorption (μa) and reduced scattering coefficients (μ's) found in pear. Validation on phantoms indicated that fitting with diffusion theory model resulted in high measuring uncertainty, while the referencing with PDW data provided distinguished μa and μ's coefficients in absolute values [cm-1]. Using μ's from PDW in comparison to using μa from PDW resulted in decreased measuring uncertainty.The approach was applied on European pears (n=80). The fruit samples were measured for 17 days and the measurement using LBI, PDW spectroscopy and fruit quality analyses considering fruit flesh firmness, soluble solids content, and water content were conducted in 4 days interval. The measurement of LBI and PDW spectroscopy were carried out at 660 + 9 nm. The analyses of μa and μ's was, again, carried out using inverse algorithm of Farrell's diffusion theory by fixing either μa or μ's considering values obtained from PDW spectroscopy. Results indicated that the optical properties obtained from PDW spectroscopy as well as LBI changed concurrently in correspondence to water content and firmness. A destructive batch-wise measurement of μ's and online analysis of variable μa of individual fruits may become a valuable tool for pear monitoring throughout the supply chain.

Keywords: Absorption coefficient, backscattering imaging, fruit quality, scattering coefficient, solid phantoms, spatially resolved spectroscopy

P8- Studies on chromosome number of some *Pyrus* by flow cytometry

Assoc. Prof. Luming Tian , no.98 Xinghai South Street, Xingcheng City, 125100, China; tianluming@caas.cn

Dan Qi, no.98 Singhai South Street, Singcheng City, 125100, China; qidan@caas.cn

Prof. Dr. Yufen Cao, no.98 Cinghai Couth Street, Xingcheng City, Liaoning Province, 125100, China; yfcaas@263.net

Assist. Prof. Xingguang Dong, no.98 Xinghai South Street, Xingcheng City, Liaoning Province, 125100, China; dongxingguangde@126.com

Assist. Prof. Ying Zhang, no.98 Xinghai South Street, Xingcheng City, Liaoning Province, 125100, China; wodeying1314@163.com

Many karyotypes of pear varieties and *Pyrus* germplasm were observed by Giemsa staining during the last 30 years. Some triploid and tetraploid Pyrus germplasms were found and used to create novel polyploidy germplasms. The chromosome number of 400 *Pyrus* germplasms were identified by flow cytometry (FCM) in this study to help to understand their diversity in chromosome level and provide evidence about the study of system evolution or polyploid breeding. The results indicated that the chromosome number of known polyploidy germplasms were same as Giemsa staining and 15 new triploid germplasms were found. In total, a simple, rapid and efficient method of FCM suitable for *Pyrus* ploidy identification was optimized and could be generally used to identify *Pyrus* polyploid and polyploid F1seedlings.

Keywords: *Pyrus*; chromosome; polyploidy; flow cytometry

P9- Leaf morphological diversity and its taxonomic relationship of pear (*Pyrus* L.)

Prof. Dr. Cao Yufen, Res. Inst. of Pomology, Chinese Academy of Agric. Sciences, Xinghai South Street 98, Xingcheng, Liaoning 175100, China; yfcaas@263.net

Ying Zhang, Res. Inst. of Pomology, CAAS, Xingcheng, China; wodeying1314@163.com

Hongliang Huo, Res. Inst. of Pomology, CAAS, Xingchng, China; hu_ohongliang@126.com

Luming Tian, Res. Inst. of Pomology, CAAS, Xingcheng, China; tlm158@163.com

Xingguang Dong, Res. Inst. of Pomology, CAAS, Xingcheng, China; dongxingguangde@126.com

Dan Qi, Res. Inst. of Pomology, CAAS, Xingcheng, China; 648701025@qq.com

Jiayu Xu, Res. Inst. of Pomology, CAAS, Xingcheng, China; aa881031@sina.com

Twelve leaf characters (leaf length, leaf width, leaf shape, petiole length, shape of leaf base, shape of leaf apex, leaf margin, seta on leaf margin, status of leaf surface, presence of stipules, colour of young leaf, latitude of leaf in relation to shoot) in 548 *Pyrus* accessions were investigated in order to reveal the diversity and discuss the taxonomic relationship. There were abundant diversity in leaf characters of pear. The ovate leaf shape, wide wedge-shaped leaf base, sharp-acuate leaf apex, serrate on leaf margin with seta, enclasped status of leaf surface, downward latitude of leaf in relation to shoot and redish-green young leaf were abundant, accounting for 90.33%, 58.03%, 66.97%, 81.57%, 87.23%, 59.27% 86.68% and 35.40%, respectively. The average leaf length, leaf width and petiole length are 10.8cm, 7.0cm and 4.3cm respectively, and the average coefficients of variation were 17.25%, 19.04% and 21.06% respectively. The genetic diversity of color of young leaf and shape of leaf base were higher than other traits. The variation in pear germplasm resources based on leaf traits among populations was higher than within populations. For almost all of the *P. bretschneideri*, *P. ussuriensis* and *P. pyrifolia* accessions, the leaf shape is ovate, while for the *P. communis* accessions, 71.4% are elliptic. For 94.3% of the *P. bretschneideri*, *P. ussuriensis* and *P. pyrifolia* accessions, the leaf margins are serrate, while for *P. communis* accessions, the crenate, circular, serrate, and entire margin account for 39.7%, 34.9%, 15.9%, and 9.5% respectively. For all of the *P. bretschneideri*, *P. ussuriensis* and *P. pyrifolia* accessions, the seta on margin are present, while for *P. communis* accessions, in 93.7% of accessions they are absent. The taxonomic relationship of pear based on leaf morphological characters were also discussed.

Keywords: pear; leaf; morphological diversity; taxonomic relationship

P10- Pear cultivar and rootstock research in North East Europe: an overview

Darius Kviklys, Institute of Horticulture, Lituanian Res.Ctr.for Agric. and Forestry, Kauno 30, 54333 Kaunas Distr. Babtai, Lithuania; dkviklys@gmail.com

Winter hardiness is the main factor limiting pear growing and use of quince rootstocks at North East Europe climate conditions. Therefore, several cultivar and rootstock trials were performed from 1998 till 2018 at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. Investigations of pear cultivars were conducted in 2005–2015. Twelve cultivars on quince S1 rootstock were tested aiming to find optimal replacement for cv. Conference that is not enough winterhardy at North East Baltic countries. After the evaluation of winterhardiness, productivity and fruit quality only cv. Mramornaja showed desirable characteristics. Rootstock breeding was based on winterhardy *Cydonia oblonga* population and resulted in 3 registered rootstocks of K series in Lithuania. K series rootstocks were compared with QMA, QMC, Sydo, QS1, *Pyrus communis*. According tree growth control and productivity they were equal to QMA. Rootstock testing project in 2001 – 2011 included *Cydonia* and *Pyrus* vegetative and seedling rootstocks. According fertility index rootstocks were ranged in following groups: 1. BA 29 and Quince MC 2. Quince MA 3. Pyrodwarf 4. OHxF 333 5. Mostbirne and Kazrausu. New European pear rootstock trial coordinated by EUFRIN (European Fruit Research Institute Network) will be established in 9 countries and will include recently released rootstocks.

Keywords: *Pyrus communis*, *Cydonia oblonga*, productivity, winterhardiness

P11- Phenological behavior of European pears grown in the mountainous plateau in Southern Brazil

Aike Anneliese Kretzschmar, University of Santa Catarina State, Avenida Luiz de Camões 2090, 281, 88 520-000 Lages, Brazil; aike.kretzschmar@udesc.br

Deivid Silva de Souza, Avenue Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; deividsilvadesouza@hotmail.com

Dr. Alberto Ramos Luz, Avenue Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Choose a country; albertoramosluz@yahoo.com.br

Rafael Petineli, Avenue Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; rafael_petineli@hotmail.com

Aline Melo dos Santos, Avenue Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; alinemeloagronomia@gmail.com

Prof. Dr. Leo Rufato, Avenue Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; leoruffato@yahoo.com.br

The phenological knowledge of the cultivars is important for the choice of the best cultivars to establish a pear orchard. To achieve profitable yields it is important at least two cultivars, with different S-haplotypes or sharing just one, synchronized flowering, a vector that would transmit the pollen, and favorable environmental conditions for pear pollination and fertilization. Although pear has been studied in Brazil for approximately 50 years, there are few studies that describe these parameters. The objective of this study was to evaluate the phenological behavior of the European pear cultivars 'Rocha', 'Abate Fetel', 'Packham's Triumph', 'Santa Maria', 'Williams' and 'Forelle' grafted on 'Adams' rootstock grown in Lages, SC, Brazil. The orchard establishment occurred in 2008 and the evaluations were performed from the season 2011/12 to 2015/16. The phenological observations were done through daily monitoring identifying the period of budding, beginning of flowering, full bloom, and end of the flowering. The climatic conditions during flowering, although not favorable in some years, allowed the fertilization and fruit set of the studied pears. There were different phenological behaviors among the studied seasons. Until the 2012/13 season, there were many anticipation and delay changes in the flowering behavior of cultivars. While from the 2013/14 season ahead, the pear trees began to show similar flowering behavior throughout the years. In general, the cultivars 'Abate Fetel' and 'Forelle' started budding earlier than other cultivars and had synchronized flowering. The 'Rocha' pear has the beginning of flowering synchronized with the end of flowering of 'Abate Fetel' and 'Forelle'. The 'Rocha' full bloom synchronizes with the beginning of flowering of 'Packham's Triumph' and 'Santa Maria', while the end of flowering of these two cultivars synchronizes with the beginning of flowering of 'Williams' pear which has the later flowering.

Keywords: Pollination, flowering synchronization, fertilization, *Pyrus communis* L., *Cydonia oblonga* Mill

P12- New Japanese pear cultivar developed in Brazil: 'SCS421 Carolina'

Prof. Dr. Ivan Dagoberto Faoro, Estação Experimental de Caçador, EPAGRI, Caixa Postal 591, 89501.032 - Caçador - SC, Brazil; ivanfaoro@uol.com.br

Japanese pears (*Pyrus pyrifolia var. culta*) are still little consumed in Brazil because most consumers are unaware of the good quality of their fruits and the high selling price. Tasting panels in markets have shown great interest by consumers for this type of pear, but the area of planting is small and all cultivars currently planted were originated in countries where climatic conditions differ from Brazil. The low adaptation of Asian pears in Brazil has caused poor flowering, low productivity, and production of fruit with irregular shape. In order to mitigate these deficiencies, the Epagri / Experimental Station of Caçador genetic improvement program launched in 2017 the 'SCS421 Carolina' cultivar, obtained from the cross between 'Housui' x 'Osanijisseiki' in 1998. It produces fruits with a more symmetrical rounded shape than 'Housui', with golden brown color, medium size (220 g), good commercial appearance and organoleptic quality. This new cultivar is moderately resistant to entosporiosis (*Diplocarpon mespili*). Evaluations show that there is good uniformity of size among the fruits produced. The harvest takes place in the first half of February, along with 'Housui', its competitor in appearance. Fruit bagging is indicated during development for best commercial appearance.

Keywords: *Pyrus pyrifolia*, breeding, variety

P13- Induction of bud mutations in 'Early Bon Chrétien' pears

Julio Pisano, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km.10, Canelones, Uruguay; jpisano@inia.org.uy

Maximiliano Dini, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km. 10, Canelones, Uruguay; mdini@inia.org.uy

Global climate change is modifying adaptation of different fruit species. Pear culture is one of them, therefore, having a cultivar that adapts to these changes is of real importance. With the induction of mutations, it is intended to generate variability and improve the adaptation of 'Early Bon Chrétien' pear to different production regions, modifying aspects such as chilling requirements, flowering time, harvest date, fruit size, and resistance to diseases. In August 2017, shoots from 'Early Bon Chrétien' were collected in an orchard in Canelones, Uruguay. Twelve shoots of 25cm were subjected to absorption of each of the different concentration colchicine solutions (0, 0.025, 0.050, and 0.10%). They remained with the basal end immersed in the solution in Bohemian glasses for six to thirteen days in darkness at an average temperature of 23°C. Then buds were over grafted on adult pear tree branches (chip budding), identifying the buds as basal or apical according to the portion of the shoots from where they were taken. After 30 days, sprouted buds were counted. Of 240 grafts performed, 14.2% of buds sprouted, with a lower sprouting percentage the greater the colchicine rate. The apical buds of the treatment that combined absorption during 13 days of the solution with 0.025% of colchicine presented the highest percentage of sprouted buds (43.8%). A morphological study of leaves and shoots was carried out. In the leaves differences were determined in regard to shape of the base, shape of the apex, incisions of the edge in the upper half, presence and distribution of stipules, and number and size of stomata. The length of shoots was measured showing differences among materials. These results indicating presence of mutations will be discussed, as determinations by flow cytometry.

Keywords: *Pyrus communis* L.; pear breeding; genetic variability; colchicine; European pear

P14- Orchard productivity and fruit quality of three pear (*Pyrus communis* L.) cultivars grafted on different rootstocks

Prof. Dr. Metka Hudina, Biotechnical Faculty., Department of Agronomy, Jamnikarjeva 101, 1000 Ljubljana, Slovenia; metka.hudina@bf.uni-lj.si

The influence of different pear rootstocks (Quince MA, Quince BA 29, Fox 11, Farold 40, pear seedling, own rooted) on growth, fruit quality, and yield of cultivars 'Williams', 'Conference', and 'Abate Fetel' were evaluated. Trees were observed from 2009 until 2017. For all three cultivars, Fox 11 trees showed signs of incompatibility. During the hot summer months we noticed that the leaves of the 'Conference' were most affected by the sunshine, followed by the cultivar 'Williams' and then 'Abate Fetel' cultivar, where there were not many sunburns of leaves. The leaf damage was the strongest in all three cultivars on trees grafted on Quince MA and the least leaves were damaged in trees on seedlings and on their own roots. In 2017 the yield of trees of all three cultivars was affected by spring frost. Trees grafted on Quince MA were most affected by low temperatures and had the least yield. Cultivar 'Williams' trees on their own roots were 20% more vigorous than on seedling and had the highest average yield in the first 9 yielding years (24.6 t/ha). The average yield of 'Williams' cultivar was the lowest on Quince MA (12.99 t/ha) and Quince BA 29 (10.17 t/ha) rootstocks. 'Abate Fetel' trees on Farold 40 rootstock had the highest average yield in the first 9 yielding years (23.06 t/ha). The average yield of 'Abate Fetel' cultivar was the lowest on Quince MA (12.94 t/ha) and Fox 11 (10.44 t/ha) rootstocks. 'Conference' trees on their own roots had the highest average yield in the first 9 yielding years (26.25 t/ha). The average yield of cultivar 'Conference' was the smallest on Quince MA (11.19 t/ha) and Quince BA 29 (13.71 t/ha).

Keywords: 'Williams', 'Conference', 'Abate Fetel', yield

P15- Morphological and anatomical leaf characteristics of some European and Asian pear cultivars

Assoc. Prof. Milica Fotiric Aksic, Poljoprivredni fakultet, Nemanjina 6, 11080 Beograd - Zemun, Serbia; fotiric@agrif.bg.ac.rs
Dr. Radosav Cerovic, Univeristy of Belgrade, Innovation Center, Faculty of Technology, 11000 Belgrade, Serbia; radosav.cerovic@gmail.com
Dr. Slavica Colic, Institute for Science Application in Agriculture, 11000 Belgrade, Serbia; slavicacol@yahoo.com
Assoc. Prof. Dragan Radivojevic, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; dragan1970@agrif.bg.ac.rs
Assoc. Prof. Gordan Zec, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; zec@agrif.bg.ac.rs
Prof. Dr. Vlado Licina, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; licina@agrif.bg.ac.rs
Prof. Dr. Mekjell Meland, Norwegian Institute of Bioeconomy Research, NIBIO, Ullensvang, Norway; mekjell.meland@nibio.no

The objective of this study was to determine morphological and anatomical leaf characteristics and stomatal traits of three European (*Pyrus communis* L.) cultivars, three Asian [*Pyrus pyrifolia* (Burm. f.) Nakai] pear cultivars together with one interspecies hybrid (P. pyrifolia x P. communis cv. Bartlett). Pear trees were grown under the standard practice without irrigation. Fully developed leaves were picked from the middle part of the extension shoots at the beginning of July. Leaf traits were measured on leaves the same day of picking. Anatomy of leaves was determined under light microscopy (LM) while scanning electron microscopy (SEM) was used for the examination of the stomata cells. Asian pear cultivars ('Kousui', 'Nijisseiki', and 'Niitaka') had much higher values for leaf parameters (width, length, stem length, and leaf area) than the European cultivars ('Conference', 'Williams or Bartlett', 'Abbate Fetel') and interspecies hybrid ('Kieffer Seedling'). Midrib parameters (length and width) were the highest in 'Kosui' and 'Nijisseiki'. Leaves of 'Kieffer Seedling' and 'Abbate Fetel' were the thickest, mainly due to increased palisade and spongy parenchyma thickness. The leaf stomata density significantly varied among the pear cultivars, ranging from 89.53 stomata/mm2 ('Nijisseiki') up to 134.07 stomata/mm2 ('Kousui'). SEM proved that Asian pear cultivars and 'Kieffer Seedling' shared 'amphiparacytic' stomata type, while European pear cultivars had 'anomocytic' stomata type. Cluster analysis distinguished pear cultivars into two distinct groups, where European cultivars formed first sub-cluster and Asian together with 'Kieffer Seedling' second sub-cluster. Midrib traits and type of stomata made a clear separation between the clusters.

