PLANT PROTEOSTASIS

TOWARDS A GREEN BASED INDUSTRY

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September 27th and 28th, 2016

WELCOME

Dear Invited Speakers and Participants,

We are pleased to welcome you to Barcelona and to the meeting "Plant proteostasis – towards a green based industry", co-organised by B-Debate International Centre for Scientific Debate Barcelona, an initiative of Biocat and support of "la Caixa" Foundation and the European Cooperation in Science and Technology (COST) and the Centre for Research in Agricultural Genomics (CRAG).

The negative impact on environment and economy resulting from the use of non-renewable energy sources and plastic pollution, together with the limited availability of fossil-derived products, are the driving forces to make a major effort for achieving a sustainable production and conversion of biomass into industrial products and energy. In this context, the generation of a broad understanding of the molecular processes controlling plant agronomic traits related to crop productivity and biomass quality is a basic pillar for creating a sustainable and knowledge-based bioeconomy. In contrast to the wide use of genomic approaches for agriculture development, this debate will explore the applications of proteomic approaches for improving plant performance, but also for generating innovative industrial products.

This workshop is the first of its kind addressing plant proteostasis, but also addressing the translational aspects of plant proteostasis into fiber and oil plant breeding/industry. Overall, we foresee that this workshop will have a positive impact in plant proteostasis research, but also in economy and society needs regarding sustainability.

On behalf of CRAG, COST and B-Debate, we thank you for joining us in this exciting debate.

Yours sincerely,

L. Maria Lois, Núria Sànchez Coll (Scientific Leaders), Scientific Committee and B-Debate

PROGRAM

Tuesday, September 27th, 2016

9:00 **Welcome**
Jordi Portabella, Director, Area of Research and Knowledge, la Caixa Foundation
Albert Barberà, CEO, Biocat
L. Maria Lois, CSIC-CRAG, Barcelona
Núria Sànchez Coll, CRAG, Barcelona

9:30 **SESSION 1: NOVEL INSIGHTS INTO PLANT PROTEOSTASIS**
Chair: **Claus Schwechheimer,** Technical Univeristy of Munich, Freising, Germany

Autophagy during abiotic stress
Diane Bassham, Iowa State University, Ames, USA

N-end rule pathway of targeted proteolysis in plant-environment interactions
Michael Holdsworth, University of Nottingham, Nottingham, UK

Viral deubiquitinases (DUBs) : new players in the regulation of plant viral infections?
Isabelle Jupin, Institut Jacques Monod, Paris, France

11:00 **Coffee Break***

11:30 Chair: **Núria Sànchez Coll,** CRAG, Barcelona, Spain

The role of neddylation and deneddylation in plants
Claus Schwechheimer, Technical Univeristy of Munich, Freising, Germany

Autophagy in development
Peter Bozhkov, University of Agricultural Sciences, Uppsala, Sweden

Water stress regulates Cullin-Ring Ubiquitin Ligase neddylation in Arabidopsis thaliana
Giovanna Serino, La Sapienza University, Roma, Italy

N-terminal protein targeting in proteostasis and for switchable phenotypes
Nico Dissmeyer, Leibniz Institute of Plant Biochemistry, Halle, Germany

13:30 **Lunch***

15:00 Chair: **Giovanna Serino,** La Sapienza University, Roma, Italy

Autophagy in algae
Jose Luis Crespo, Instituto de Bioquímica Vegetal y Fotosíntesis, Sevilla, Spain

Differential Integration of E3 ligase-Target-based Co-Receptor Systems for Hormone Sensing
Irina Calderón Villalobos, Leibniz Institute of Plant Biochemistry, Halle, Germany

Post-translational control of ARGONAUTE proteins
Pascal Genschik, Institut de Biologie Moléculaire des Plantes CNRS, Strasbourg, France

16:30 **Coffee Break***

*Coffee breaks and lunchs of the meeting are funded
by the Severo Ochoa Project (SEV-2015-0533)

17:00 Chair: **Andreas Bachmair**, Max F. Perutz Laboratories, University of Vienna, Austria

Regulation of Protein Ubiquitination in Endosomal Trafficking
Erika Isono, Vedanta Biosciences, Boston, USA

Endosomal Sorting of Membrane Proteins For Degradation
Marisa Otegui, University of Wisconsin, Madison, USA