Keywords: *Pyrus communis* L., *Pyrus pyrifolia* (Burm. f.) Nakai], *P. pyrifolia* x *P. communis*, leaf parameters, leaf stomata, cluster analysis

P16- Embolism of different pear tree rootstocks and the relationship with plant vigor

Everton Sozo de Abreu, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; sozodeabreu@hotmail.com
Bruno Carra, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; brunocarra@hotmail.com
Maximiliano Dini, Campus Universitário UFPel, 354, Capão do Leão, Rio Grande do Sul, Brazil; maxidini@hotmail.com
Tuane Araldi da Silva, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; tuanearaldi17@gmail.com
Dr. Fabiano Simões, Avenida Antônio Ribeiro Branco 1060, Vacaria-Rio Grande do Sul, Brazil; fabiano-simoes@uergs.edu.br
Dr. Mateus Pasa, Oregon State University, Mid-Columbia Agricultural Research and , Extension Center, Hood Rive Oregon, United States of America; mateus.pasa@gmail.com
Dr. Alberto Fontanella Brighenti, Epagri - Estação Experimental São Joaquim, Araújo Lima 102, R. João e de Souza, São Joaquim-Santa Catarina, Brazil; albertobrighenti@epagri.sc.gov.br
Dr. Paulo Celso Mello-Farias, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; mellofarias@yahoo.com.br
Dr. Flavio Gilberto Herter, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; flavioherter@gmail.com (presenting-author)
Prof. Ana Lucia Soares Chaves, Campus UniversitarioUFPel 354 Capao do Leao, Rio Grande do Sul, Brazil; analucia.soareschaves@gmail.com

Water relation between rootstocks and cultivars is a key issue in pear culture. Studies suggest that the plant water flow may be related to the greater or lesser grafted plant vigor, where an increase in the hydraulic resistance caused by the graft union would lead to plants with lower vigor. The Xyl'em-Plus apparatus was developed to measure the level of embolism in the vascular system of woody plants, which through small segments of plant stems, measures the percentage of loss of conductance (PLC) in the xylem due to air blockage. From this parameter, along with a variable related to plant vigor, such as trunk cross section area (TCSA) increase, we can infer if the embolism caused by the rootstock is interfering in the plant development. Thus, this work evaluated the PLC of 'Rocha' pear trees, grafted on three different rootstocks, comparing the vigor between these rootstocks with the purpose of inferring the effect of embolism on plant vigor. Shoots of 'Rocha' pear trees grafted on *Pyrus calleryana*, 'BA29' and 'EMA' quince rootstocks, were collected in an orchard in the Municipality of São Joaquim, SC, Brazil, after fruit harvest. This material was taken to the laboratory, where 5cm cuttings were prepared to be inserted in the Xyl'em apparatus to carry out the PLC measurements. PLC and TCSA increase showed significant difference in the different rootstocks. *Pyrus calleryana* showed the lowest PLC compared to the other rootstocks with the highest TCSA increase, differing significantly from 'EMA' for PLC and both 'BA29' and 'EMA' for TCSA increase. 'BA29' and 'EMA' did not present significant differences between them, in either PLC nor TCSA increase. These results show that the restriction in water flow in the xylem caused by the embolism of different rootstocks may be related to the lower vigor of pear trees.
Keywords: *Pyrus communis*; Xylem apparatus; vegetative growth; water flow; hydraulic resistance

P17- Breeding for fire blight resistance in an interspecific pear breeding programme

Richard Volz, Plant and Food Research, Private Bag 1401, Havelock North, 4157, New Zealand; richard.volz@plantandfood.co.nz

Lester Brewer, Plant Food Research, Motueka Research Centre, 55 Old Mill Road, 7198 Motueka, New Zealand; lester.brewer@plantandfood.co.nz

Marlene Aldsworth, Plant Food Research, Motueka Research Centre, 55 Old Mill Road, 7198 Motueka, New Zealand; marlene.aldsworth@plantandfood.co.nz

Natalie Profitt, Plant Food Research, Hawke's Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; natalie.profitt@plantandfood.co.nz

Gagan Singla, Plant Food Research, Hawke's Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; gagan.singla@plantandfood.co.nz

Dr. Vincent Bus, Plant Food Research, Hawke's Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; vincent.bus@plantandfood.co.nz

Mary Horner, Plant Food Research, Hawke's Bay Research Centre, Private Bag 1401, 4157 Havelock North, New Zealand; mary.horner@plantandfood.co.nz

The Plant & Food Research pear breeding programme in New Zealand is developing interspecific pear hybrids for pear industries in New Zealand, Australia and globally. The major aim of this breeding programme is to produce a new type of pear that is attractive, crisp, juicy, and flavoursome with long storage life. Historically from 1983 to 2001, the programme used European, Japanese and Chinese pear progenitors that are mostly regarded as susceptible to fire blight disease, caused by the bacterium Erwinia amylovora. Since 2002, breeding lines have been initiated to actively introgress multiple fire blight resistances from a number of sources. Seedlings produced from these breeding lines have been screened annually in the glasshouse and those deemed resistant planted in the field for selection based on fruit characteristics. All selections from seedling plots have been retested in the glasshouse to confirm fire blight resistance. Mapping of resistance genes to understand the genetic architecture of resistance and to identify possible molecular markers linked to resistances that may aid in the breeding process is also underway. We report on breeding progress made to date in understanding the genetics and best sources of fire blight resistance, and the quality of fruit being developed in these new fire blight-resistant pear breeding lines.

Keywords: plant genetics, disease, susceptibility, *Erwinia amylovora,* fruit quality

P18- Phenotypic incompatibility among European pear cultivars and `Adams´ quince rootstock grown in Brazil

Mariana Mendes Fagherazzi, Universidad do Estado de Santa Catarina, DOUTOR JORGE BLAYER, 88523-340 Lages-Santa Catarina, Brazil; marianaargentamendes@gmail.com

Deivid Silva de Souza, Av. Luiz de Cames 2090, Coral, Lages, Brazil; deividsilvadesouza@hotmail.com

Alberto Ramos Luz, Av. Luiz de Cames 2090, Coral, Lages, Brazil; albertoramosluz@yahoo.com.br

Prof. Dr. Antonio Felippe Fagherazzi, Av. Luiz de Cames 2090, Coral, DOUTOR JORGE BLAYER, 88523-340 Lages-Santa Catarina, Brazil; antonio.fagherazzi@gmail.com

José Roberto Rodrigues, Av. Luiz de Cames 2090, Coral, Lages, Brazil; joserobertoagro@yahoo.com.br

Prof. Dr. Aike Anneliese Kretzschmar, Av. Luiz de Cames 2090, Coral, Lages, Brazil; aikeanneliese@yahoo.com.br

Prof. Dr. Leo Rufato, Av. Luiz de Cames 2090, Coral, Lages, Brazil; leo.rufato@udesc.br

The pear tree culture has ‘Adams’ quince rootstock as an alternative due to its characteristics of promoting low vegetative growth, high yield efficiency, high crop production, good fruit set and fruit weight, and ease of propagation. Although, ‘Adams’ quince has fasciculate and superficial root system and low affinity with widely used European pear cultivars. The objective of this study was to evaluate the phenotypic incompatibility of ‘Adams’ rootstock grafted with different European pear cultivars: Rocha, Abate Fetel, Packham’s Triumph, Santa Maria, Williams, Forelle, Conference, Clapp’s Favourite and Max Red Barlett. The orchard establishment occurred in 2008 and the evaluation was performed until 2015/2016 season. The 'localized' incompatibility was evaluated by calculating the difference between the diameter of the rootstock and the diameter of the scion and by the internal and external anatomical analysis of the union region between the rootstock and the scion. The 'translocated' incompatibility was evaluated by the average of chlorophyll content (SPAD). The cultivars William's, Max Red Barlett and Clapp's Favorite showed 'localized' incompatibility and are not recommended for grafting directly on ‘Adams’ quince. The cultivar Santa Maria presented a perfect union in the grafting zone, indicating that it has a good compatibility with the 'Adams' quince. The cultivars Rocha, Abate Fetel, Packham's Triumph and Forelle presented union with discontinuity in the region of grafting, characterizing a partial incompatibility.

Keywords: Compatibility, *Pyrus communis*, dwarf rootstock

P19- Williams pear (*Pyrus communis* L.) productivity and fruit quality, grafted onto different rootstocks

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones., Uruguay; dcabrera@inia.org.uy

Pablo Rodríguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; prodriguez@inia.org.uy

Alison Uberti, Federal University of Fronteira Sul - UFFS, Chapecó, Brazil; alisonuberti@hotmail.com

Dr. Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; rzoppolo@inia.org.uy

Andrés Coniberti, Instituto Nacional de Investigación Agropecuaria, Ruta 48, km 10, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; aconiberti@inia.org.uy

Edgardo Disegna, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; edisegna@inia.org.uy

Williams, the most cultivated pear (*Pyrus communis*) in Uruguay, was grafted on: three P. communis rootstocks ('OH×F333', 'OH×F51', 'OHxF97'); one P. calleryana ('D6'); and two *Cydonia oblonga* (quince) rootstocks ('BA29' and 'EMC'). To evaluate the performance of these combinations in the South of Uruguay, trees were planted in 1999 at the INIA Las Brujas, 'Wilson Ferreira Aldunate' Experimental Station (34° 67' S - 56° 34' W). Rows were 5 m apart and 1,5 m between trees (1333 pl/ha). The experimental design used was randomized blocks with six treatments, each composed of six plants, with four replications. The crops considered were from 2014 to 2018. Productivity was evaluated as well as average fruit weight, firmness, diameter, soluble solids and number of fruits. The data were submitted to analysis of variance by the F test and, when significant differences were detected, the means were compared through the Tukey test at 5%. The different rootstocks evaluated had no influence on diameter, firmness and soluble solids of fruits. For average fruit weight, it was observed that the quince 'EMC' presented the highest value in the first three cycles evaluated, and the cultivar on 'OH×F51' presented lower fruit weight during the same period. Regarding productivity, the rootstocks 'OH×F333', 'OH×F51' and 'OH×F97' were higher in the 2013/14, and 2016/17 cycles. These periods comprise good years of precipitation and cold units. However, in cycles of unsuitable climatic conditions, the 'BA29' rootstock was superior in productivity showing higher stability among years. Main withdraw for quince rootstocks was high rate of plant death occurred, being a possible reason the incompatibility which can be solved with an interstem. According to the results there is need of further research to identify the proper combination which will achieve maximum pear production potential under Uruguayan conditions.

Keywords: *Cydonia*, incompatibility, climatic condition, OHxF, Uruguay

P20- Performance of `Celina´, `Ingeborg´ and `Kristina´ pear cultivars on quince rootstocks growing in a nordic climate

Prof. Dr. Mekjell Meland, Nibio Ullensvang, Norwegian Institute of Bioeconomy Research, N-5781 Lofthus, Norway; mekjell.meland@nibio.no

Oddmund Froynes, Norwegian Institute of Bioeconomy Research, N-5781 Lofthus, Norway; oddmund.froynes@nibio.no

Prof. Dr. Milica Fotiric-Aksic, University of Belgrade, Faculty of Agric., Belgrade, Serbia; fotiric@agrif.bg.ac.rs

Performance of quince rootstocks 'Adams', 'C', and 'Eline' all grafted with the three pear cultivars 'Celina', ' Ingeborg', and 'Kristina' were compared at the experimental farm of NIBIO Ullensvang, Western Norway. Feathered trees were planted 1.0 × 3.5 m apart in October 2011 and trained to a slender spindle with grass between rows and 1 m wide herbicide strips. Complete randomized block design with four replications and two trees per plot was used. Tree vigor, yield, fruit size and fruit quality were evaluated annually for six years. No severe winter damage was observed during these years and none of the trees died. No significant differences in tree size between the different rootstocks were found. Both 'Ingeborg' and 'Kristina' produced the smallest trees whereas 'Celina' resulted in the largest, as measured by trunk cross-sectional area. Averagely, mature fruits were picked during mid-September. 'Ingeborg' was mature a week behind the two other cultivars. Trees began producing a small crop in the third season and yields peaked in the sixth season. 'Adams' and 'C' were the most productive rootstocks in average for all cultivars. Accumulated yield for the first four cropping years were 15.0 kg tree-1 for 'Adams' followed by 'C' (14.2 kg) and 'Eline' (11.0 kg). 'Celina' was the most productive cultivar and alternate bearing was observed with all rootstocks. Fruit sizes were little affected by the rootstocks, 'Eline' averaged 181 g for all cultivars and 'Adams' and 'C' 161 g. These differences were due to crop load effects. Soluble solid contents in average for three rootstocks were generally high (11.3%), but was not significantly affected neither by rootstocks nor by cultivars. Fruit acidity was similar for all rootstocks (0.20 -0.30 %). Considering all results, 'Adams' can be recommended as a rootstock to these pear cultivars in a cool, mesic northern climate.

Keywords: *Pyrus communis* L., crop load, high density, tree size, yield, fruit quality

P21- CREA 194, the new pear variety released by CREA-Research Center of Olive, Citrus and Tree Fruits

Dr. Giuseppina Caracciolo, Unità di ricerca per la frutticoltura, via La Canapona 1bis, 47122 Forlì (FC), Italy; giuseppina.caracciolo@crea.gov.it

Dr. Gianluca Baruzzi, via La Canapona 1 bis, 47122 Forlì (FORLÌ-CESENA), Italy; gianluca.baruzzi@crea.gov.it

Sandro Sirri, via La Canapona 1 bis, 47122 Forlì (FORLÌ-CESENA), Italy; sandro.sirri@crea.gov.it

'CREA 194' pear (*Pyrus communis* L.) is a new attractive early-season fresh market pear variety. It was obtained by CRA-FRF, now CREA-Research Center of Olive, Citrus and Tree Fruits, in 1994 from an open pollination of Carmen* and seedling was selected in 2002 at the experimental farm of Magliano – Forlì. Trialled on different rootstocks, this selection proved to adapt well to the cultural conditions of the Po Valley area and to other cultural areas characterized by more temperate climate. It has a consistent, medium-high productivity and sometimes thinning is required to obtain good sized fruits. Very early bearing both on *Pyrus communis* and on quince rootstock (*Cydonia oblonga*). It is fully adapted to different production areas in Northern Italy and in other European countries. The tree has an erect growth habit, a medium vigour and a high graft compatibility with vigorous rootstocks (FAROLD® 40 DAYGON*, SYDO®) while on quinces it is recommended to add an interstock (Ba29; EMC, EMH). The start of flowering is early and it is successfully pollinated by Coscia, Conference, Williams and Carmen*. The harvest time in the Po valley is late July, 8-10 days after Carmen*. The fruits are medium-to-big sized, fruit is yellow colored with red blush for 40-50% of the surface and flesh is medium-fine, juicy, sweet and aromatic. The resistance to handlings and the storability is higher than Carmen*.

Keywords: variety, early bearing, productivity, storability, *Pyrus communis* L.

P22- A New Hardy and Free Thinning Fruit Pear variety `Danhua´

Prof. Dr. Maojun Zhang, Pomology Institute , Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; nkyzmj@sina.com

Prof. Qiang Wang, Pomology Institute , Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; wangq7505@163.com

Assist. Prof. Mingyan Lu, Pomology Institute , Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; lumingyan790101@163.com

Assist. Prof. Xingkai Yan, Pomology Institute , Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; 188135519@qq.com

Chunhao Wu, Pomology Institute , Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; 1104013069@qq.com

Assist. Prof. Jiaxian Hou, Jilin Academy of Agricultural Sciences, China, Gongzhuling, Jilin, 136100, China; jlhoujiaxian@163.com

A main objective for pear breeding is to find a variety with strong stress resistance, good quality, and manageability in main growing areas. According to the data, nearly all of pear varieties usually contain more than 5 flowers per inflorescence. The new pear variety ‘Danhua’, selected from a variant branch with single-flower feature of Yanbian Daxiangshui pear in 1999, was released in 2016. The mother cultivar is a traditional ussurian pear type and was grown in northeast of China before 1990. The fruit ripens during middle September at Jilin province of China.The single-flower feature can be stable in the offspring of plants by asexual reproduction. The tree from bud-grafted on rootstock seedling of wild ussurian pear (*Pyrus ussuriensis* Maxim) is rather upright, moderate vigorous with abundant spurs, which begin to bear after 4 years old. Anthesis is middle about May Day, and most inflorescences put up single-flower feature.Fruits are usually oval and 158g in wt., large relatively compared with other pears of *Pyrus ussuriensis* as ‘Nanguo’, ‘Xiaoxiangshui’, ‘Huagai’, ‘Jianba’, and so on. The skin color is green or yellow-green with yellow skin when nearly ripe. The flesh is hard so that fruit just picked can’t be eaten as occidental pear varieties; they turn soft and juicy after ripening with sweet and sour flavor and aroma. Brix is 14.1, soluble sugar 10.49%, total acid 7.13g/kg, vitamin C 4.74mg/100g FW. The quality of the fresh fruit is good. Fruits have high juice yield with cloud juice 80.9%, clear juice 62.1%, total acid 0.77% and sugar-acid ratio14.6 , therefore it is dual purpose pear variety with fresh eating and juice extraction .It is strongly resistant to cold and can endure -35℃ and even lower temperatures, as well it is insensitive to scab and brown spot in fruit and leaf.

Keywords: pear variety, free thinning fruit, hardy

P23- Characterization of the "S" alleles of the new self-compatible pear cultivar 'SCS421 CAROLINA'

Prof. Dr. Ivan Dagoberto Faoro, Estação Experimental de Caçador, EPAGRI, Caixa Postal 591, 89500.000 Caçador - SC, Brazil; ivanfaoro@uol.com.br

Dr. Maraisa C. Hawerroth, Estação Experimental de Caçador, Caixa Postal 591, Rua Abílio Franco 1500, Bom Sucesso, 89501-032 Caçador-SC, Brazil; maraisahawerroth@epagri.sc.gov.br

Dr. Thyana Lays Brancher, Estação Experimental de Caçador, Caixa Postal 591, Rua Abílio Franco 1500, Bom Sucesso, 89501-032 Caçador-SC, Brazil; thyanalays@hotmail.com

Luane Bosetto, Estação Experimental de Caçador, Caixa Postal 591, Rua Abílio Franco 1500, Bom Sucesso, 89501-032 Caçador-SC, Brazil; luaneb_94@hotmail.com

The pear tree presents the gametophytic self-incompatibility system as genetic control to prevent self-fertilization and avoid inbreeding depression. This system is governed by the multi-allelic locus S that codes for RNases which act on the pistil of the plant and prevent the development of the pollen tube when the S allele present in the pollen grain is equal to that present in the diploid tissue of the pistil. In this case and in the absence of parthenocarpy, the natural production of fruits and seeds does not occur. The new Carolina SCS421 cultivar has shown high natural fixation of fruits, even at unfavorable climatic conditions, which suggests the possibility of containing the mutant allele S4sm for autofertility. The objective of this work was to determine the S alleles of the Carolina SCS421 cultivar and its possible parents in order to confirm their genealogy based on the segregation of the S alleles. In addition, the self-fertilization rate was evaluated through isolation of flowers, preventing cross-pollination. Genotyping of the S alleles was performed via genetic markers using five sets of primers associated with the pear S locus. The results indicated that SCS421 Carolina has the S3S4sm alleles, with Housui (♀) and Osanijisseiki (♂) as its parents, and the average rate of autofertility through protection of floral clusters was 50.5% because it carries the S4sm autofertility allele.

Keywords: pear, *Pyrus*; gametophytic self-incompatibility

P24- New OHxF series and selection CAV 03 rootstocks for *Pyrus communis* L. in Southern Brazil

Prof. Dr. Antonio Fagherazzi, Av. Luis de Cames 2090, lages, 88520000, Brazil; antonio.fagherazzi@gmail.com

Augusto José Posser, Avenida Luís de Cames, 88520-000 Lages-SC, Brazil; augustoposser@hotmail.com

Mariana Mendes Fagherazzi, Avenida Luís de Cames, 2090, 885200-000 LAGES-SC, Brazil; marianaargentamendes@gmail.com

Pricila Silva dos Santos, Avenida Luís de Cames, 88520-000 Lages-SC, Brazil; pricilassilva@hotmail.com

Josiele Alves da Silva, Avenida Luís de Cames, 2090, 885200-000 LAGES-SC, Brazil; josiele.alves.silva@hotmail.com

Prof. Dr. Aike Anneliese Kretzschmar, Avenida Luís de Cames, 2090, 885200-000 LAGES-SC, Brazil; aikeanneliese@yahoo.com.br

Prof. Dr. Leo Rufato, Avenida Luís de Cames, 2090, 88520-000 LAGES-SC, Brazil; leoruffato@yahoo.com.br

In order to meet international demand for fruit, orchard management techniques have been investing in densification of plants, optimizing space using compact trees, which facilitates, even, canopy interventions. Productivity and vigour are directly influenced by the rootstock, as well as height and architecture of plants. In Brazil, there are still few options for pear tree rootstocks satisfactorily adapted to different production regions. Based on this assumption, an experimental area was installed in Southern Brazil conditions for pear tree in 2017 to evaluate vegetative performance of rootstocks and cultivar combinations in Caxias do Sul city, in Rio Grande do Sul state. Experimental design was four randomized blocks 2 x 3 factorial arrangement (two cultivars –'Rocha" and "Santa Maria'- and three rootstocks OHxF 69, OHxF 87 and CAV 03). Variables analysed were: plant height, branch length, total number of sproutings (spur, branch and shoot), graft point diameter and compatibility by Perraudin coefficient. 'Rocha" on rootstock OHxF 69 had less spurs and this same cultivar developed the highest number of shoots on both OHxF rootstocks and also on CAV 03. 'Santa Maria' on CAV 03 had less total sproutings than 'Santa Maria' on OHxF 87. 'Rocha" on CAV 03 formed more sproutings than it did on OHxF 69. According to Perraudin analyses, 'Santa Maria" grafted on CAV 03 has the best affinity in comparison to other combinations, even though it had lower canopy height.

Keywords: vegetative performance; vigour; pear tree; grafting

P25- Pear accession fingerprinting through microsatellite markers in Uruguay

Wanda Iriarte, Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; wiriarte@inia.org.uy

Sara Murchio, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; smurchio@inia.org.uy

Pablo Rodríguez, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; prodriguez@inia.org.uy

Danilo Cabrera, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; dcabrera@inia.org.uy

Jorge Soria, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; jsoriabaraibar@gmail.com

Julio Pisano, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; jpisano@inia.org.uy

Dr. Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; rzoppolo@inia.org.uy

Dr. Marco Dalla Rizza, , Instituto Nacional de Investigación Agropecuaria, Ruta 48, Km. 10, Rincón del Colorado, Canelones 90200, Uruguay; mdallarizza@inia.org.uy

A selection of eleven microsatellite markers (SSRs) reported for fingerprinting germplasm collections of *Pyrus* spp. was used to genotype a collection of cultivars and rootstocks. This set of markers included the "minimum core" established by Evans et al. (2009). Cultivars with known origin (Williams Bon Chrétien, Abbé Fetel and Doyenné du Comice) were included as reference accessions. The comparison was performed among 44 accessions collected from old pear plantations with different commercial origins and date of introduction to the country. The aim of this study was to genotype pear accessions that were introduced in Uruguay to evaluate the genetic variability among clones and pear rootstocks. The selected markers proved to be effective for variability discrimination in all the accessions having 3 to 8 alleles per locus. The most informative markers were CH01d09 and GD96. Within cultivars, the observed variability among the thirteen Williams clones could respond to the numerous introductions from different origins that were performed throughout the years of pear production in the country. Although the accessions were grouped in clearly defined clusters as expected before the analysis, they showed variability within cultivars. The accession 00LBPrSJ is a rootstock collected from the locality of San José, and selected because of its medium to low vigor that leads to medium-sized fruit trees. This accession showed particular molecular pattern profile characterized by unique alleles that make it genetically distant from other accessions. The above mentioned phenotypic feature represents a very appealing condition that is suitable for the current cultivation practices overcoming incompatibility problems.

Keywords: *Pyrus* spp, SSR, genotyping, average linkage

P26- Correlation between climatic factors and productivity of different pear rootstocks

Dr. Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Km. 10 Ruta 48, Rincon del Colorado (Canelones), 90200 Las Piedras, Uruguay; rzoppolo@inia.org.uy

Pablo Rodríguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, El Colorado 90700, Canelones, Uruguay; prodriguez@inia.org.uy

Alison Uberti, Federal University of Fronteira Sul - UFFS, Chapecó, Santa Catarina, Brazil; alisonuberti@hotmail.com

Alice Silva Santana, Federal University of Fronteira Sul - UFFS, Chapecó, Santa Catarina, Brazil; alice.ifrr@hotmail.com

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, El Colorado 90700, Canelones, Uruguay; dcabrera@inia.org.uy

Pear (*Pyrus communis*) has good adaptation in Southern Uruguay, but climatic factors not always reach desirable values for a satisfactory production. The objective of this work was to evaluate the correlation between climatic factors and the productivity of Williams cultivar on different pear rootstocks. The experiment was installed at Instituto Nacional de Investigación Agropecuaria – INIA Las Brujas (S 34° 67', W 56° 37'). Local climate according to classification of Köppen is 'Cfa' and soil is a Tipic Argiudoll. Trees were planted in July 2003, and the cycles evaluated were 2014/15, 2015/16, 2016/17, and 2017/18. The cultivar is Williams on rootstocks 'OH×F40' and 'BA29'. Productivity of these rootstocks, was correlated with: precipitation, cold units, chilling hours (<7,2°C), relative humidity, evapotranspiration and average temperature. Climatic data was collected from the meteorological station at INIA Las Brujas, located less than 500 m from the experiment. To value the incidence of climatic factors on productivity of pear trees, a Principal Components Analysis - PCA was applied using the statistical software R. The climatic factors had correlation with the productivity of pear trees independently of the rootstock used, and showed significant differences between years. Cycles 2014/15 and 2016/17, had high productivity with no significant difference between rootstocks and an average of 25,3 and 38,4 t.ha-1, respectively. Between the climatic factors analyzed, precipitation correlated strongly with the productivity these years, being correlation of the positive type. In years of low productivity (cycle 2015/16 average of 0,0 t.ha-1 and cycle 2017/18 average of 7,2 t.ha-1 for the two rootstocks), precipitation had a negative correlation. During the period of bud induction, of these two last cycles (period of December to January), there was low precipitation and high evapotranspiration, which might have harmed formation and proper nutrition of buds. This and other relationships will be discussed.

Keywords: *Pyrus communis*, PCA, Principal Components Analysis, alternate bearing, precipitation

P27- European pear selections adapted to mild winters in Uruguay

Julio Pisano, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincon del Colorado. Canelones, Uruguay; jpisano@inia.org.uy

Maximiliano Dini, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km.10, Rincon del Colorado. Canelones, Uruguay; mdini@inia.org.uy

Jorge Soria, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado. Canelones, Uruguay; jsoria@inia.org.uy

In Uruguay, climate change that has been observed in the world, is causing serious adaptation problems in most temperate climate fruit species. To solve this limitation, INIA began a European pear breeding program intended to create genotypes adapted to winter seasons with low chilling accumulation, and with fruits which have good organoleptic quality (Williams type). To generate variability, the crosses were made in 2012 using the following combinations: Abate Fètel x Butirra Precoz Morettini (AF x BPM) and Abate Fètel x Early Bon Chretien (AF x EBC). Obtained seedlings were 26 and 40, respectively. In 2013, to decrease time from seedling planting to fruit evaluation, apexes from each single seedling were overgrafted onto mature pear trees. At the fourth season after overgrafting (2016/2017) scions started fruiting. During the last harvest season (2017/2018), two genotypes were selected: Selection INIA 42.08-45 and Selection INIA 41.08-23. From the cross (AF x BPM), Selection INIA 42.08-45 matures during the first half of January. Its fruit averages 68mm. in diameter and 180g. in weight. Fruit shape is oblong pyriform, and the skin is light yellow with notorious lenticels, in which some fruits have the russet characteristic of their female parent. Its flesh is white, fine textured, with a good sweet taste, and slightly astringent. Selection INIA 41.08-23 (AF x EBC) is harvested in mid February, with an average fruit diameter of 63mm., fruit weight of 151g, ovate pyriform, green yellow skin, smooth with russet on much of the surface, has also fine texture, and very good sweet taste. The two genotypes selected look promising due to the good adaptation they showed to winter with low or mild chilling accumulation, as was last season with only 187 Chill Units accumulated (Utah model).

Keywords: *Pyrus communi*s L.; pear breeding; genetic variability; climatic adaptation; fruit quality

P28- The Scientific History of Pear Culture in Brazil

Antonio Fagherazzi, Av. Luis de Cames, 2090, Lages, CEP 88520 - 000, Brazil;
antonio.fagherazzi@gmail.com

Alberto Ramos Luz, Avenida Luís de Cames, 2090, 88520-000 LAGES-SC, Brazil;
albertoramosluz@yahoo.com.br

Deivid Silva de Souza, Avenida Luís de Cames, 2090, 88520-00 LAGES-SC, Brazil;
deividsilvadesouza@hotmail.com

André Emmel Mario, Avenida Luís de Cames, 2090, 88520-000 LAGES-SC, Brazil;
andre_emmel@hotmail.com

Mariana Mendes Fagherazzi, Avenida Luís de Cames, 2090, 88520-000 LAGES-SC, Brazil;
marianaargentamendes@gmail.com

The pear is a very important fruit for Brazil due to high consumption, needing to import around 90% of the pears consumed, with an annual cost over 200 million dollars. There were several commercial pear production attempts, but few producers were successful. This study aimed to describe the scientific evolution of pear tree culture in Brazil, based on the first results of scientific research published up to 2017 publications. There are more than 200 scientific articles published beginning in 1978. The first significant results began to be presented in 1992, about rootstocks, propagation and mainly studies on overcoming pears tree dormancy. Results on plant propagation and floral bud abortion were published during the late 1990s. Even with an intensification of the results publications since 2000, a reduction of the cultivated area started at that time, which continues to this day, due to the difficulties of regular production. The most studied subjects were about propagation, behavior of cultivars grafted on different rootstocks, and floral bud abortion, followed by some studies on genetics, post-harvest, plant growth regulators and dormancy. The most studied rootstocks were the *Pyrus calleryana* and the 'Adams' and 'EMC' quinces. The most studied European cultivars were Packham's Triumph, Williams, Rocha, Abate Fetel and Santa Maria, while the hybrid pears were Kieffer, Carrick and Seleta, and the Asian pears were Hosui, Nijisseiki and Kosui. The studies were carried out mainly in the southern region of Brazil. The results allowed to improve the technological level in a little expressive way, where the average productivity went from 10 t ha-1 in 2010 to 14.5 t ha-1 in 2015, productivity that still does not make the activity economically viable. Therefore, it is evident the need to develop more studies with this crop to make pear production an alternative for Brazilian fruit growers.

Keywords: *Pyrus communis, Cydonia oblonga*, Asian pears, hybrid pears, plant growth regulator, rootstock

P29- Phenological evaluation for determination of pruning strategies on pear trees in the tropics

Daniela da Hora Farias, Campus Universidade Federal de Lavras, Lavras, Brazil; dhorafarias@gmail.com

Prof. Dr. Rafael Pio, Universidade Federal de Lavras, 37200000 Lavras-Minas Gerais, Brazil; rafaelpio@hotmail.com

Caio M. de Alcântara Barbosa, Campus Universidade Federal de Lavras, Lavras, Brazil; caio_seven@yahoo.com.br

Filipe Bittencourt M. de Souza, Campus Universidade Federal de Lavras, Lavras, Brazil; fbmsouza@yahoo.com.br

Rayane Barcelos Bisi, Campus Universidade Federal de Lavras, Lavras, Brazil; rayanebbisi@gmail.com

José Emílio Bettiol Neto, Instituto Agronomico de Campinas, Campinas, Brazil; bettiolneto@iac.sp.gov.br

Pear production in the tropics is limited not only by the reduced number of cultivars more adapted to places with higher temperatures, but also due to the lack of strategies for correct culture management. The intensity and the way of pruning the branches and the vegetative and reproductive structures are external factors that most influence the production and quality of pears. Thus, the aim of this studywas to evaluate the structure type that is related with the yield levels of pear trees and to establish strategies for the pruning of cultivars with greater adaptability and reproductive stability in the tropics. The experimental design was complete randomized blocks in the factorial design of split-plot in time, being six pear tree cultivars and two crop years. The duration of the phenophases in days, the percentage of vegetative spurs, reproductive spurs, reproductive brindles, vegetative brindles, bourses, yield per plant, and the number of fruits per plant were evaluated. Moreover, the adaptability and reproductive stability of species were verified. The pruning should be guided in order to maintain the reproductive spurs, the pear tree's main developed reproductive structure in the tropics and related to the greater yield of pears. Pruning in the tropics should be mild due to the evolution of vegetative brindles. There is no difference in the total length of the cultivar's phenological cycle regarding the reproductive spurs and reproductive brindles. 'Seleta' and 'Shinseiki' cultivars show greatest adaptability and reproductive stability to be cultivated in the tropics.
Keywords: *Pyrus* sp., culture management, fruit yield

P30- High yield characteristics of soil mound rhizosphere restricted culture system for Japanese Pears

Dr. Yoshio Oya, 1080, Utsunomiya City kawaraya Town, Japan; aanzubo@yahoo.co.jp

The aging of the Japanese pear tree in Japan has been progressing, which needs to replant the tree for recovering the productivity. Therefore, the nursery trees were basically planted on soil mounds separated from the ground by root-proof sheets for developing the soil mound root restricted culture system(SM) with an irrigation method suitable for individual tree ages and growth stages with the purpose of establishing a technique for early-high yield and high quality in fruit production. In this study, I investigated the individual cultivars for early fruiting and an annual yield. In early cultivar 'Kosui', the yield was 18t · ha-1 in the second year, proving early-high yielding characteristics of the system. The yield of 55 to 60t · ha-1 was maintained from the 5th to 15th year after the transplanting, followed by a gradual decreasing: the yield in the 22th year was 50t · ha-1. In contrast, the conventional cultivation of maximum yield was 32t · ha-1 in the 10th year. The yield of medium maturing cultivar 'Hosui' was 21t · ha-1 in second year and 72t · ha-1 in fifth year. The yield of 60 to 70t · ha-1 was maintained from the 10th to 15th year. In contrast, the conventional cultivation of maximum yield was 43t · ha-1 in the 11th year. The yield of late maturing cultivar 'Nikkori' developed by Tochigi prefectural Agricultural Experiment Station was 42t · ha-1 in the second year and 127t · ha-1 in the 6th year. The yield of 90 to 120t · ha-1 was highly maintained until the 15th year. In contrast, the conventional cultivation of maximum yield was 68t · ha-1 in the 13th year. Based on the results, the Japanese pear planted on SM can have early-high yielding characteristics, high maximum yield, and more than 15 years of productive age.

Keywords: early fruiting, high-yield, irrigation control, Japanese pear, soil mound root restricted culture system

P31- Diversification of the pollinator community in European pear cultivar 'Sweet Sensation': impact on fruit set and quality

Agneta Colda, Willem de Croylaan 42, 3001 Leuven, Belgium; agneta.colda@kuleuven.be

Stijn Raymaekers, Fruittuinweg 1, 3800 Sint-Truiden, Belgium; stijn.raymaekers@pcfruit.be

Bart Lievens, Fortsesteenweg 30A, 2860 Sint-Katelijne-Waver, Belgium; bart.lievens@kuleuven.be

Olivier Honnay, Kasteelpark Arenberg 31, 3001 Leuven, Belgium; olivier.honnay@kuleuven.be

Serge Remy, Fruittuinweg 1, 3800 Sint-Truiden, Belgium; serge.remy@pcfruit.be

Wannes Keulemans, Willem de Croylaan 42, 3001 Leuven, Belgium;
wannes.keulemans@kuleuven.be

Yield in European pear depends strongly on (cross) pollination. Despite pear being the most important fruit in the region of Flanders, Belgium, measures taken to improve the pollination conditions are still poor. However the lack of good cross-pollination in pear is a real problem and causes insufficient fruit set in self-incompatible new cultivars like ‘Sweet Sensation’, ‘Celina’ and ‘Cepuna’. For instance, growers indicate that at least every two years the fruit set of ‘Sweet Sensation’ pears is too low. To tackle this problem and to give these new cultivars a better chance for introduction into the market, currently dominated by ‘Conference’, the pollination process needs to be optimized. To optimize this process both the pollinators as the pollinizers need to be looked at. The presented research will focus mainly on the pollinators. The aim of the study is to investigate if cross-pollination can be improved by diversifying the pollinator community and what the effects are on pollination intensity, fruit set and fruit quality. Therefore Apis mellifera (honeybee), Bombus terrestris (bumblebee) and Osmia cornuta (horned mason bee) as well as nesting blocks for Osmia (pollinator treatments) were introduced into different ‘Sweet Sensation’ orchards across the main pear growing areas of Flanders. The diversity of pollinators and visitation intensity in these orchards as well as in control orchards with and without gibberellin treatment were followed up by transect walks and pan trapping. In all these orchards the pollination intensity, fruit set and fruit quality (fruit size, mass, sugar content, firmness and titratable acid content) as well as seed set were studied to investigate the impact of the pollinator treatments and the diversity on these parameters. The results of the season 2018 of this study will be presented.