18:00 **Open debate**

Moderators: **Michael J. Holdsworth,** University of Nottingham, Nottingham, UK
Diane Bassham, Iowa State University, Ames, USA

Wednesday, September 28th, 2016

9:30 **SESSION 2: Industrial crops research and applications**
Chair: **Peter Bozhkov,** University of Agricultural Sciences, Uppsala, Sweden

Exploiting protein modification systems to boost crop productivity
Ari Sadanandom, University of Durham, Durham, UK

Biofixation of CO2 from industrial flue gases by microalgae and its transformation into products of commercial interest
Federico Witt, AlgaEnergy, Madrid, Spain

Cell wall research in fiber plants
Simon Hawkins, Universite Lille Nord de France, Lille, France

11:00 **Coffee Break***

11:30 Chair: **Simon Hawkins,** Universite Lille Nord de France, Lille, France

Improved biomass and bioprocessing properties of lignocellulosic forest feedstocks
Hannele Tuominen, Umeå Plant Science Centre, Umeå, Sweden

Developing crops for a biobased economy
Luisa M Trindade, Wageningen University, Wageningen, The Netherlands

Actual and innovative cultivation techniques for comprehensive use of hemp
Gil Gorchs, Universitat Politècnica de Catalunya, Barcelona, Spain

13:00 **Lunch***

14:30 Chair: **L. Maria Lois,** CSIC-CRAG, Barcelona, Spain

The potential of natural fibres in composites
Aart van Vuure, KU Leuven, Leuven, Belgium

Bio-based building materials
Ana Maria Lacasta Palacio, Universitat Politècnica de Catalunya, Barcelona, Spain

Role of Plant Research in European Bioeconomy
José Pío Beltrán, European Plant Science Organization, Brussels, Belgium

16:00 **Coffe break***

16:30 **Open Debate**

Moderators: **José Pío Beltrán,** European Plant Science Organization, Brussels, Belgium
Hannele Tuominen, Umeå Plant Science Centre, Umeå, Sweden

*Coffee breaks and lunchs of the meeting are funded by the Severo Ochoa Project (SEV-2015-0533)

SCIENTIFIC COMMITTEE

L. Maria Lois, CSIC Assistant professor, **Centre for Research in Agricultural Genomics (CRAG)** CSIC-IRTA-UAB-UB, Cerdanyola Del Vallès, Barcelona, Spain.

In 1999, L. Maria Lois obtained her PhD in Biochemistry at the University of Barcelona under the supervision of Prof. Albert Boronat. Dr. Lois pursued post-doctoral training at Rockefeller University and WCM of Cornell University (NY, USA) under the supervision of Prof. Nam-Hai Chua and Prof. Christopher D. Lima. During this training period, Dr. Lois worked in 5 independent laboratories specialized in different disciplines as microbiology, organic chemistry, plant genetics and molecular biology, and structural biology, using bacteria, plants and human systems. In 2004, Dr. Lois joined the University of Barcelona (UB) as a research track fellow and, in 2008, she was appointed to the Spanish Research Council CSIC as Assistant Professor at the Center for Agricultural Genomics (CRAG).

As a group leader, Dr. Lois is interested in elucidating the molecular mechanisms involved in protein regulation by SUMO and its implications in plant development. For supporting her research, she has successfully applied to national and international funding (ERC-StG2007) programs. Recently, Dr. Lois is exploring translational aspects of her research, for which she has received training at the University of Berkeley (2015) and also successfully applied to specific funding programs (LLAVOR2014, ERC-PoC2014). Since 2014, Dr. Lois is academic editor for PeerJ.

Chair of the SESSION 2

Núria Sànchez Coll, Ramon y Cajal Researcher, **Centre for Research in Agricultural Genomics (CRAG)** CSIC-IRTA-UAB-UB, Cerdanyola Del Vallès, Barcelona, Spain.