Keywords: European pear, cross-pollination, honeybees, bumblebees, mason bees

P32- Performance of `Rocha´ pears on three rootstocks planted in high-density

Dr. Mateus Pasa, Oregon State University, 3005 Experiment Station Drive, Hood river Oregon 97031, United States of America; mateus.pasa@oregonstate.edu

Dr. Alberto Brighenti, Epagri/Estação Experimental de São Joaquim, Rua João Araújo Lima, 88600000 São Joaquim-Santa Catarina, Brazil; albertobrighenti@epagri.sc.gov.br

Dr. Marlise Ciotta, Rua João Araújo Lima, 88600000 São Joaquim-Santa Catarina, Brazil; marlise@epagri.sc.gov.br

Bruno Carra, Campus Universitário, Capão do Leão-Rio Grande do Sul, Brazil; brunocarra@hotmail.com

The objective of this study was to evaluate the effect of different rootstocks on the performance of 'Rocha' pears planted in high-density. Single-axis trees of 'Rocha' pears grafted on *Pyrus calleryana* (PC), quince BA29 and quince EMA were planted (1 x 4 m; 2500 trees ha-1) in the winter of 2008 in São Joaquim/SC (Southern Brazil). The experiment was arranged in a randomized block design, with four replications (five trees each). Adjacent rows of 'Packham's Triumph' were planted for pollination. Yield components, trunk cross sectional area (TCSA) and fruit quality attributes were assessed from the growing seasons of 2014/15 to 2017/2018. The quince 'BA29' showed the greatest values for yield components, although not differing of 'EMA' in some cases (yield and yield efficiency), while PC showed the lowest values. On the other hand, trees on PC had larger TCSA than both quinces. Fruit of 'EMA' were smaller than PC, whereas 'BA29' did not differ from the other rootstocks. Fruit firmness was reduced by both quinces but total soluble solids increased relative to PC. Growing pear trees in high-density systems requires an adequate control of vegetative growth, which is primarily provided by the right choice of rootstock. Our results show that the vigorous PC is not a suitable rootstock choice for such systems in Southern Brazil, due to low yields and excessive vigor induced. The quince BA29 seems to be the best choice for high-density plantings in São Joaquim, since it induces a moderate vigor (greater TCSA than EMA and lower than PC), acceptable yields, and good fruit size. Considering that there is a wide range of soil types in Southern Brazil and rootstock performance is closely related to soil type, the rootstock choice should carefully consider representative research results of a given region.

Keywords: *Pyrus* sp., *Cydonia oblonga*, yield, vigor control, fruit quality

P33- Budbreak promoters in different chilling hours accumulation in `Hosui´ pear

Everton Sozo de Abreu, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; sozodeabreu@hotmail.com

Maximiliano Dini, Campus Universitário UFPel, 354, Capão do Leão, Rio Grande do Sul, Brazil; maxidini@hotmail.com

Bruno Carra, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; brunocarra@hotmail.com

Priscila M. Marchi, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; priscilammarchi@yahoo.com.br

Flavio Gilberto Herter, Campus Universitário UFPel, 354 Capão do Leão-Rio Grande do Sul, Brazil; flavioherter@gmail.com

Paulo Celso Mello-Farias, Campus Universitário UFPel, 354 Capão do Leão, Pelotas-Rio Grande do Sul, Brazil; mellofarias@yahoo.com.br

Pear is a temperate crop, which when grown in mild winter regions may present several anomalies in its development, which can negatively affect yield and fruit quality. To overcome these obstacles and achieve economically satisfactory yields, the use of budbreak promoters has shown promising results. The most used for this purpose are hydrogen cyanamide (HC), mineral oil (MO), and Erger®. The present study aims to evaluate the effectiveness of HC, MO, and Erger® with different chilling hour accumulation on 'Hosui' pears budbreak. 'Hosui' pear shoots were collected with 103 chill hours (CH) and conditioned in cold storage at 4±1°C for 0, 6, 12, 18, 24, and 30 days. For each date, shoots were cut as single bud cuttings, where the following treatments were applied in four repetitions of ten cuttings: control (water), HC 1%, MO 5%, Erger® 3% + calcium nitrate 3%, and HC 0.5% + MO 3%. After applications, they were conditioned in a growth chamber until budbreak, being assessed every two days to estimate the budbreak percentage and average budbreak time. Budbreak percentage showed no difference between treatments when submitted to 0 and 6 days (247 CH) on cold storage. After 12 days (391 CH), HC and HC + MO increased budbreak percentage compared to control. From 18 days (535 CH), HC and HC + MO treated cuttings showed no significant difference or decrease of the budbreak percentage compared to control, whereas Erger® and MO significantly decreased the budbreak percentage compared to other treatments. Regarding average budbreak time, HC treated cuttings anticipate budbreak showing the lowest values and control the highest, delaying budbreak. When cuttings were subjected to low chilling hour accumulation, HC and HC + MO were more effective in budbreak than Erger® and control, while with higher chilling hour accumulation, the budbreak promoters use was dispensable.

Keywords: *Pyrus pyrifolia*; Nakai; dormancy; hydrogen cyanamide; mild winter conditions; Erger®; mineral oil

P34- Prediction of fruit drop on `Bartlett` pear by a fruit growth model

Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, Casilla de Correo 12, Cinco Saltos 8303, Argentina; curetti.mariela@inta.gob.ar

Dolores Del Brío, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; delbrio.dolores@inta.gob.ar

Andrea Betiana Rodríguez, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; rodriguez.andrea@inta.gob.ar

Dr. Pablo Daniel Reeb, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 151 Km 12,5, Cinco Saltos, Argentina; pdreeb@gmail.com

Early prediction of fruit drop is a simple tool to determine initial fruit set, to estimate crop load and to make thinning decisions. One of the first indicators of fruit abscission is a reduction in the fruit growth rate. In this paper a model for predicting fruit drop was adapted for `Bartlett` pears from a model that had been previously developed for apples. This model suggests that a fruit will abscise if its growth rate is less than 50% of the growth rate of the fastest growing fruits at a given period of time. A trial was carried out in a `Bartlett` pear orchard in Rio Negro, Argentina, during two seasons (2009-2010, 2017-2018). Between 360 and 480 fruit clusters were randomly selected and their main fruit was marked for this study. Growth rate of fruits was measured from 22-30 days after full bloom until their abscission or harvest. The model was evaluated using the fruit growth rates obtained between the first two measurements. During the trial, about 30-40% of fruits were abscised. In both seasons the highest number of abscised fruits was registered during November (more than 85% of total abscised fruits) in concordance with “June drop”. Fruits with initial growth rate lower than 40%, showed more than 75% of abscission. Similarly as it was observed during “June drop” period, fruits that abscised next to harvest also showed decreased growth rates in the previous weeks. In conclusion, pear fruits similar to apple fruits, decelerate their growth rate weeks before their abscission. This physiological phenomenon could be used for the prediction of fruit drop in `Bartlet` pears.

Keywords: fruit abscission, fruit set, abscission moment, *Pyrus communis*

P35- Reproductive biology in cultivars 'Abate Fetel' and `Williams´: characterization of the compatibility and parthenocarpic capacity

Carolina Fasiolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Las Piedras 90200, Uruguay; cfasiolo@inia.org.uy

Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Las Piedras, Uruguay; rzoppolo@inia.org.uy

Alfredo Gravina, Garzón 780, Montevideo, Uruguay; agravina@fagro.edu.uy

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Las Piedras, Uruguay; dcabrera@inia.org.uy

Pear (*Pyrus communis*) tends to have erratic productions in Uruguay, presenting self-incompatibility and floral inter-compatibility, with an estimated important role of parthenocarpy in Williams. Causes of variability in production are numerous, being the variation of rate in pollination a determining factor. The objective of this work was to characterize reproductive biology and evaluate genetic compatibility of cultivars 'Abate Fetel' and 'Williams' with other pollen sources, for Uruguayan agroclimatic conditions. Flowers of each cultivar were analyzed starting when sepals opened and flower petals were closed and visible (E2 according to Fleckinger). In 'Abate Fetel', 60 flowers were bagged with a mesh (self-pollinated), 60 were emasculated and bagged (unpollinated), and another 120 were emasculated, manually pollinated and then bagged (cross-pollinated). Pollen from BP1 rootstock (*Pyrus communis*) was used for 60 flowers, and 'Early Bon Chretien' was pollinator for the other sixty. In 'Williams' the pollinator was 'Packam's Triumph'. Simultaneously, flowers of each treatment were sampled at 2, 4, and 6 days after treatment application and fixed in formaldehyde-acetic acid (FAA), to study the germination of pollen grains and pollen tube growth. This was observed in a fluorescence microscope with ultraviolet light after staining with aniline blue. In the field, fruit set was evaluated biweekly starting at petal fall; and at harvest the presence of seeds and the size of fruits was determined. The results allowed to confirm that 'Abate Fetel' presents self-incompatibility of the gametophytic type, stopping the growth of its pollen tube halfway through the style. For this cultivar, treatments of self-pollinated and unpollinated flowers resulted in 0% fruit set evaluated 30 days after treatment application. Manual pollination (cross-pollinated) achieved 58% (BP1) and 76% (Early Bon Chretien) of fruit set. In 'Williams' the treatment of self-pollinated and unpollinated, resulted in 13% and 14% fruit set respectively, while cross-pollinated flowers reached 40%.

Keywords: self-incompatibility, fruit set, pollination, *Pyrus communis*

P36- Effect of fosetyl-Al on flower bud formation, flower bud development and flower bud quality in European pear (*Pyrus communis*)

Prof. Dr. Wannes Keulemans, KU Leuven, Willem de Croylaan 42, 3001 Leuven, Belgium; wannes.keulemans@biw.kuleuven.be

Agneta Colda, KU Leuven, Willem de Croylaan 42, 3001 Leuven, Belgium; agneta.colda@kuleuven.be

Yield and fruit quality are most important in pear production worldwide. It is expected that fruit quality will be the most important factor for a profitable pear production at least in North Europe since the area of the main pear cultivar, 'Conference', has dramatically increased the last decade. One of the most important aspects in fruit quality is fruit size, affected by many pre-bloom and post-bloom factors. In this study we well concentrate on the effect of fosetyl-Al on pre bloom factors: number of flower buds and flower bud quality. Fosetyl-Al (FEA) is a well-known anti-oomycetes fungicide with efficacy mainly based on an indirect action as stimulation of the natural plant defenses. In pome fruit there is also a bacteriostatic activity and the product has a clear effect against ascomycetes. Here we study the effect of FEA on flower bud formation and flower but quality. Field applications of FEA at different doses at different time points during the growing season were applied on mature 'Conference' trees. Flower buds, including dead flower buds, caused by Pseudomonas synringae, were counted. As flower bud quality parameters we evaluated the number of appendices at the endodormant stage, the number of flowers per cluster, the number and the size of cluster leafs, the cell number in the hypantium (fruit cortex) at flowering time. The numbers of flower buds was increased while the amount of dead flower buds deceased. Flower buds contained more flowers and more and better developed cluster leafs. Flowers were better developed as was illustrated by more cells in the hypantium of the flower and by higher contents of IAA and Gas in the flowers. All these aspects point to a better potential for improved fruit quality after FEA treatment. Results were similar to those obtained in comparable experiments in apple.

Keywords: European pear, Fruit quality, pre-bloom factors, Fosetyl-Al

P37- Use of plant growth regulators in `Clapp´s Favourite' pears

Dr. Biane de Castro, Av. Bento Gonçalves 7712, 91540-000 Porto Alegre-RS, UFRGS - Faculdade de Agronomia, Departamento de Fitotecnia, Brazil; bianedecastro@gmail.com

Prof. Dr. Gilmar Arduino Bettio Marodin, Av. Bento Gonçalves 7712, 91540-000 Porto Alegre-RS, UFRGS - Faculdade de Agronomia, Departamento de Fitotecnia, Brazil; marodin@ufrgs.br

Pedro Henrique Guardiola Ferreira, Av. Bento Gonçalves 7712, 91540-000 Porto Alegre-RS, UFRGS - Faculdade de Agronomia, 91540-000 Porto Alegre-RS, Brazil; pedro_hgf@yahoo.com.br

The objective of the present study was to evaluate the effect of different plant growth regulators in the flowering and production of ‘Clapp’s Favourite’ pears. The experiment consisted of applying prohexadione-calcium (2,40 g L-1), gibberellin (GA3 10,00 mg L-1), cytokinin combined with gibberellins (6-BA 16,92 mg L-1+ GA4+7 16,92 mg L-1), its combinations and control (water) in a orchard of ‘Clapp’s Favourite’ pears cultivated in São Francisco de Paula city (29°05’50”S; 50°50’14”W, altitude 892 m), Rio Grande do Sul State, Brazil. The treatments were applied at early petals fall and about 30 days after the first pulverization. The number of flowers and inflorescences produced by branch, fruit set, stem diameter and length of plant and shoots were monitored. At harvest: production, productivity, fruit weight, diameter, epidermis color, flesh firmness, soluble solids, pH, and acidity were evaluated. The fecundity and tendency to the occurrence of parthenocarpy were estimated by seeds produced. The use of growth regulators tested at the early petals fall and one month later did not increase fruit set and yield of ‘Clapp’s Favourite’. Recurrent application of prohexadione-calcium decreased the vegetative vigor and caused lower fruit weight since the first harvest. Reapplication of different sources of gibberellic acid compromised the induction and floral differentiation and fruit set over the years, favoring parthenocarpy production. The reduction of floral induction was even more pronounced with the combination of the three growth regulators, inhibiting totally the floral differentiation and consequently the production in the third year of consecutive application.

Keywords: prohexadione-calcium, gibberellin (GA3 and GA4+7), cytokinin (6-BA), floral differentiation, parthenocarpy, fruit set

P38- 'Clapp's Favorite' as interstock on *Pyrus calleryana* rootstock increases 'Packham's Triumph' fruit weight

Dr. Leo Rufato, Universidade do Estado de Santa Catarina, Rua Cel Pedro Pacheco 186, 85550-000 Coronel Vivida-Parana, Brazil; leoruffato@yahoo.com.br
Bruna Bernardes de Castro, Av Luiz de Cames 2090, Lages, Brazil; bbernardes.castro@gmail.com
Mariana Mendes Fagherazzi, Av Luiz de Caes 2090, Lages, Brazil; marianaargentamendes@gmail.com
Prof. Dr. Aike Anneliese Kretzschmar, Av Luiz de Cames, Lages, Brazil; aikeanneliese@yahoo.com.br
Juliana Fátima Welter, Av Luiz de Cames, Lages, Brazil; julianawelter_@hotmail.com
Pricila Santos da Silva, Av Luiz de Cames, Lages, Brazil; pricilassilva@hotmail.com
Ana Luiza Arruda, Av Luiz de Cames, Lages, Brazil; analuiza1arruda@hotmail.com
Prof. Dr. Antonio Felippe Fagherazzi, Av Luiz de Camoes, Lages, Brazil; antonio.fagherazzi@gmail.com
Prof. Dr. Francine Regianini Nerbass, Av Luiz de Cames, Lages, Brazil; fnerbass@hotmail.com
Dr. Tiago Afonso Macedo, Av Luiz de Cames 2090, Lages, Brazil; macedoafonso@yahoo.com.br
Guilherme Fontanella Sander, Av Luiz de Cames, Lages, Brazil; guimesander@hotmail.com

Pear is the main imported fresh fruit in Brazil, but this country has potential to be a prominent producer in pear trees, mainly in its southern region. Deficiencies found for this fruit crop are the insufficient studies on rootstocks and adaptability of canopy cultivars for this region where favourable soil and climatic conditions are found. This study evaluated agronomic performance of European pear tree cultivars in Southern Brazil in the 2016/2017 season, in CAV-UDESC, Santa Catarina State. Training system was central leader, spacing 3.5m between rows and 1.5m between plants. Orchard implantation was in 2013 with cultivars 'Packham's Triumph' and 'Williams' grafted on *Pyrus calleryana* rootstock with and without 'Clapp's Favourite' interstock. Analyzed variables were: plant height, stem cross-sectional area, internode length, fruit diameter and weight, soluble solids and pulp firmness. Experimental design was randomized blocks with five replications of five plants per plot. There was no effect of cultivars and rootstocks in plant height, internode length and pulp firmness. Stem section area and soluble solids were larger in 'Williams' cultivar without interstock. Fruit diameter was larger in 'Packham's' with interstock. Fruit weights increased in 'Packham's' with and in 'Williams' without interstock. Agronomic performance of 'Packham's Triumph' and 'Williams' on *Pyrus calleryana* rootstock was influenced by presence of interstock in stem section area, fruit diameter and weight, and also in soluble solids.

Keywords: Agronomic performance; Packham's Triumph and William's; *Pyrus calleryana*

P39- Nutrition status of pear trees cv. Cascatense using as sources of nutrients powder of basalt rock and poultry litter

Prof. Dr. Renato Vasconcelos Botelho, Dpt. de Agronomia - UNICENTRO, R. Simeão Varella de Sá, 03, Bairro Cascavel, 85040-080 Guarapuava-Paraná, Brazil; rbotelho@unicentro.br

Prof. Dr. Andricia Verlindo, Universidade Federal do Paraná - UFPR, Rua dos Funcionários 1540, 80035050 Curitiba-Paraná, Brazil; andriciaverlindo@hotmail.com

Luis Antonio Biasi, Universidade Federal do Paraná - UFPR, Rua dos Funcionários 1540, 80035050 Curitiba-Paraná, Brazil; biasi@ufpr.br

Prof. Dr. Marcelo Marques Lopes Müller, Universidade Estadual do Centro-Oeste, Unicentro, Rua Simeão Camargo Varela de Sá 03, 85040 080 GUARAPUAVA-Paraná, Brazil; mmuller@unicentro.br

Fertilization and soil management affects nutritional status and growth of plants. In this context, the pear production in agroecologic system, using specific nutrient sources, organics and/or mineral, could impose some limitations to the crop. This study aimed to evaluate the nutritional status and vegetative growth of pear trees cv. Cascatense grafted on the 'Quince CP' rootstock fertilized with different doses of poultry litter and basalt powder. The following treatments were applied in planting furrows: T1) without fertilization; T2) 2 kg poultry litter; T3) 2 kg poultry litter + 2 kg basalt rock powder; T4) 4 kg poultry litter; T5-) 4 kg poultry litter + 2 kg basalt rock powder. The higher leaf levels of N, Mg, K and Ca were found in the treatment with 2 kg poultry litter + 2 kg basalt rock powder. The N content was above normal values, the K content in the normal range and Ca content with insufficient level. The higher content S was verified for the treatment with 4 kg poultry litter, with levels above normal. Moreover, this treatment resulted in a higher absorption efficiency ratio for N, and higher utilization efficiency index for S. The addition of 2 kg poultry litter + 2 k basalt rock powder showed significant difference in dry mass of leaves with high vegetative growth, and could be used as fertilizers in pear orchards managed organically.

Keywords: plant nutrition, fertilizers, organic system, agroecology

P40- Effect of environmental factors and application time on benzyladenine thinner efficacy in `Bartlett` pear

Dr. Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, Casilla de Correo 12, Cinco Saltos 8303, Argentina; curetti.mariela@inta.gob.ar

Andrea B. Rodríguez, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo 782, General Roca, Argentina; rodriguez.andrea@inta.gob.ar

Gustavo Giménez, Ruta Nacional 151 Km 12,5, Cinco Saltos, Argentina; gunegim@gmail.com

Pablo D. Reeb, Ruta Nacional 151 Km 12,5, Cinco Saltos, Argentina; pdreeb@gmail.com

The stage of fruitlet development at application time of chemical thinners is a determining factor of the thinning efficacy. Benzyladenine (6-BA) applications significantly thin `Bartlett` pears when fruitlets have a diameter between 9 and 19 mm. Crop thinning response to 6-BA depends on weather variables like maximum daily temperature. The research of the influence of weather variability on thinner efficacy requires numerous observations with different conditions. The objective of this work was to study the thinning response of `Bartlett` pear to different moments and weather conditions during 6-BA applications along five seasons (2013-2018). 6-BA was applied at various stages of fruit development (8 to 20 mm fruit diameter FD) with four replicates per treatment in a complete randomized design. 6-BA concentrations applied were 150 ppm for the first two seasons and 120 ppm thereafter. Response variables were fruit set, fruit number per tree and average fruit weight at harvest. Weather factors included were temperatures (maximum, average and minimum), rainfall, radiation (W/m2), wind speed (km/h) and relative humidity the day of application, previous days and following days. Effects of FD and weather factors on response variables were evaluated and a multiple regression with step-wise selection of variables was done with statistical software R. An effective thinning response was obtained when 6-BA applications were made with fruit diameter between 10 to 16 mm. Thinning effect was reduced when 6-BA applications were done with low maximum temperatures (below 18ºC). A rainfall (39 mm) started one day after 6-BA application did not nullify its efficacy. Some 6-BA applications did not show an effective thinning effect but generated a better fruit size with respect to control at harvest time. Recommendations are made in regard to conditions under which it is preferred to wait a few days to apply 6-BA.

Keywords: Chemical thinning, fruit size,weather conditions, temperature, rainfall

P41- Evaluation of budbreak promoters in pear cultivar Williams

Sofía Ramos, Universidad de Agronomía, Universidad de la República, Avenida Gral. Eugenio Garzón 809, Sayago 12900, Montevideo, Uruguay; sofiarabb@gmail.com

Bruno Wlasiuk, Universidad de Agronomía, Universidad de la República, Avenida Gral. Eugenio Garzón 809, Sayago 12900, Montevideo., Uruguay; bruno.wlasiuk@hotmail.com

Vivian Severino, Universidad de Agronomía, Universidad de la República, Avenida Gral. Eugenio Garzón 809, Sayago 12900, Montevideo, Uruguay; vseverino@fagro.edu.uy

Carlos Danilo Cabrera Bologna, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones, Uruguay; dcabrera@inia.org.uy

Williams cultivar (*Pyrus communis* L.) is the most cultivated (82.14%) pear in Uruguay. This region has temperate-humid climate and the accumulation of chilling hours during dormancy period is a limiting factor to obtain acceptable budbreak in this crop. The objective of this work was to evaluate different budbreak promoters, applied at different dates. The experiment was carried out on Williams pear trees, in the Experimental Station INIA Las Brujas, Canelones, during the 2017-2018 cycle. The treatments evaluated were a control with no application of promoter, ErgerG® 2% + CaNO3 3%, applied on Aug/15th and Set/1st), ErgerG® 4% + CaNO3 3% applied on Aug/15th, Set/1st and Set/28th, ErgerG® 8% + CaNO3 6% applied on Aug/15th, hydrogenated cyanamide1% + mineral oil 2% applied on Aug/15th, and mineral oil 4% applied on two dates Aug/15th and Set/1st. The response of plants to the different treatments was evaluated once a week from October 12 to December 21, 2017. Significant differences were found in the percentage of sprouting of 1-year-old branches in the first evaluation date. These results showed that ErgerG® 8% + 6% CaNO3 treatment (Aug/15th) increased the percentage of budbreak compared to other treatments, evidencing an advancement in sprouting. For the following evaluation dates, no significant differences were found in total sprouting. Last date of evaluation, significant differences were recorded with higher vegetative shoot sprouting percentage for mineral oil treatment 4% (Aug/15th) compared to all others. As well, it was observed that mineral oil treatments 4% (Aug/15th), hydrogenated cyanamide 1% + mineral oil 2% (Aug/15th), ErgerG® 2% + CaNO3 3% (Aug/15th) and ErgerG® 4 % + CaNO3 3% (Aug/15th) have a higher sprouting tendency compared to other treatments. According to the results, mineral oil and ErgerG® + CaNO3 are interesting alternatives for breaking dormancy of Williams pear cultivar in Uruguayan conditions.

P42- Rootstocks and training systems influences on nonstructural carbohydrates at dormancy release in above-ground organs of 'Abbé Fétel' pear trees

Assist. Prof. Karen Mesa, Universidad de O'Higgins, Rancagua 2841959, Chile; karen.mesa@uoh.cl

Assist. Prof. Sara Serra, Washington State University Tree Fruit Rese, Wenatchee, United States of America; sara.serra@wsu.edu

Prof. Dr. Stefano Musacchi, Washington State University, Wenatchee, United States of America; stefano.musacchi@wsu.edu

Several studies have been conducted on pear to understand the behavior of the different combinations of rootstocks and training systems and to improve yield and fruit quality with orchard management practices. However, there is a lack of information about the effect of vigorous/dwarfing rootstocks and training systems on the seasonal storage of carbohydrate reserve in pear tree orchards. The partitioning of carbon within the tree implicates the mobilization of assimilates from source organs (leaves) to various sinks (flowers, fruits, shoots). Therefore, to understand the mechanism of assimilates distribution in the pear tree, knowledge about the role of different branch types acquire a great importance. An experiment was conducted in Italy throughout three growing seasons (2011-2012-2013) on pear trees (*Pyrus communis* L.) cv. 'Abbé Fétel' planted in 2005 to investigate carbohydrate concentrations in different organs. The aims were: 1) to analyze the relationship between starch concentrations in diverse bearing woods (brindle-type shoots, 2-year-old branches, 3-and-over-year-old branches, and short-old spurs) in pear trees trained at Spindle and Bi-axis, grafted on Sydo®; 2) to compare 'Abbé Fétel' trees grafted on three quince rootstocks with increasing level of vigor: Adams, MH®, and Sydo® trained as Spindle for their storage of starch and soluble carbohydrates in the different bearing woods at dormancy release (February); and 3) to evaluate the effect of the position (high and low) of bearing woods within the tree on the concentration of nonstructural carbohydrate (NSC). Significant differences were found between organs (wood or flower buds) when the bearing formations, canopy positions and the year of evaluation were compared. A reduction trend of starch concentration was detected with the aging of wood formation. Regardless the training system and rootstock, the type of organ had a strong effect on the starch concentrations in February, unlike to the non-significance observed for soluble carbohydrate.

Keywords: starch, soluble carbohydrates, *Pyrus communis*, Spindle, Bi-axis, Adams, MH®, Sydo®

P43- Evaluation of efficiency of pollinizers for ʻCelinaʼ pear in a Nordic climate

Dr. Radosav Cerovic, University of Belgrade, Innovation Centre, Faculty of Technology and Metallurgy, Belgade, Serbia; radosav.cerovic@gmail.com

Assoc. Prof. Milica Fotiric Aksic, University of Belgrade, Faculty of Agriculture, Belgrade, Serbia; fotiric@agrif.bg.ac.rs

Prof. Dr. Mekjell Meland, Norwegian Institute of Bioeconomy Research, Ullensvang, Norway; mekjell.meland@nibio.no

The Norwegian newly bred pear cultivar ʻCelinaʼ/QTree® ('Colorée de Juillet' x 'Williams') was launched in 2010. In Norway the flowering is medium to late in May and it ripens in beginning of September. The red blushed fruits are very attractive showing good fruit quality (smooth texture), good storability and good shelf life. Significant areas of the ʻCelinaʼ cultivars are planted in other countries, mainly Europe. Most commercially grown pear (*Pyrus communis* L) cultivars, like `Celina`, are completely or almost completely self-incompatible. Thus, for the successful cultivation of this cultivar it is necessary to determine the best pollinizers in order to obtain high yields. The dynamics of pollen tube growth (third, sixth and ninth day after anthesis) in the style and ovary in different crossing combinations were observed by fluorescent microscopy over two years (2016/2017) in relation to fruit set. As pollen donors the cultivars ʻAnnaʼ, ʻConferenceʼ, ʻClara Frijsʼ, ʻKristinaʼ, ʻHerzogin Elsaʼ and ʻFritjofʼ were used in addition to open- and self-pollination. The flowering of these pollinizers overlapped with ʻCelinaʼ under the field conditions during both years. Emasculation, pollen gathering and pollination were done in the open filed, just prior to the full bloom of cultivar ʻCelinaʼ during May both years in Norway. As a conclusion, in 2016 ʻConferenceʼ was the best pollinizer, followed by ʻKristinaʼ, while in 2017 the best pollinizers were ʻHerzogon Elsaʼ, ʻKristinaʼ and ʻFritjofʼ, which matched fruit set in the field trial. This study revealed the existence of year-to-year variation in fertilization success of ʻCelinaʼ in relation to tested pollinizers and will be repeated for a third season in 2018.

Keywords: *Pyrus communis* L., fluorescent microscopy, phenology, pollen tube growth, fruit set

P44- Ethephon increases return bloom and yield of `Rocha´ pear trees

Bruno Carra, Universidade Federal de Pelotas, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; brunocarra@hotmail.com
Maximiliano Dini, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; maxidini@hotmail.com
Everton Sozo de Abreu, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; sozodeabreu@hotmail.com
Dr. Mateus Pasa, 3005 Experiment Station Drive, Hood River Oregon 97031, United States of America; mateus.pasa@oregonstate.edu
Dr. Carina Pereira Pasa, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; carpers.rs@gmail.com
Dr. Poliana Francescatto, 630 W. North Street, Geneva New York 14456, United States of America; pf246@cornell.edu
Prof. Dr. Flávio Gilberto Herter, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; flavioherter@gmail.com
Prof. Dr. Paulo Celso Mello-Farias, Campus Universitário, 354 Capão do Leão-Rio Grande do Sul, Brazil; mellofarias@yahoo.com.br
Prof. Ana Lucia Soares Chaves, Campus Universitario, 354 Capao do Leao, Rio Grande do Sul, Brazil; analucia.soareschaves@gmail.com

Flower induction and differentiation is a complex phenomenon not fully understood in pear trees. Ethylene is a plant hormone that seems to play an important role on flower induction. Ethephon (Eth) and naphthaleneacetic acid (NAA) exogenous application has shown promising results to increase return bloom and yields in some pear cultivars. The objective of this study was to evaluate the effect of Eth and NAA on return bloom, yield, and shoot length of 'Rocha' pear trees in Southern Brazil. The study was performed during 2015/2016 and 2016/2017 growing seasons, in a five-year-old 'Rocha' pear orchard grafted onto quince rootstock 'BA29'. Treatments consisted of control, Eth 100 mgL-1; NAA 5 mgL-1; NAA 75 mgL-1; NAA 10 mgL-1; Eth 100 mgL-1 + NAA 5 mgL-1; Eth 200 mgL-1 + NAA 7.5 mgL-1; Eth 300 mgL-1 + NAA 10 mgL-1 all them sprayed at 40 + 60 + 80 days after full bloom (DAFB); Eth 150 mgL-1 + NAA 7.5 mgL-1 sprayed at 60 + 70 + 80 + 90 DAFB; and Eth 150 mgL-1 + NAA 7.5 mgL-1 sprayed at 40 + 60 + 80 + 100 DAFB. Shoot length in the year of application, return bloom, number of fruits per tree, yield, average fruit weight and projected yield in the year following application were assessed. Return bloom and yield were increased when trees were sprayed with Eth 100 mgL-1 at 40 + 60 + 80 DAFB and Eth 150 mgL-1 + NAA 7.5 mgL-1 at 40 + 60 + 80 + 100 DAFB. On the other hand, NAA sprayed alone did not increase return bloom and yield. These results suggest that only ethephon was effective to increase return bloom, since NAA alone had no effect. Shoot length was reduced by all treatments.

Keywords: *Pyrus communis*; naphthaleneacetic acid, plant growth regulators; vegetative growth, flower induction, flower differentiation

P45- Different doses of hydrogenated cyanamide in the budding development of 'Rocha' pear tree

Mariana Mendes Fagherazzi, Universidade do Estado de Santa Catarina, DOUTOR JORGE BLAYER, 88523-340 Lages-Santa Catarina, Brazil; marianaargentamendes@gmail.com

Augusto José Posser, Av. Luiz de Cames 2090, Coral, 88520000 Lages, Brazil; augusto.posser@hotmail.com

Prof. Dr. Leo Rufato, Av. Luiz de Cames 2090, Coral, 88520000 Lages, Brazil; leo.rufato@udesc.br

Prof. Dr. Aike Anneliese Kretzschmar, Av. Luiz de Cames 2090, Coral, Lages, Brazil; aike.kretzschmar@udesc.br

Prof. Dr. Antonio Felippe Fagherazzi, Av. Luiz de Cames 2090, Coral, DOUTOR JORGE BLAYER, 88523-340 Florianópolis-Santa Catarina, Brazil; antonio.fagherazzi@gmail.com

Prof. Dr. Francine Regianini Nerbass, Av. Luiz de Cames 2090, Coral, Lages, Brazil; fnerbass@hotmail.com

Marllon Fernand Soares dos Santos, Av. Luiz de Cames 2090, Coral, 88520000 Lages, Brazil; marllon.soares@outlook.com

Henrique Stockhausen, Av. Luiz de Cames 2090, Coral, Lages, Brazil; henriquestockhousen@hotmail.com

Betina Pereira de Bem, Av. Luiz de Cames 2090, Coral, Lages, Brazil; betadebem@yahoo.com.br

Alberto Ramos Luz, Av. Luiz de Cames 2090, Coral, 88520000 Lages, Brazil; albertoramosluz@yahoo.com.br

This study evaluated the effect of hydrogen cyanamide on budding percentage and speed on Rocha cultivar of *Pyrus communis* grafted on “Adams” quince rootstock. Experiment was conducted in an orchard located in Lages, Southern Brazil. Dormant buds were sprayed with different treatments for dormancy, consisting of hydrogen cyanamide at the dose of: 0.5; 1.0 and 1.5 percent. All doses had 3% oil. Control treatment was sprayed with water. The experimental design was in randomized blocks with six replicates. Four evaluations were performed: 15, 22, 29 and 37 days after application of the products to identify sprouted buds. Data were submitted to analysis of variance to verify effect and polynomial regression between the doses in test. The effect of hydrogen cyanamide in concentration of 1.5% + 3% oil gave 40.2% more sprouting than the control treatment and reached 25% of flowering buds at 15 days after application. Pear cultivar Rocha responds to the use of sprout inducer and higher doses result in higher sprout percentages.

Keywords: *Pyrus communis* L.; dormancy; shoot inducers

P46- Morphological characteristic and viability of pollen in Norwegian pear cultivars

Dr. Radosav Cerovic, University of Belgrade, Innovation Centre, Faculty of Technology and Metallurgy, Belgade, Serbia; radosav.cerovic@gmail.com

Assoc. Prof. Milica Fotiric Aksic, University of Belgrade, Faculty of Agriculture, Belgrade, Serbia; fotiric@agrif.bg.ac.rs

Prof. Dr. Mekjell Meland, Norwegian Institute of Bioeconomy Research, Ullensvang, Norway; mekjell.meland@nibio.no

Most commercial pear (*Pyrus communis* L) cultivars are completely or almost completely self-incompatible. Pollination process depends on many factors including adaptation to different environmental conditions. Pollen morphology and viability are some of the most important factors related to the pollination process. It is especially important for pear production under Norwegian conditions, where the cool spring can limit this process. In May 2017 pollen was collected from the cultivars 'Anna', 'Ingeborg', 'Clara Frijs', 'Herzogin Elsa', 'Celina' and 'Fritjof'. Pollen grain morphology by scanning electron microscopy (SEM) and pollen germination in vitro, were studied. SEM was used to determine the pollen grain size, germinal furrows length and distance, and exine ornamentation. Differences between pollen grains of the studied pear cultivars revealed specific variation in some morphological properties between the tested pear cultivars. Pollen germination in vitro had the highest value for 'Fritjof' (57.1%) and the lowest value for 'Ingeborg' (7.2%). The obtained results of pollen morphology and viability of pollen in vitro showed the existence of certain correlation. This study allows a better prediction of capacity of tested cultivars as possible pollinizers. However, it is necessary to combine those results with in vivo pollen tube growth and paternity testing for each combination of pollination.