Núria Sánchez Coll obtained her PhD degree at the Swiss Federal Institute of Technology (ETH-Zürich) in 2006 under Dr. Klaus Apel direction. Her work focused on the signalling pathways leading to programmed cell death in response to reactive oxygen species. She then joined the lab of Dr. Jeff Dangl at the University of North Carolina with a Swiss National Research Foundation fellowship to study the mechanisms driving programmed cell death during plant immune reactions to pathogens. Since 2012 she is the co-group leader of the team “Bacterial plant diseases and cell death” at the Centre of Research in Agricultural Genomics (CRAG) in Barcelona. She has been awarded a Marie Curie Fellowship and Career Integration Grant, a Beatriu de Pinós fellowship and she is currently a Ramon y Cajal fellow. She has recently obtained research awards from the Spanish Association of Scientists and from the Catalan Society of Biology. Her team is currently investigating the dynamics of protein aggregates during cell death, aging and immune responses in plants.

Chair of the SESSION 1

Simon Hawkins, Professor, **Université de Lille**, CNRS, UMR 8576 – UGSF - Unité de Glycobiologie Structurale et Fonctionnelle, Lille, France.

After a B.Sc. and Ph.D. in plant physiology at University College London, England, Simon Hawkins worked for a few years in the field of adult literacy before becoming an assistant editor for the Annals of Botany Journal. He then returned to plant biology and undertook several years of post-doctoral research on the formation of lignified cell walls in trees. Dr Simon Hawkins is currently head of the 'Plant Fiber Team', one of the 15 research units making up the UMR CNRS 8576 UGSF at the University of Lille, France. His team undertakes research on the molecular mechanisms associated with the formation of the poorly-lignified, cellulose-rich cell wall of bast fibres. In these studies functional genomics and systems biology approaches are mainly being developed in flax. The results should also help to improve our understanding of bast fiber formation in other economically important species (hemp, ramie, jute etc.). Dr Simon Hawkins has previously been involved in several local, national and European cell wall-based project networks and is actually a member of the management committee of the French Cell Wall network (RFP). He is also head of the international masters degree in Plant Sciences at the University of Lille.

Chair of the SESSION 2

Claus Schwechheimer, Full Professor Plant Systems Biology **Technical Univeristy of Munich**, Freising, Germany.

Claus Schwechheimer has been head of the Chair of Plant Systems Biology at the Technical University of Munich since 2008. Prior to this, he had been an Independent Group leader at the Center for Plant Molecular Biology in Tübingen, Germany. Claus Schwechheimer was educated as a biologist and biotechnologist at the University of Heidelberg, Germany, and the Ecole Supérieure de Biotechnologie de Strasbourg, France. He performed his doctoral studies at the John Innes Centre in Norwich, UK, and received postdoctoral training at Yale University, USA. Throughout his career, he has been interested in signal transduction in plants, with a major focus on auxin and gibberellin signal transduction and protein degradation. At BDebate, he will present his group's most recent work on the role of the ubiquitin-related protein NEDD8 in plants.

Chair of the SESSION 1

Giovanna Serino, Associate Professor at **La Sapienza University**, Roma, Italy.

Giovanna Serino graduated cum laude in Biological Sciences from La Sapienza University, Rome. She obtained an MS and a PhD in "Molecular, Cellular and Developmental Biology" from Yale University, with a dissertation on the "COP9 signalosome", a protein complex essential for the development of all higher organisms, from plants to animals. She has been awarded of several fellowships and awards, both from Italian and international Institutions), including a grant. In 2003 to start her own lab at La Sapienza University in Rome, Italy. Since 2007 she is associate professor in Molecular Biology at La Sapienza University.
Her group currently focuses on the study of the mechanisms of protein homeostasis and on how they regulate plant growth and development using Arabidopsis thaliana as a model organism.

Chair of the SESSION 1

INVITED SPEAKERS

Tuesday, September 27th, 2016

Session 1: Novel insights into plant proteostasis

Claus Schwechheimer, Full Professor, Plant Systems Biology - **Technical Univeristy of Munich,** Freising, Germany.

See his CV at the Scientific Committee section.

Chair of the SESSION 1

Diane Bassham, Professor, Department of Genetics, Development and Cell Biology, **Iowa State University**, Ames, USA.

Diane Bassham received her B.Sc. (Honours) in Biochemistry from the University of Birmingham, England and Ph.D. in Biological Sciences from the University of Warwick, England. After completing a post-doctoral appointment in the MSU-DOE Plant Research Laboratory, Michigan State University in East Lansing, Michigan, she joined the faculty at Iowa State University in 2001. She is currently the chair of the Interdepartmental Plant Biology graduate program. In 2013, Prof. Bassham was chosen as the first Walter E. and Helen Parke Loomis Professor of Plant Physiology. Her research focuses on trafficking of macromolecules to the plant vacuole in response to environmental signals. A major project is analysis of the mechanism and regulation of autophagy, a vacuolar degradation pathway, in response to abiotic stress. Autophagy is required for the tolerance of multiple stress conditions, and therefore is a promising target for generation of stress-resistant plant varieties. Her lab is also studying how newly-synthesized proteins are transported to the vacuole, and the importance of this transport pathway in responding to environmental cues such as gravity.