Keywords: *Pyrus communis* L., pollen germination in vitro, SEM

P47- Use of temporary immersion bioreactors and solid culture medium for in vitro propagation of rootstocks of pear tree

Aike Anneliese Kretzschmar, University of Santa Catarina State, Avenida Luiz de Camões 2090, 281, 88 520-000 Lages, Brazil; aike.kretzschmar@udesc.br
Ana Luiza Arruda, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; analuiza1arruda@hotmail.com
Dr. Francine Regianini Nerbass, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; fnerbass@hotmail.com
Brenda Vieira Vedana, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; brenda.vvieira@hotmail.com
Carolina Ayumi Kaneji Abatt, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; carolina.kaneji@gmail.com
Prof. Dr. Leo Rufato, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; leo.rufato@udesc.br
Mariana Mendes Fagherazzi, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; marianaargentamendes@gmail.com
Augusto José Posser, Avenida Luiz de Camoes, 2090, 88520000 Lages-Santa Catarina, Brazil; augustoposser@hotmail.com
Pricila Santos da Silva, Avenida Luiz de Camoes 2090, 88523000 Lages-Santa Catarina, Brazil; pricilassilva@hotmail.com

The micropropagation through the use of temporary immersion bioreactors is considered an alternative to increase the efficiency of production of explants in vitro, reducing costs by automating the process. The objective of this study was to compare different systems of micropropagation of pear tree rootstocks. The experiment was carried out at the plant bio-factory of the State University of Santa Catarina (UDESC / CAV). Four rootstocks of pear tree were studied: OHxF69; OHxF87; OHxF97 and Pyrodwarf; and two cropping systems: temporary immersion bioreactors system (SIT) and solid culture medium comprising completely randomized design in 4x3 factorial scheme in a total of twelve treatments. Explants were cultured for 40 days in culture medium QL modified supplemented with 1 mg L-1 of benzylaminopurine (BAP). There were statistical differences verified between the SIT and the solid culture medium for the variable number of shoots among the rootstocks, with OHxF69 being more expressive in solid medium (20 shoots) while Pyrodwarf was more expressive in SIT (29 shoots). For average length and greater sprouting, rootstocks OHxF69 and Pyrodwarf differed statistically, being higher in SIT, while OHxF97 was higher in SIT only for the length of greater sprouting. For the number of leaves, there was a statistical difference between the materials in the conventional system, and the best results were obtained in the rootstocks OHxF69, OHxF87 and OHxF97 with values of 136.67; 125.67 and 100.33 respectively. Differences were also observed between systems for leaf number, being SIT more expressive in the rootstocks OHxF97 and the use of the solid culture medium provided better results for the rootstock OHxF69. In general, SIT was promising for the in vitro propagation of most of the rootstocks of pear tree studied.

Keywords: *Pyrus communis*, in vitro propagation, cropping systems, bioreactors

P48- Metamitron, a photosynthesis inhibitor, is an effective thinner for `Bartlett´ pears in Argentine

Dr. Maria Dolores Raffo Benegas, Instituto Nacional de Tecnología Agropecuaria, Fleming 534, General Roca 8332, Argentina; raffo.dolores@inta.gob.ar

Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, CC 782 Río Negro, Fleming 534, General Roca 8332, Argentina; curetti.mariela@inta.gob.ar

`Bartlett` pear is the main cultivar in Argentine and fruit size is a limiting factor for export. Chemical thinning allows to adjust fruit load to a desirable level and diminish the need for hand-thinning. The aim of this study was to evaluate the efficacy of diverse strategies of Metamitron (MM) applications (different doses, single and double applications). Four experiments were conducted during different seasons 2014/15, 2015/16, 2016/17 and 2017/18 in different orchards located in Rio Negro, Argentine. MM was evaluated at three concentrations (165 ppm, 248 ppm and 330 ppm) at the 8-10 mm. diameter stage, and two concentrations in single applications (165 ppm, 248 ppm) at 8-10 mm and double applications at 8-10 mm and 12-14 mm. All treatments were compared with untreated control and 6-Benzyladenine (6-BA, 120-160 ppm, 8-10 mm). Fruit set, tree production, fruit size, maturity indices, phytotoxicity symptoms and return bloom were assessed. All MM concentrations applied at the 8-10 mm fruit diameter stage resulted in a significant thinning respect to control and some seasons also respect to 6-BA. The effectiveness of the lowest concentration seems to be affected by a rainfall occurred two days after application (40 mm) in the first season. The reduction of fruit number in MM treatments was more evident in small fruits.

Keywords: `Williams`, fruit size, fruit quality, thinning, return bloom

P49- Photosynthetic inhibition by ABA and metamitron is associated with postbloom thinning of `Bartlett´ pears

Todd Einhorn, Michigan State University, Horticulture, 1066 Bogue Street, Plant Soil Sciences Building A338, East Lansing, MI 48824, United States of America; einhornt@msu.edu

Matthew Arrington, Mount Vernon Northwestern Washington Resear, Mount Vernon, United States of America; matthewarrington@gmail.com

Andrew Hubbard, OSU MCAREC 3005 Experiment Station Drive, Hood River OR, United States of America; hubbarda@oregonstate.edu

Assist. Prof. Mateus Pasa, OSU, MCAREC , 3005 Experiment Station Drive, Hood River OR, United States of America; mateus.pasa@oregonstate.edu

Two relatively new products for pear thinning have been evaluated in the USA: the plant hormone, abscisic acid (ABA) and the triazinone herbicide, metamitron. Both compounds reduce photosynthesis, ABA indirectly by limiting CO2 diffusion via partial stomatal closure and metamitron directly via PSII inhibition by blocking electron transport. Between 2013 and 2017, we conducted 10 trials to evaluate the postbloom thinning efficacy of ABA and metamitron on 'Bartlett' pear trees. Experimental design (CRD and RCBD), replication (4 to 6), application rate (50-500 ppm ABA, 100-600 ppm metamitron) and timing (petal fall to 12 mm fruit size) varied among trials. ABA thinned in all but one trial. The most efficacious rate was 125 ppm ABA, which generally reduced fruit set 25% to 50% compared to controls. Higher rates overthinned and rates exceeding 400 ppm were phytotoxic. ABA reduced gas exchange in a rate-dependent manner between 50-500 ppm ABA. Stomatal response was rapid and persisted up to ~14 days, albeit diminishing over time and recovering to ~80% of control levels by 7 days. Tree yield, fruit size and quality were unaffected by 125 ppm ABA compared to hand-thinned control trees. Metamitron thinned 'Bartlett' pears in four of five trials. Thinning was rate-dependent between 100 and 300 ppm. Higher rates did not increase thinning. Minor phytotoxicity was observed at 600 ppm. The most efficacious rates (150 to 300 ppm) reduced fruit set by 40% (ideal) to 80% (severe overthinning) of nontreated controls. Metamitron reduced photosynthesis in a rate responsive manner, persisting 18 days after application. The duration and magnitude of Pn inhibition varied among trials but were generally greater than ABA. Metamitron-treated trees tended to have larger fruit size compared to controls but fruit quality was unaffected. Environmental factors that contributed to, or limited the thinning efficacy of both compounds will be discussed.

Keywords: thinning, carbohydrate deficit, fruit set, plant growth regulators, photosynthesis

P50- Response of Tuscan *Pyrus communis* L. pear cultivars to psylla artificial infestation

Dr. Edgardo Giordani, DISPAA, University of Florence, Viale delle Idee 30, 50019 Sesto Fiorentino FI, Italy; edgardo.giordani@unifi.it

Stefania Nin, CREA, Centre for Vegetable and Ornamental Crops, 51012 Pescia Pistoia, Italy; stefania.nin@unifi.it

Alessio Ferri, DISPAA, University of Forence, Firenze, Italy; Ferri.Alessio@libero.it

Patrizia Sacchetti, DISPAA, University of Forence, Firenze, Italy; patrizia.sacchetti@unifi.it

Enzo Picardi, DISPAA, University of Forence, Firenze, Italy; enzo.picardi@unifi.it

Valter Nencetti, DISPAA, University of Forence, Firenze, Italy; valter.nencetti@unifi.it

The development of *Cacopsylla pyri* generation was observed on 24 European pear cultivars regarded as native to Tuscany according to the Regional Law on Germplasm L.R. Toscana 64/2004. 'William', known to be sensitive and 'NY 10355' (hybrid *P. ussuriensis* x *P. communis*), known to be resistant, were used as control. The study was conducted in a semi-confined environment (tunnel), provided laterally with a shading net. Pears (six 3-year-old potted trees per cultivar) were infested with 5 adult female and 2 adult male psylla, by depositing the insects on one actively growing shoot per each tree within an insect-proof sleeve cage. The mode of host resistance was investigated by estimating oviposition and antibiosis. Nymphal survival and adult emergence of the psylla populations were recorded over 30-day period on each cultivar. Ovipositional response showed that all pear cultivars were attractive, but five levels of egg-laying during a 2-day oviposition could be distinguished ($P < 0.01$). Cvs. 'Spadona' and 'Molinaccio' had the smallest egg masses (< 30) and 'Coscia' was the most preferred cultivar for oviposition (≈ 195). Large variations among pear psylla development were observed in antibiosis trial. On 'NY 10355' the percentage of the emerged adults was zero. Pear cultivars that demonstrated higher antibiosis resistance ('Allora' and 'San Giovanni') were not necessarily those that presented non-preference for oviposition. A delay in the growth and development of the nymphs was evidenced in cv. 'Moscatellina', with the almost total presence of nymphs and the releasing of a few number of adults at the end of the trial.

Keywords: *Cacopsylla pyri*, host plant resistance, germplasm, oviposition, antibiosis

P51- Studies on pear decline disease in Uruguay

Diego Maeso, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones, 90200, Uruguay; dmaeso@inia.org.uy

María Teresa Federici, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90200, Uruguay; mfederici@inia.org.uy

Anabel Martinez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90200, Uruguay; anabellmb@hotmail.com

Mariana Silvera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90200, Uruguay; msilvera@inia.org.uy

Ana Lucía Goncalvez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90200, Uruguay; lgoncalvez@inia.org.uy

Pear decline (PD) caused by '*Candidatus* Phytoplasma pyri' (subgroup 16SrX-C of apple proliferation group of phytoplasmas) is an important pear (*Pyrus communis* L) disease. Pear production in Uruguay is based in self-rooted Williams plants initially grafted on quince. Recently less vigorous rootstocks that could be more susceptible to decline are being planted for precocity. Surveys were conducted to know if PD was present in the pear growing area of Uruguay (southern part near Montevideo city) during 1995 looking for premature reddening, upward rolling of leaves and decline. Phytoplasma were observed in 35 of 70 samples using DAPI test. Ten positive and 10 negative samples were analyzed by PCR assay using AP-group specific primers f01/r01. A 1050 bp amplicon was obtained only from all DAPI positive samples. The f01/r01 amplicon was sequenced showing 100% identity with 16S ribosomal RNA gene sequences of PD phytoplasma in NCBI database. An association was observed between phytoplasma detection, reddening, psylla infestation and premature leaf fall in this survey. Presence of PD-symptoms and phytoplasma detection were evaluated in an experiment where 20 scion/rootstock combinations were compared during 2005-2011. Self-rooted, OHxF 40, and OHxF 69 grafted plants showed less early reddening and leaf fall than those grafted onto quince rootstocks. Phytoplasma detection in this trial varied among seasons and was not associated to symptoms. Phytoplasma were detected on psylla during the whole 2009-2011 seasons on four pear orchards. An association between the efficiency of psylla control, phytoplasma detection and symptoms was found on an experiment with traditional Williams self-rooted plants in 2011. These results indicate the presence of PD phytoplasma in Uruguayan pear orchards, on psylla insects during the whole season, and its association to decline symptoms on plants depending on scion/rootstock affinity.

Keywords: *Pyrus communis* L, '*Candidatus* Phytoplasma pyri', *Psylla*, rootstock

P52- Monitoring the occurrence of ˈ*Candidatus* Phytoplasma pyriˋ depending on the pear varieties in the Czech Republic

Dr. Tomas Necas, Mendel University, Faculty of Horticulture, Fruit Growing Dept., 69144 Lednice, Czech Republic; tomas.necas@mendelu.cz

Dr. Tomas Kiss, Valtická 337, 69144 Lednice, Czech Republic; tomasko.kiss@gmail.com

Dr. Jan Wolf, Valticka 337, 69144 Lednice, Czech Republic; janwolf21@gmail.com

Dr. Ivo Ondrasek, Valtická 337, 69144 Lednice, Czech Republic; ondrasek@zf.mendelu.cz

In Europe, pear orchards are increasingly affected by the pathogen *'Candidatus* phytoplasma pyri', the causal agent of pear decline. The situation in the Czech Republic is very similar, where the intensity of infection depends on the variety, the origin of the planting material, the growing system and the locality. In 2016 the pear growing area was 710 ha with the production of 6 643 t with the average yield 10.54 t.ha-1. In the framework of the experiment, the largest pear producers in four main growing regions in the Czech Republic: Northern Bohemia, Eastern Bohemia, South and Western Bohemia and Moravia, were monitored. The area of pear orchards at monitored regions ranged from 66 ha to 5 ha. The most planted cultivars of the world assortment were: 'Williams' ('Bartlett'), 'Conference', 'Clapp's Favorite', 'Beurre Bosc', 'Packham's Triumph', 'Hortenzia'®, 'Alexander Lucas'. The Czech cultivars were represented by: 'Bohemica', 'Nitra', 'Nela', 'Erika', 'Jana' and others. Preliminarily tested samples showed high proportions of infected trees for cultivars 'Hortenzia'® (50.0 %), 'Packham's Triumph' (50.0 %) and 'Williams' (33.3 %) grown on quince rootstocks, while less proportions of infected trees were found in varieties such as 'Alexander Lucas' (33.3%), 'Decora' (25.0%) 'Nela' (10.0%), and 'Dicolor' (10.0%) grown on pear seedling rootstocks. In order to evaluate the results, it is necessary to include besides the rootstock material, also the influence of the plantation age and the climatic factors which may affect the phytoplasma transmission by psyllids in some localities.

Keywords: pear decline, *Pyrus*, pear cultivars, phytoplasma disease

P53- Occurrence and pathogenicity of brown spot disease in `Rocha´ pear Portuguese orchards

Assoc. Prof. Cristina Oliveira, LEAF - Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1399 Lisboa Codex, Portugal; crismoniz@isa.ulisboa.pt

Pedro Reis, LEAF - Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1399- 017 Lisboa, Portugal; pedroreis@isa.ulisboa.pt

Tiago Comporta, CPF - Centro de Produção e Comercialização, Estrada Nacional 8, Km 69 - Sobreiral, 2540-170 Bombarral, Portugal; tiago.comporta@cpf.com.pt

Dr. Mariana Mota, LEAF - Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1399- 017 Lisboa, Portugal; mariana@isa.ulisboa.pt

Dr. Cecilia Rego, LEAF - Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1399- 017 Lisboa, Portugal; crego@isa.ulisboa.pt

Brown spot, caused by *Stemphylium vesicarium*, is the main fungal disease of pear causing severe crop losses. Disease incidence and severity were evaluated in flowers and fruits throughout the growing season in two orchards with Moderate (MI) and Low (LI) disease incidence history, both of them with two different weed control systems, mechanical cultivation (M) and natural cover (C). Flowers' disease incidence on May 16th (BBCH 65) in LI-C orchard was the lowest (31.7 %) differing significantly from the other treatments. Sepals, styles and stigma were the most infected organs, however the pathogen was also isolated from ovaries and stamens. Regarding fruits' disease incidence, on the 30th May (BBCH 72, 15 mm fruit diameter), LI-M showed the lowest incidence (20,0%) and MI-C, the highest (56.7%) meaning that infection in the initial stages of fruit growth is strongly influenced by natural cover (inoculum source) and by the orchard history. However, on July 15th (BBCH 72, 30 mm fruit diameter), orchard history disease incidence was dominant with 51.7% of the fruits in MI-C and MI-M were symptomatic whereas in LI–C and LI-M only 17.5%, in average showed symptoms. Fruit severity was also lower in the orchard with LI history. Selected isolates were used in pathogenicity tests. These tests were performed in a commercial orchard, without the disease. Fruits were inoculated, without lesion, with mycelial discs of 15 isolates. Controls were inoculated with PDA discs. Results revealed that 53.4% of the isolates were pathogenic, 25% and 75% of these isolates were obtained from flowers and fruits, respectively. The most virulent isolates were obtained from fruits, but there was no relation with orchard treatments. These results show that control cultural measures based on inoculum reduction are of outmost importance and that isolate's pathogenicity is a genetic feature.

Keywords: flower and fruits infections, incidence, Koch postulates, severity, *Stemphylium vesicarium*

P54- Effect of the ground cover management on *Cacopsylla bidens* ('ulc, 1907) populations in pear orchards

MSc. Diana Valle, Instituto Nacional de Investigación Agropecuaria. Alicante 1808, Montevideo 11900, Uruguay; dvalle@inia.org.uy

Dr. Valentina Mujica, Instituto Nacional de Investigación Agropecuaria, Ruta 48 Km10, Canelones, Uruguay; vmujica@inia.org.uy

Mariana Silvera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 Km10, Canelones, Uruguay; msilvera@inia.org.uy

Dr. Alejandra Borges, Facultad de Agronomía, Universidad de la República, Sayago, Montevideo, Uruguay; aborges@fagro.edu.uy

Dr. Roberto Zoppolo, Instituto Nacional de Investigación Agropecuaria, Ruta 48 Km10, Canelones, Uruguay; rzoppolo@inia.org.uy

Dr. Enrique Morelli, Facultad de Ciencias, Universidad de la República, Mataojo, Montevideo, Uruguay; emorelli@fcien.edu.uy

Cacopsylla bidens (Šulc, 1907), is one of the key pests of pear, belonging to the superfamily Psylloidea. Its management has been based on broad-spectrum insecticides, which causes the appearance of resistance and the disappearance of the population of the natural controllers. The need to reduce the use of insecticides is growing. This fact makes it necessary to find alternative strategies to control this pest, and the biological control can be a sustainable solution in the long term. The aim of this work was to evaluate the effect of the ground cover management on psyllid populations and its natural enemies and register the natural enemies' families present in Uruguay. Sampling was conducted in Southern Uruguay, between 2013-2015. Two treatments were evaluated: regular cut of spontaneous vegetation of interrow with herbicide in the row, and uncut vegetation of the interrow with no herbicide. To determine the presence of beneficial arthropods, a garden vacuum cleaner was used on a weekly basis. Psylla catches were significantly lower in the uncut treatment compared to the other treatment. Natural enemies, on the contrary, were higher in the uncut treatment. The pool of natural enemies found was present throughout the year and was composed of predators belonging to the families Anthocoridae, Miridae, Chrysopidae, Coccinellidae, Syrphidae and the order Aranae, as well as parasitoids belonging to the family Encyrtidae. These results allow us to conclude that the treatment without periodical cutting of the ground cover generates a condition beneficial for the increase of populations of natural enemies, probably due to better feeding and multiplication conditions. This beneficial fauna seems to control psyllid populations providing an alternative for management of pear psyllid, reducing the use of insecticides in the orchards.

Keywords: Psyllidae, entomophagos, parasitoids, William's pear, conservational biological control, Integrated pest management

P55- Looking for alternatives to control superficial scald in `Beurré d'Anjou´ pear

Dr. Gabriela Calvo, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km. 1190, General Roca 8332, Argentina; calvo.gabriela@inta.gob.ar

Dr. Ana Paula Candan, Instituto Nacional de Tecnología Agropecuaria, Ruta Nacional 22 km. 1190, General Roca 8332, Argentina; candan.ana@inta.gob.ar

Dr. Christian Larrigaudière, IRTA Postharvest, PCiTAL, Parc de Gardeny, Edifici Fruitcentre, 25003 Lleida, Spain; Christian.Larrigaudiere@irta.cat

Diphenylamine and ethoxyquin antioxidants has been used for decades to prevent superficial scald, however the need for safer fruit restricted their use and warrant the search for alternative strategies to control this disorder. The objective of this work was to evaluate the effectiveness of different strategies to control superficial scald in 'Beurré d'Anjou' pears through the reduction of the synthesis or action of ethylene by application of polyamines, 0.30 mL L-1 1-methylcyclopropene (1-MCP), storage in controlled atmosphere (CA) or dynamic controlled atmosphere (DCA) and the application of conditioning treatments before storage (UVC, heat treatment). Pears were harvested at optimum maturity. Ethylene production, maturity and superficial scald incidence were determined monthly during 210 days of storage. Of all the evaluated treatments, only DCA and 1-MCP application effectively control superficial scald but were also associated to the development of internal disorders (cavities) and ripening impairment respectively. Both treatments are currently being used commercially in apples, but to achieve commercial use in 'Beurré d'Anjou' pears it is necessary to optimize the application protocols. Consequently, further studies are needed to prevent storage disorders in 'Beurré d'Anjou' pear and to ensure fruit softening, striking the right balance between O2 and CO2 and optimizing 1-MCP application.

Keywords: 1- methylcyclopropene, controlled atmosphere, polyamines, UVC, heat treatment

P56- Yield maps in tree fruit production: Analysis of spatial and temporal variability to establish homogeneous zones

Edgardo Benitez Piccini, Instituto Nacional de Tecnología Agropecuaria, Esteban Echeverría 164, Neuquén 8300, Argentina; benitez.edgardo@inta.gob.ar
Dr. Darío Fernández, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; fernandez.dario@inta.gob.ar
Mariela Curetti, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; curetti.mariela@inta.gob.ar
Mauricio Romitelli, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; romitelli.mauricio@inta.gob.ar
Dolores Del Brío, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; delbrio.dolores@inta.gob.ar
Santiago Ocampo, Buenos Aires 1400, Neuquén, Argentina; san_trash@hotmail.com
Dr. Sergio Bramardi, Buenos Aires 1400, Neuquén, Argentina; sbramardi@gmail.com
Dr. Carlos Magdalena, Instituto Nacional de Tecnología Agropecuaria, Casilla de correo N782, General Roca, Argentina; magdalena.carlos@inta.gob.ar

Precision agriculture involves the use of information to manage field spatial and temporal variability and has advanced considerably supported by electronic and computer technologies. Crop properties are analyzed to delimit field areas with homogenous characteristics called management zones. Although many crop properties could be evaluated, yield is one of the mostly used parameters, and yield maps can be considered as a key factor in Precision Agriculture. In this paper, spatial and temporal variability were analyzed in a 1.8 ha plot during four seasons to evaluate if site specific management can be an alternative to improve productivity. The plot had 57 rows with 36 trees each. Crop rows were divided in sub-units of 12 trees with practical purpose for future yield monitors. Yield maps were obtained using an automatic system locally developed, which geo-references the weight of the fruit during harvest. Data set was analyzed using GS+ software. A spherical variogram model was fitted and the interpolation was made using ordinary krigging. Plot spatial variability was shown on the resulting yield maps. Three management zones were delimitated based on average fruit production. Yield data was analyzed using ANOVA where fixed factors of the model were “year”, “sector”, and “year*sector” interaction. Also, temporal stability was evaluated using a coefficient of temporal variation that indicates the variance over the time of a sub-unit yield relative to the field mean yield. As mostly years showed non-significant “year*sector” interaction, production could be considered as relatively stable for all sectors. It is remarkable that spatial and temporal variability could be showed in a single yield map. Finally, possible causes of temporal and spatial variability were analyzed, and potential improvements were presented in order to increase fruit quality and yield.

Keywords: Bartlett pear, site-specific management, precision agriculture

P57- Impact of different factors on minimally processed pear quality

Ana Cecilia Silveira Gómez, Facultad De Agronomía, Universidad de la República, Garzón 780, 12300 Montevideo, Uruguay; acsilver@fagro.edu.uy

Vanessa Couzzo, Facultad De Agronomía, Universidad de la República, Avda. Garzón 780, Montevideo, Uruguay; vanecuozzo15@gmail.com

Eva Torres, Facultad De Agronomía, Universidad de la República, Avda. Garzón 780, Montevideo, Uruguay; evafagro@gmail.com

Víctor González, Facultad De Agronomía, Universidad de la República, Avda. Garzón 780, Montevideo, Uruguay; davidgonzalez199307@hotmail.com

Yanina Pariani, Facultad De Agronomía, Universidad de la República, Avda. Garzón 780, Montevideo, Uruguay; yanina.pariani.marrero@gmail.com

The impact of raw material storage time (non stored, three, and six months at 3% O2 and 3% CO2, 0°C) on some quality parameters of minimally processed (MP) pear packaged on polypropylene (PP, 45 µm) and/or low density propylene (LDPE, 60 µm) bags during 1, 5, 10, and 15 days at 0 °C, was determined. TThe bags head space atmosphere composition showed higher CO2 level for MP pears from 6 months stored raw material (5% after 10 and 15 days of storage) while MP pears from non stored showed 3% of CO2. PP bags determined greater CO2 accumulation. O2 levels did not show substantial differences (16-18 % after 15 days). Psychrotrophic and mesophilic growth reached 4.5 cfu log -1 after 15 days when processing three and six months stored pears. Pears packaged on PP bags showed 1 cfu log g-1 less than the packaged on LDPE. Enterobactericeae, molds and yeast were counted only after 10 and 15 days with values around 1 cfu log without differences among the considered factors. MP pear flesh firmness was higher on non stored raw material. PP bags allowed to maintain firmness values during 15 days independently of storage time of the raw material. Total antioxidant capacity by DPPH assay was only affected by the storage time of the raw material being lower in non stored (6.72 mg ascorbic acid equivalent 100 g-1 fresh weight) and higher on 6 months stored pears (12.74 mg AAE 100 g-1 FW). FRAP analysis also found differences in the same factor (11.46 mg AAE 100 g-1 FW from non stored and 20.34 mg AAE 100 g-1 FW on MP from 6 months). Raw material stored in CA condition would not affect the MP pear quality and it would even improve its functional quality especially when PP bags are used.

Keywords: raw material, *Pyrus communis*, organoleptic quality, functional quality

P58- Effect of pollination on `Rocha´ pear quality

Claudia Sánchez, National Institute for Agricultural, and Veterinary Research, Alcobaça, Portugal; claudia.sanchez@iniav.pt

Mário Santos, National Institute for Agricultural, and Veterinary Research, Oeiras, Portugal; mario.santos@iniav.pt

Paula Vasilenko, National Institute for Agricultural, and Veterinary Research, Oeiras, Portugal; paula.vasilenko@iniav.pt

Rui Maia de Sousa, National Institute for Agricultural, and Veterinary Research, Alcobaça, Portugal; rui.sousa@iniav.pt

Cross pollination is a highly important process in pear orchards. Most pear cultivars are partially self-incompatible and dependent on cross pollination for a high fruit set. In 'Rocha' pear, parthenocarpic fruit set can be stimulated by gibberellins application, which is a common practice in high-intensity agriculture. However, there are some problems with the fruit quality resulting from parthenocarpic phenomenon, since several fruit quality parameters are driven by the pollination-mediated production of hormonal growth regulators. Despite ´Rocha' pear being one of the most important fruits in the western region of Portugal, the value of pollination is still underestimated or even disregarded. Thus, to better understand the importance of pollination for this culture, the aim of this research was to study its effects on fruit quality and conservation. For this, three modalities were considered: natural insect pollination, manual pollination and use of gibberellins. Besides physic-chemical properties such as weight, size, firmness, peel colour, total soluble solids and titratable acidity, several important compounds such as phenolics, antioxidants, α-farnesene and conjugated trienols were analysed. The development of physiological disorders like superficial scald and internal browning was also evaluated during the period of conservation under normal atmosphere conditions. At harvest, we observed that the quality of manually pollinated pears was higher than in the control or gibberellin treated pears. Moreover, the long-term storage capacity of 'Rocha' pear was improved, as less physiological disorders were observed.

Keywords: *Pyrus communis*; cross pollination; postharvest; fruit quality; phenolic and antioxidant compounds; physiological disorders; internal browning

P59- Effects of fertilizer types and fertilization periods on fruit quality and tree nutrition status in `Ya´ pear

Prof. Guoying Wang, Hebei Agricultural University, 289 Lingyusi Street, Baoding, 071001, China; yywgy@hebau.edu.cn

Prof. Dr. Yuxing Zhang, Hebei Agricultural University, 289 Lingyusi Street, 071001, Baoding, China; zhyx@hebau.edu.cn

This experiment consisted in the study of fruit quality and tree nutrition status of 'Ya' pear. The treatments included three fertilizer types and two fertilization periods. The objective was to identify appropriate fertilizer type and fertilization period which could effectively improve fruit quality of 'Ya' pear. Therefore, providing the test basis for guiding rational fertilization and producing high quality fruit. Fertilizer types used were: organic-inorganic compound fertilizer (balanced fertilizer), biodynamic organic fertilizer (bio-fertilizer), and conventional fertilizer (compound fertilizer). Fertilization periods considered were: two weeks after petal fall, and one and a half months before fruit ripening. The major results are the following: 1. Effects of fertilizer types on fruit quality: after the application of the three fertilizers in the two periods, it was concluded that the fruit quality with the treatment of balanced fertilizer was significantly higher than that of the bio-fertilizer and compound fertilizer in both of the two periods. 2. Effect of fertilization periods on fruit quality: the test showed that no matter fertilizing balanced fertilizer or bio-fertilizer at the stage of one and a half months before fruit ripening all had a more obvious improvement in fruit quality than that of the two weeks after petal fall. 3. Effects of fertilizer types on the nutrition status of tree: through the experiment, it was showed that the nutrition status with the treatment of bio-fertilizer was significantly higher compared to that of the balanced fertilizer and compound fertilizer in both of the two stages. 4. Effects of fertilizer periods on the nutrition status of tree: the results indicated that independently of using balanced fertilizer or bio-fertilizer, when applied at the stage of two weeks after petal fall, both fertilizers had a more obvious improvement in nutrient growth than when applied at one and a half months before fruit ripening.

Keywords: 'Ya' pear, fertilization, fruit quality, nutrition status, organic-inorganic compound fertilizer, biodynamic organic fertilizer

P60- Sclereid development in 'Conference' pear throughout progress of quality

Nicole Brandes, Leibniz Institute for Agric. Engineering, Max-Eyth-Allee 100, 14469 Potsdam, Germany; nbrandes@atb-potsdam.de

Dr. Manuela Zude-Sasse, Max-Eyth-Allee 100, 14469 Potsdam, Germany; mzude@atb-potsdam.de

Pear quality requirements differ throughout supply chain. However, the quality progress of 'Conference' pear (*Pyrus communi*s L.) is important to reach varietal characteristics. Not only juicy and mellow fruit flesh, but also mouthfeel of sclereid cluster is important to meet the pear quality sensation of consumers. Pears used in this project were grown in a commercial orchard in Germany. During pre-harvest development, free-hand mounted tissue samples were analysed weekly. Additionally, cells were singularised by boiling 3 mm3 tissue in 5 ml 0.05 M Na2CO3 in 0.3 M mannitol for 60 min. Singularised sclereid clusters were stained with 1% SafraninO for 20 min. After staining was completed, sclereid clusters were rinsed by diluting stained cell suspension with water 5 times. Both, cell enlargement and sclereid shape and size was measured by confocal laser scanning microscopy (TSC SP5, Leica, Germany) using excitation at 488 nm emitted by argon laser. Additionally, UV diode providing excitation at 405 nm was used. Sclereid cluster shape and quantity of single stone cells of singularised sclereid cluster were characterised by taking z-stacks built from 80 frames with an interval of 6 µm. The cell diameter increased from 96.7 ± 10.3 µm (75 dafb) to 230.5 ± 39.5 µm (158 dafb). ANOVA results show no difference (p=0.34) of sclereid cluster size from 75 (165.5 ± 40.1 µm) to 158 (192.5 ± 0.7 µm) dafb. Microscopy results of ripe pear revealed spherical shaped symmetric structure of sclereid cluster. Considering the results, sclereid size and shape can be characterised microscopical using intact cell compounds. However, to analyse sclereid shape and quantity of single stone cells, imaging singularised sclereids enables improved staining results and enhanced insight in the sclereid-parenchym cluster.

Keywords: Sclereid cluster, confocal microscopy, fruit development, pear, supply chain

P61- Effect of bagging on soluble sugar metabolism and related enzyme activity in `Huangguan´ pear

Yaru Wang, No. 5 Xuefu Road, Changan District, shijiazhuang, China; liyuzhongsjz@163.com

Prof. Yong Li, No. 5 Xuefu Road, Changan District, shijiazhuang, China; 82308805@163.com

Prof. Xiao Li, No. 5 Xuefu Road, Changan District, shijiazhuang, Choose a country; 1062497681@qq.com

Yongbo Wang, No. 5 Xuefu Road, Changan District, shijiazhuang, China; 76342146@qq.com

Prof. Yingtao Wang, No. 5 Xuefu Road, Changan District, shijiazhuang, China; wjajj@163.com

The effects of bagging on soluble sugar metabolism and related enzyme activity in 'Huangguan' pear were studied to provide a scientific basis for improving sugar contents of pear fruit. Using 15-year-old 'Huangguan' pear trees as the material, the content of sucrose, glucose, fructose, sorbitol, the activities of their related enzymes including acid invertase (AI), neutral invertase (NI), sucrose synthase (SS) and sucrose phosphate synthase (SPS) during the development of pear fruit were studied. The change trend of sugar contents and enzyme activities of bagged fruit was basically in accordance with that of the unbagged one. The contents of fructose, glucose, sucrose, and total soluble sugar in the fruits increased with the fruit growth. Bagging reduced the soluble sugar increases. The activity of AI, NI and SSc (breakdown direction) decreased with fruit development, while SPS and SSs (synthetic direction) increased. Bagging decreased the activity of SPS and SSs (synthetic direction) within the fruit development late stage, but increased AI activity in fruit development early stage. Bagging did not show significant effect on the SSc (breakdown direction) and NI activity in most tested points. Therefore, it is concluded that the changes of activities of related enzymes in sugar metabolism regulated by bagging environment may be responsible for the regulation of fruit growth, sugar accumulation and quality formation.