Autophagy during abiotic stress

Autophagy is a macromolecule degradation pathway in which cellular components are transported to the vacuole to recycle nutrients during nutrient deficiency and senescence and to clear damaged molecules and organelles during environmental stress. Autophagy therefore contributes to plant survival and growth during adverse environmental conditions. Autophagy can be non-selective, indiscriminately degrading cellular components, or selective, in which substrates for autophagy are recognized by receptor proteins and targeted for degradation. Autophagy is activated during many different abiotic stresses, including nutrient deficiency, drought, salt and heat stress. We are analyzing the function and regulation of autophagy during abiotic stress conditions, focusing on the degradation of the endoplasmic reticulum during ER stress as an example. We have shown that fragments of ER are incorporated into autophagosomes specifically during ER stress, and not in other stress conditions, and that this is triggered by the accumulation of unfolded and aggregated proteins. Upstream regulators of autophagy activation have been identified, some of which are common to multiple stresses and some are specific to individual stresses.

Moderator of the open debate of **Session**

Michael Holdsworth, Professor, Head of Plant and Crop Science Division, **University of Nottingham**, Loughborough, UK.

Pioneered molecular and biochemical studies to show the importance of the N-end rule pathway of ubiquitin-mediated targeted proteolysis in plant growth and development (PNAS 2009, TICB 2014) Discovered the N-end rule mediated molecular-mechanism of oxygen sensing in plants and identified the first plant substrates of the pathway (Nature 2011), and used this information to develop flood-tolerant barley (Plant Biotech J 2016.
Demonstrated for the first time that oxygen sensing via the N-end rule pathway controls photomorphogenesis (Current Biology 2015). Identified a highly novel N-end rule mediated molecular mechanism of nitric oxide (NO) sensing in plants (Molecular Cell 2014). Identified key genetic and biochemical components determining seed quality (Development 2000, EMBO J 2002, PNAS 2002). Led international efforts to advance systems-based approaches to understand seed germination (ERANET vSEED 2009-12) and the role of targeted proteolysis in plant-environment interactions (ERACAPS N-vironment 2014-17), contributing to the development of mathematical and computational models describing plant hormone perception (PNAS 2012, EMBO J 2011). Pioneered computational approaches to define gene networks controlling seed dormancy and germination (PNAS 2011, Plant Physiology 2013, PNAS 2014), and established the development of user-friendly web-based community resources for gene network interrogation (vseed.nottingham.ac.uk).

The N-End Rule Pathway of targeted proteolysis controls plant-environment interactions

Our recent work uncovered the simple biochemical mechanism that plants use to simultaneously sense oxygen and nitric oxide (NO), through the N-end rule pathway of ubiquitin-mediated proteolysis [1,2]. The AP2-domain ERFVII transcription factors were shown to be substrates of this pathway, with conditional stability based on the oxidation status of Cys-2 providing a homeostatic response mechanism to changes in oxygen and NO levels. This mechanism is used by plants to measure important ecological cues to protect the stem cell niche and enhance survival [3]. I will discuss our attempts to understand how plants use this unique and evolutionarily ancient branch of the Ubiquitin Proteasome System to perceive environmental change through sensing fluctuations in both gases. I will also provide evidence that this mechanism includes not only ERFVII substrates, but a cohort of other unrelated proteins, allowing a rapid response to changes in gas levels at the proteome level. Although the N-end rule pathway is ancient, evolution of ERFVIIs and other substrates occurred relatively recently in the land plant lineage.
1. Gibbs et al Nature 2011 / 2. Gibbs et al Molecular Cell 2014 / 3. Abbas et al Current Biology 2015

Moderator of the open debate of **Session 1**

Isabelle Jupin, Director of Research, **Institut Jacques Monod - CNRS- Univ Paris-Diderot,** Paris, France.

After graduating from the Ecole Normale Supérieure in Paris (France), I obtained my Ph.D. from Strasbourg University in 1990. I then undertook a post-doctoral stay at the Rockefeller University in New-York (USA) in the laboratory of Plant Molecular Biology headed by Prof. Nam-Hai Chua, and obtained a CNRS scientist position at the Institut des Sciences Végétales in Gif-sur Yvette (France). In 1995, I moved to the Institut Jacques Monod in Paris, where I am now a CNRS Research Director, heading the team of Molecular Virology since 1998. The main interests of our team concern the host / virus interactions, using a simple and well-characterized plant virus, Turnip yellow mosaic virus, as a model system. In recent years, we were particularly interested in deciphering the roles of ubi-and de-ubiquitylation events in the regulation of viral replication.

Viral deubiquitinases (DUBs) : new players in the regulation of plant viral infections ?

Selective protein degradation via the ubiquitin-proteasome system plays an essential role in many major cellular processes, including host-virus interactions. Recent results on Turnip yellow mosaic virus (TYMV) - a representative model of plant RNA viruses, have highlighted an unprecedented connection between viral infection and the ubiquitin-proteasome system, as TYMV was found capable of interfering with protein degradation through its encoded deubiquitinase (DUB) activity, a finding without precedent in plant viruses. Moreover, the DUB activity was also found critical for viral infectivity. Biochemical and structural analyses of TYMV DUB revealed very peculiar features as compared with its closest relatives, as it displays a specificity towards particular substrates, including the viral polymerase which can thus be protected from degradation. The importance of the viral DUB for viral infection will be discussed, as well as possible strategies to interfere with its function.

Núria Sànchez Coll, Ramon y Cajal Researcher, **Centre for Research in Agricultural Genomics (CRAG)** CSIC-IRTA-UAB-UB, Cerdanyola Del Vallès, Barcelona, Spain.

See his CV at the Scientific Committee section.

Chair of the SESSION 1

Claus Schwechheimer, Full Professor, Plant Systems Biology - **Technical Univeristy of Munich,** Freising, Germany.

See his CV at the Scientific Committee section.

The role of neddylation and deneddylation in plants

The ubiquitin-like protein NEDD8 is an 8 kDa protein that can be conjugated to and deconjugated from proteins through biochemical mechanisms highly related to the mechanisms of ubiquitylation and deubiquitylation. NEDD8 is best known for its role as a modifier of the cullin subunits of cullin-RING-type E3 ubiquitin ligases, an essential modification in higher eukaryotes. NEDD8 is deconjugated from cullins by the COP9 signalosome. Studies on a second NEDD8 deconjugating enzyme, DENEDDYLASE1, have revealed that, besides cullins, there must be many other NEDD8 modified proteins. The identity of these modified proteins as well as the biochemical role of this modification has remained elusive. Although the strong biochemical phenotype of den1 mutants from Arabidopsis suggest that DEN1 has a major function in plant development, den1 mutants only display phenotypes in sensitized backgrounds. We have previously uncovered that Arabidopsis AXR1 is one major NEDD8-modified protein in Arabidopsis. More recently, we could reveal the biochemical processes underlying AXR1 modification and through this analysis gain insights into the regulatory role of DEN1 in plant development. We can also present evidence that the corresponding mechanism may also hold true for other, non-plant species.

Peter Bozhkov, Professor of Biochemistry, Dept Chemistry and Biotechnology, **Swedish University of Agricultural Sciences and Linnean Centre for Plant Biology**, Uppsala, Sweden.

Peter Bozhkov graduated St.Petersburg Forestry Academy with a Master degree in Biology in 1987. He was awarded his PhD in 1994 for research in plant embryogenesis, and was soon appointed as a director of laboratory investigating biosynthesis of anticancer compounds in plant cells at the St. Petersburg Chemical-Pharmaceutical Institute. Owing to economic collapse and severe budget cuts in Russian science, Bozhkov decided to relocate his research and joined Swedish University of Agricultural Sciences in Uppsala in 1997. He became an Associate Professor in 2009 and then a Full Professor in 2015. Peter Bozhkov was among the first scientists who had demonstrated importance of cell death for plant life and discovered unique mechanisms regulating death of plant cells. Recently, he embarked on studying how intracellular breakdown of macromolecules and organelles contributes to plant development, aging and stress response. During his research carrier, Bozhkov established a strong collaborative network, served editorial boards of leading international journals, gave plenary and keynote talks on numerous occasions and taught students at Swedish, South Korean, Brazilian and Chinese universities.