Keywords: Pear; bagging; sugar content; sugar metabolizing enzymes

P62- Antioxidant enzyme changes in relation to superficial scald development in pear fruit during cold storage

Dr. Giuseppina Caracciolo, Unità di ricerca per la frutticoltura, via La Canapona 1bis, 47122 Forlì(FC), Italy; giuseppina.caracciolo@crea.gov.it

Dr. Milena Petriccione, via Torrino, 2, Caserta, Italy; milena.petriccione@crea.gov.it

Luigi Zampella, via Torrino, 2, Caserta, Italy; luigi.zampella@crea.gov.it

Francesco Mastrobuoni, via Torrino, 2, Caserta, Italy; francesco.mastrobuoni@crea.gov.it

Maria Luigia Maltoni, via La Canapona 1 bis, 47122 Forlì(FORLÌ-CESENA), Italy; marialuigia.maltoni@crea.gov.it

Dr. Gianluca Baruzzi, via La canapona 1 bis, 47122 Forlì(FORLÌ-CESENA), Italy; gianluca.baruzzi@crea.gov.it

Superficial scald is a physiological disorder of apple and pear fruits associated to the pre-/postharvest treatment and genetic traits of each cultivar. In Po valley, two pear cultivar (Abate Fetèl and Decana del Comizio) and two pear selections (FRF 171, FRF 264), picked in August-September, were stored at 2.5°C and 85% RH until February. In this study, antioxidant enzymatic system of the four cultivar/selections was evaluated during storage to investigate differences in scald susceptibility. Some enzymatic activities, in pear skin and flesh, such as superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), guaiacol peroxidase (POD), polyphenol oxidase (PPO), and lipoxygenase (LOX) were evaluated.Significant differences in scald incidence were observed both in pear cultivars and selections. Abate Fétel and FRF 171 showed lower superficial scald susceptibility compared to Decana del Comizio and FRF264, after being cold stored for three months.In fruit skin, SOD and CAT activities were higher in scald-resistant than in scald-susceptible pear cultivars and selections. However, APX activity in skin and flesh was very similar in all tested pear fruits. Superficial scald induced an increase in PPO and POD activities involved in fruit-browning during cold storage. Furthermore, we observed an increase in LOX activity due to deoxygenation of polyunsaturated fatty acids producing toxic hydroperoxy fatty acids and consequent membrane damage in fruit skin and flesh.A multivariate statistical approach, including principal component analysis, provided a global view of the responses of both pear cultivars and selections analysed in relation to superficial scald.This study indicates that some pear cultivars and selections have different superficial scald susceptibility enabling them to induce activities of several antioxidant enzymes following cold storage. Regulation of antioxidant enzymes alleviates oxidative damage and in addition to other biochemical features could be involved in determining the susceptibility/resistance to superficial scald development of pear fruit.

Keywords: pear, superficial scald, antioxidant enzymes, fruit-browning

P63- Influence of rootstocks on nutritional composition of pear fruits

Dr. Facundo Ibañez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Las Brujas, Uruguay; fibanez@inia.org.uy

Adriana Lugaresi, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Canelones 90200, Uruguay; adrianalugaresi@yahoo.com.br

Ana Laura Alvarez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Canelones 90200, Uruguay; alalvarez@inia.org.uy

Pablo Rodriguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Canelones 90200, Uruguay; prodriguez@inia.org.uy

Danilo Cabrera, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Canelones 90200, Uruguay; dcabrera@inia.org.uy

Pear is a fruit of great importance for human nutrition due to the organoleptic characteristics and nutritional composition. Its cultivation in Uruguay generally uses rootstocks for adaptation to the soil, productiveness and precociousness, but rootstock selection may also influence fruit quality, with the ability to change its chemical composition. The objective of this work was to evaluate the influence of rootstocks on some physicochemical and nutritional compounds of pear cv. Williams, grafted on six rootstocks (EMC, BA29, OHxF333, OHxF40, OHxF69 and Adams) in Uruguayan production conditions. The experimental design was a randomized complete block design with four replicates located in an orchard at INIA-Las Brujas Experimental Station. At harvest, twenty fruits were sampled per replicate, conditioned in a cold chamber and then at room temperature until consumer maturation. Soluble solids content, acidity, color and texture were evaluated and then fruit peel and pulp were separated for determination of ascorbic acid and mineral contents. As a result, in relation to the soluble solids, titratable acidity, color and texture, no differences were found between the rootstocks. For ascorbic acid content, no significant differences between rootstocks were found, but the concentration was higher in the fruit peel than pulp. The highest phosphorus content was found in the pulp, but calcium and magnesium contents were higher in the peel. The OHxF 40 and OHxF 69 rootstocks provided higher phosphorus and zinc contents and the boron content was higher in fruits of plants grafted on OHxF 40 rootstock. As a conclusion, rootstocks are influencing the nutritional content of Williams pear fruits under Uruguayan cultivation conditions, and it is possible to select a more convenient rootstock in terms of production and to contribute with a greater amount of nutrients in fruits.

Keywords: Fruit quality, Human nutrition, *Pyrus communis* L., mineral content

P64- A comparative study between different sensors to detect the lower oxygen level during dynamic controlled storage of Conference pears

Laia Torregrosa, Universitat de Lleida, Dept. Computing & Industrial Engineering, 25001 Lleida, Spain; ltorregrosa@diei.udl.cat

Dr. Gemma Echeverria, Edifici Fruitcentre, Parc Científic i Tecnològic Agroalimentari, Lleida, Spain; gemma.echeverria@irta.cat

Dr. Josep Illa Alibés, University of Lleida, C. Jaume II, 69, Lleida, Spain; jilla@macs.udl.cat

Joan Garcia, Industrial Leridana del Frío, C. Josep Segura Farré, 706, Lleida, Spain; JGARCIA@sic24.com

Dr. Jordi Giné-Bordonaba, Edifici Fruitcentre, Parc Científic i Tecnològic Agroalimentari, Lleida, Spain; Jordi.Gine@irta.cat

To guarantee the availability of high quality pears throughout the year, the new trend in storage is to reduce the oxygen levels within a chamber, referred as dynamic controlled atmosphere (DCA), and continuously monitor the lower oxygen level (LOL) tolerated by the fruit prior to anaerobiosis. Lower oxygen level (LOL) monitoring includes measurements of chlorophyll fluorescence (CF), respiratory quotient (RQ) and/or ethanol accumulation (EtOH), all of them well implemented in apples but not in pears. The objectives of this trial were to explore the suitability of DCA to store pears and to reveal the best method to determine the LOL based on the fruit physiology. To do so, we used cv. Conference pears harvested at the optimal commercial maturity and stored in a semi-commercial chamber at 0ºC for 9 months. The O2 and CO2 levels within the storage atmosphere were controlled by an Advanced Control Respiration (ACR) system and O2 levels decreased until a consistent LOL signal (depicted by either RQ, CF or EtOH) was clearly observed. Changes in the volatiles concentration within the storage atmosphere were also recorded. Our data shows a correlation between CF and RQ measurements at the beginning of the cold storage, having a CF peak when RQ values were higher than 1. However, this correlation was lost as the storage period increased, observing exclusively CF peaks that were not paralleled by either higher RQ values or ethanol levels. Overall both RQ and CF signals were only useful during the period of acclimatization of the fruit to the cold or when moving from relatively high (ca. 2%) to low O2 levels. This new approach is suitable to determine pear postharvest quality. at the period of acclimation. Further variables such as fruit volatiles can be used to correlate with observed physiological changes.

Keywords: Chlorophyll fluorescence, ethanol, physiological disorders, respiratory quotient, *Pyrus communis* L.

P65- Rootstock influence on quality parameters of Williams pear *(Pyrus communis*)

Eva Torres, Facultad De Agronomía, Universidad De La República, Avenida Gral. Eugenio Garzón, 780, Sayago, 12900, Uruguay; etorres@fagro.edu.uy

Vanessa Cuozzo, Facultad De Agronomía, Universidad De La República, Avenida Gral. Eugenio Garzón, 780, Sayago 12900, Uruguay; vcuozzo@fagro.edu.uy

Pablo Rodríguez, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado 90000, Uruguay; prodriguez@inia.org.uy

Ana Cecilia Silveira, Facultad De Agronomía, Universidad De La República, Avenida Gral. Eugenio Garzón, 780, Sayago 12900, Uruguay; acsilver@fagro.edu.uy

Carlos Danilo Cabrera Bologna, Instituto Nacional de Investigación Agropecuaria, Ruta 48 km 10, Rincón del Colorado, Canelones, Uruguay; dcabrera@inia.org.uy

The effect of the rootstocks *P. communis*: OHxF333; OHxF97; OHxF51; *P. calleryana* clon D6 and *Cydonia oblonga* (quince): BA 29 and Adams without interstem, and Adams with Beurre Hardy (*P. communis*) interestem in some quality parameters of Williams pear was determined. The parameters polar and equatorial diameter, weight, flesh firmness, total solid soluble contents (TSS, ° Brix), color (L, Hue and Chroma) and the total antioxidant capacity determined by FRAP and DPPH assay were evaluated. Equatorial diameter did not show differences among rootstocks with an average value of 65.65 mm. However, pear from Adams with interstem presented higher polar diameter (82.17 mm) than *P. calleryana* D6 and BA 29 (about 74 mm). Highest weight was registered in pears on OHxF333 with an average value of 191 g and the lowest values corresponded to BA 29 and Adams without interstem with values around 160 g. Flesh firmness, measured on the opposite side of equatorial fruit zone, presented values among 60-63 N without differences between rootstocks. TSS were higher (14.8 ° Brix) on pear on BA 29 while lower values were measured on OHxF51 (13.89 °Brix) and Adams without interstem (12.91 °Brix). No differences were found on the L (75-80) and Hue (100-106) parameter of color. Chroma measured on pear on Adams without interstem was higher than the measured on *P. calleryana* (values of 38.44 and 34.73 respectively). Total antioxidant capacity determined by FRAP showed an average value of 31.81 mg ascorbic acid equivalent (AAE) 100 g-1 fresh weight (FW) and by DPPH assay presented an average value of 13.64 mg AAE 100 g-1 FW. No differences among rootstocks were registered in either. According to the postharvest quality minor differences were registered where the prominent rootstocks were OHxF333 and BA 29.
Keywords: postharvest, interstem, *Pyrus calleryana*, *Cydonia oblonga*, OhxF

P66- Pre-harvest factors affecting quality during `Rocha´ pear long-term storage

Dr. Claudia Sánchez, National Institute for Agricultural and Veterinary Research - INIAV, Alcobaça, Portugal; claudia.sanchez@iniav.pt

Alessandro Bonora, Department of Agricultural and Food Science, University of Bologna, Bologna, Italy; alessandro.bonora3@studio.unibo.it

Prof. Dr. Henrique Noronha, Department of Biology, University of Minho, Braga, Portugal; henriquelsnoronha@gmail.com

Prof. Dr. Luca Corelli Grappadelli, Department of Agricultural and Food Science, University of Bologna, Bologna, Italy; luca.corelli@unibo.it

The present work has been focused on the study of the effect of pre-harvest treatments, such as different rates of watering and nitrogen supplementation, on post-harvest physiology and quality of 'Rocha' pear. As climacteric fruits, pears can be storaged for many months in refrigerated chambers with specific gas concentrations. Nevertheless, physiological disorders like superficial scald and internal browning can develop during this period of conservation, causing important economic losses to producers. From fruit set to harvest, the plant accumulates sugars, phenolics and antioxidant compounds in the pomes spending energy, which are affected by the growing conditions, like fertilizations and water availability. After harvest, fruits still suffer biochemical changes, and pears have the ability to continue the maturation under genetic control and ethylene signalling. Although this process can be delayed with low O_2, pear fruit under storage conditions produces reactive oxidative species or fermentative metabolites that can lead to cell death and problems in conservation. So, besides physical properties such as size, firmness and peel colour, we analysed several important compounds such as acids, sugars (glucose, sucrose, fructose and sorbitol), phenolics, antioxidants and α-farnesene. Although we observed that dynamic controlled atmosphere (DCA) can ensure good external fruit quality, excess of water and/or nitrogen affects biochemical parameters compromising long-term storage capacity and nutritional value of 'Rocha' pear.

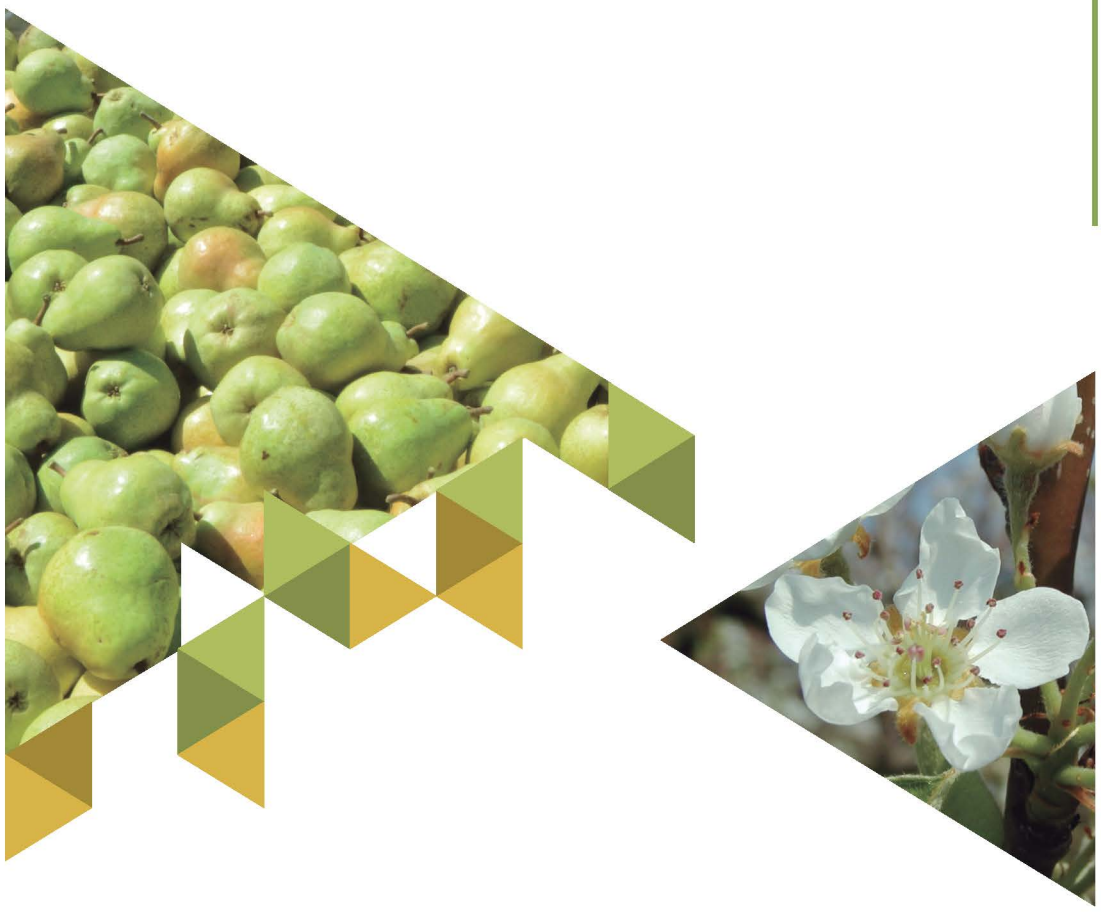
Keywords: *Pyrus communis*; nitrogen; water excess; postharvest; dynamic controlled atmosphere; fruit quality; physiological disorders

P67- Novel insights on the ripening pattern of `Blanquilla´ pears: a comparison study between on- and off-tree ripened fruit

Dr. Jordi Giné Bordonaba, IRTA, Av. Alcalde Rovira Roure 191, Av. Alcalde Rovira Roure 191, 25198 Lleida Lleida, Spain; jordi.gine@irta.cat
Violeta Lindo-Garcia, Postharvest Programme, IRTA, PCiTAL, Edif. Fruitcentre, 25003 Lleida, Spain; violeta.lindo@irta.cat
Dr. Gemma Echeverria, Postharvest Programme, IRTA, PCiTAL, Edif. Fruitcentre, 25003 Lleida, Spain; gemma.echeverria@irta.cat
Dr. Gloria Bobo, Postharvest Programme, IRTA, PCiTAL, Edif. Fruitcentre, 25003 lleida, Spain; gloria.bobo@irta.cat
Prof. Hideki Murayama, Department of Food, Life and Envir. Scienc, Faculty of Agriculture, University of Yamagata, Tsuruoka 997-8555, Japan; mhideki@tds1.tr.yamagata-u.ac.jp
Christian Larrigaudière, Postharvest Programme, IRTA, PCiTAL, Edif. Fruitcentre, 25003 Lleida, Spain; christian.larrigaudiere@irta.cat

If compared to most European pear varieties, 'Blanquilla' pears are able to ripen on-tree. Thus said, and despite fruit from this variety is harvested at a pre-climacteric stage and then ripened off-tree, scarce or no information is available comparing both on-tree and postharvest (off-tree) ripening. Accordingly, the aim of this study was to compare the ripening pattern including major physiological and organoleptic variations of on-tree and off-tree pears (stored at 20ºC and 85% RH). Changes in quality parameters, ethylene biosynthesis (ethylene production capacity, 1-aminocyclopropane-1-carboxylic acid (ACC), ACC oxidase and ACC synthase) or enzymes related to cell wall degradation (Pectin methylesterase (PME) and polygalacturonase (PG)), as well as the content of sugars and organic acids and the volatile profile were investigated. Our results show that most significant differences between on- and off-tree ripened pears were observed in the rate of softening, being higher in off- (-2.75N/day) than on-tree (-1.5N/day) ripened fruit and especially from day 3 to 6 in off-tree samples (- 10N/day). A typical climacteric behavior was observed in both samples being 10 days delayed in on-tree (ca. 6 µL Kg-1 h-1 at day 30) if compared to off-tree samples (ca. 10 µL Kg-1 h-1 at day 20). Thus said, the differences in fruit softening were neither explained by ethylene biosynthesis nor by the activity of PME and PG thereby suggesting that non-ethylene dependent softening is a characteristic trait during postharvest ripening of Blanquilla pears. The delayed ripening pattern in on-tree fruit was further confirmed by higher sucrose (over 2-fold), which was likely explained by a continuous supply of assimilates into the fruit, lower monosaccharides content together with a well distinguished volatile profile including lower levels of esters.

Keywords: ethylene, softening, sugars, volatiles, *Pyrus communis*



Declared as an event of public interest by:

MINISTERIO DE GANADERÍA AGRICULTURA Y PESCA

UruguayNatural Ministerio de Turismo

mec MINISTERIO DE EDUCACIÓN Y CULTURA

Sponsor:

Intendencia de Montevideo

Organization:

INIA Instituto Nacional de Investigación Agropecuaria URUGUAY

ISHS

GROWING IN *diversity*

XIII INTERNATIONAL PEAR SYMPOSIUM

MONTEVIDEO - URUGUAY
DECEMBER 4TH - 7TH 2018

www.pear2018.uy - info@pear2018.uy