Autophagy In Development

Animals have evolved sophisticated machinery to remove apoptotic bodies and clean up necrotic debris for damping inflammatory response. Plants appear more pragmatic, as they utilize dying and dead cells to construct their bodies, as well as to store and transport nutrients, hormones, and secondary metabolites. The presence of rigid cell walls and the absence of phagocytosis permit cell corpses to stay post-mortem for a long time. Disassembly of plant cells during developmental programmed cell death (PCD) is likewise a lengthy process, whereupon the cytoplasm is gradually removed by lytic vacuoles. This mode of cell death was therefore called vacuolar cell death. We have found that autophagy plays a central role in the execution of vacuolar cell death in the terminally-differentiated embryonic cells, since genetic suppression of autophagy switched the mode of cell death to necrosis causing early developmental arrest.

It is now well known that yeast, worms, flies and mammals with enhanced level of autophagic flux live longer, whereas suppression of autophagy results in premature death or shortened lifespan. In plants, suppression of autophagy has been shown to jeopardize resistance, impair yield and accelerate senescence. We have engineered Arabidopsis plants with enhanced autophagic flux. Stimulation of autophagy improves stress resistance, delays aging, promotes vegetative growth and increases both seed set and seed lipid content. This study provides experimental paradigm for the enhancement of autophagic flux in Arabidopsis and demonstrates its efficiency for improving plant production.

Giovanna Serino, Associate Professor at **La Sapienza University**, Roma, Italy.

See his CV at the Scientific Committee section.

Water stress regulates Cullin-Ring Ubiquitin Ligase neddylation in Arabidopsis thaliana

Cullin-RING ubiquitin ligases (CRLs) regulate different aspects of plant development. CRLs are activated by modification of their cullin subunit with the ubiquitin-like protein NEDD8 (NEural precursor cell expressed Developmentally Down-regulated 8) (neddylation) and deactivated by NEDD8 removal (deneddylation). The constitutively photomorphogenic 9 (COP9) signalosome (CSN) acts as a molecular switch of CRLs activity by reverting their neddylation status.
We have recently shown that the majority of cullin proteins are progressively neddylated during the late stages of seed maturation and become deneddylated upon seed germination. This developmentally regulated shift in the cullin neddylation status is absent in csn mutants, suggesting that CSN and its cullin deneddylation activity are required to sustain seedling development in Arabidopsis.
Here, we will present new evidence showing that csn mutants are desiccation sensitive and that water loss promotes cullin neddylation, indicating that both external and internal cues are able to regulate CSN activity and CRL neddylation status.

Nico Dissmeyer, Principal investigator and research group leader at **Leibniz Institute of Plant Biochemistry (IPB)** & ScienceCampus Halle - Plant-Based Bioeconomy, Halle, Germany.

Nico Dissmeyer studied biochemistry and philosophy with an emphasis on bioethics at the University of Tübingen, Germany. There, he worked in the Center for Plant Molecular Biology (ZMBP) in the Department of Developmental Genetics headed by Gerd Jürgens. He moved on via Oregon State University, Corvallis, USA and the Free University of Berlin to study Biochemistry and Biophysics. He joined the Max Planck Institute for Plant Breeding Research at Cologne, Germany, where he started to analyze the requirement and molecular function of core cell cycle regulators in "normal" and stressed cell division when doing his Diplom in biochemistry. He received his PhD in biochemistry from the University of Cologne in 2009 and was awarded summa cum laude. For his PhD thesis, he also received the Elisabeth Gateff Award 2010 of the German Genetics Society. From 2009 to 2011, he was a postdoctoral fellow at the Institut de Biologie Moléculaire des Plantes of the CNRS at Strasbourg, France. In spring 2011, he got appointed an independent junior research group leader at the Leibniz Institute of Plant Biochemistry (IPB) at Halle, Germany, where he is now heading the junior research group of the ScienceCampus Halle – Plant-Based Bioeconomy since October 2011. Since 2012, Nico is a Young Leaders in Science fellow of the Ernst Schering Foundation and became an elected member of the Global Young Academy in 2014. Current research focus is on the molecular basis of protein–protein recognition and targeted protein degradation. Most of the laboratory work is done in the currently best-studied plant model organism mouse-ear cress (Arabidopsis thaliana). His lab also has strong interests in translational science and one focus is on switchable systems for protein expression in living plants.

N-terminal protein targeting in proteostasis and for switchable phenotypes

The ON/OFF status of functional proteins is precisely controlled by checkpoint-like protein quality control (PQC) mechanisms sensing erroneous or mislocalized proteins and if “used up” after their action and thus need to be removed from the cell. This directly tethers targeted proteolysis to substrate protein function(s) on the level of their abundance (proteostasis). We are particularly interested in the N-end rule pathway, which is involved in targeted protein degradation. In plants, this pathway is important for breakdown of storage reserves in seeds, enabling germination, seedling establishment and growth. If mutated, it adversely influences plant development on multiple levels such as leaf and shoot development, flower induction, cell division, and possibly also plant-pathogen interaction. The molecular function of the pathway is only poorly understood and solely a small class of transcription factors has been identified as substrates with an important role in oxygen sensing. We have developed several tools for protein stability surveillance and study N-end rule enzymes (E3 ligases, etc.), substrate candidates and protein expression “on demand” as application (Faden et al., Nature Communications, 2016). Our work aims at understanding molecular functions and biological roles of the N-end rule by characterizing enzymatic components and physiological substrates (www.dissmeyerlab.org)

Giovanna Serino, Associate Professor at **La Sapienza University**, Roma, Italy.

See his CV at the Scintific Committee section.

Chair of the SESSION 1

Jose L. Crespo, Tenured Scientist (CSIC) **Instituto de Bioquímica Vegetal y Fotosíntesis**, Sevilla, Spain.

I received my Bachelor of Science in Biology (1993) and my Ph. D. in Biology (1999) from the University of Seville, Spain. I completed a post-doctoral stay (1999-2003) at the Biozentrum, University of Basel, Switzerland, working in the laboratory of Prof. Michael N. Hall about the regulation of the TOR signaling pathway in the model yeast Saccharomyces cerevisiae. In 2003 I moved to the "Instituto de Bioquímica Vegetal y Fotosíntesis (IBVF-CSIC)" in Seville holding a "Ramón y Cajal" contract to investigate the TOR pathway in photosynthetic organisms using the unicellular green alga Chlamydomonas reinhardtii as model system. In 2008 I got a permanent position (Tenured Scientist-CSIC) at the IBVF to work on the control of cell growth and autophagy by TOR in Chlamydomonas. Our current research is focused on the study of autophagy and its regulation by redox signals in Chlamydomonas as well as the biotechnological potential of this catabolic process in microalgae.

Autophagy in algae

Autophagy is a membrane-trafficking process by which unnecessary or damaged cellular components are degraded to maintain the cellular homeostasis. This degradative process is characterized by the formation of double membrane vesicles, called autophagosomes, which engulf the cellular material that is targeted to the vacuole. ATG8 protein plays an essential role in autophagosome formation and has been widely used as autophagy marker. We have described the autophagy process in the model green alga Chlamydomonas reinhardtii. Using ATG8 as autophagy marker, we demonstrated that autophagy is induced in Chlamydomonas by a wide range of stress conditions including nutrient limitation, endoplasmic reticulum stress, oxidative stress, photo-oxidative damage or metal toxicity. Therefore, autophagy can be considered as an adaptive response to stress in Chlamydomonas. Our results also revealed a link between the production of reactive oxygen species (ROS) and autophagy activation in Chlamydomonas. Mounting evidence suggests that ROS may play a role in the control of autophagy by regulating the activity of ATG4, a cysteine protease with an essential function in ATG8 maturation and thus in autophagosome biogenesis. We unraveled the molecular mechanism for the redox regulation of Chlamydomonas ATG4. We demonstrate that ATG4 activity depends on the redox potential and is regulated by the formation of a disulfide bond controlled by thioredoxin. In addition, we found that ROS led to the oxidation and consequent inactivation and aggregation of ATG4.

Luz Irina A. Calderón Villalobos, Head of Research Group "Signal Integration" Molecular Signal Processing Department, **Leibniz Institute of Plant Biochemistry (IPB)**, Halle, Germany.

Dr. Luz Irina A. Calderón Villalobos is a plant biochemist exploring small molecule sensing by the ubiquitin machinery. Luz Irina studied Microbiology (1992-1997) at the University of Los Andes in Bogotá, Colombia, and as a Young Investigator Fellow at the International Center for Medical Research and Training (CIDEIM), Cali, Colombia she studied the molecular epidemiology of tuberculosis, and the tropical infectious disease Leishmaniasis. After a traineeship in the Respiratory Research Division at Boehringer Ingelheim in Germany and Austria, Luz Irina joined the Department of Developmental Genetics at the Center for Molecular Biology of Plants in Tübingen (ZMBP) (2001) as a graduate student, where she immersed herself in the ubiquitin field seeking to understand how the ubiquitin proteasome system controls proteostasis in Arabidopsis. Subsequently, she received her PhD from the University of Tübingen (2006), and moved to USA as a post-doctoral fellow (2006-2010) researching the connection between the phytohormone auxin and the ubiquitin machinery. Specifically, she contributed to structure-function elucidation of the auxin receptor, described at the time as the 'Holy Grail' of plant biology. Since 2011, Dr. Calderón Villalobos has led the research group Signal integration at the Leibniz Institute of Plant Biochemistry (IPB) in Halle (Saale), Germany.

Differential Integration of E3 ligase-Target-based Co-Receptor Systems for Hormone Sensing

The ubiquitin-proteasome system is essential for cellular signaling in plants. The phytohormone auxin controls plant fitness by directly modulating the activity and stability of transcription factors in a nuclear, short and very rapid signal cascade. Specific degradation of unstable AUX/IAA transcriptional regulators increases gene expression via the de-repression of transcriptional activators. An SCF-type E3 ubiquitin ligase, SCFTIR1/AFBs, requires the binding of auxin to promote the recruitment, ubiquitylation and degradation of AUX/IAAs. Interestingly, this hormone-mediated E3-target mechanism constitutes in itself a sensor or co-receptor system for intracellular auxin levels. We propose that the combinatorial diversity of various co-receptors gives rise to a spectrum of auxin sensors with enough plasticity to continually assess hormone fluctuations. Although auxin is anchored in the TIR1 auxin binding pocket, AUX/IAA proteins seem to greatly determine the affinity of the auxin sensor. Currently, we are investigating biochemically the diversity and determinants for SCFTIR1/AFB1-5 and AUX/IAA associations, and we propose an explanation for the broad impact of auxin gradients in planta. Moreover, our studies in plants could contribute to explore the potential of small molecule-triggered protein-protein recognition for drug discovery.

Pascal Genschik, Directeur de Recherche DR1 at **IBMP CNRS**, Strasbourg, France.

P. Genschik, PhD (1994) University Strasbourg FR; plant science; Post-doc (1994-1997) Friedrich Miescher, Basel CH, RNA metabolism in plant and human; Group Leader at IBMP-CNRS (1998) Strasbourg FR and became the Scientific Director of the Institute (2005-2012). He obtained national and international grants (such as an ERC advanced grant, 2013) and participated in several consortium including the Network of Excellence (Rubicon). He became also elected EMBO member (2012). His laboratory has a long history of providing new knowledge in the field of post-translational regulation in plants. Amongst others studies, his group unraveled the post-translational mechanisms regulating EIN3 proteolysis in ethylene signalling, the role of proteolysis in GA-signalling (role of DELLA under stress), but also ABA-signalling. Furthermore, the group characterized several novel E3 ligases that are instrumental for host pathogen responses, maintenance of genome integrity upon UV stress and permitting cell cycle phase transitions. The group is currently focused on a novel mechanism by which viruses hijack the ubiquitin pathway to suppress the host anti-viral silencing response.

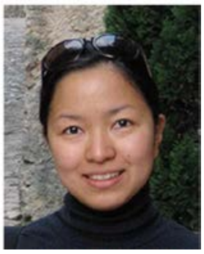
Post-translational control of ARGONAUTE proteins

Post-transcriptional gene silencing (PTGS) mediated by short interfering RNAs (siRNAs) is an evolutionary conserved antiviral defense mechanism in higher plants and invertebrates. In this process, viral-derived siRNAs are incorporated into the RNA-induced silencing complex (RISC) to guide degradation of the corresponding viral RNA. In Arabidopsis, the key component of RISC is the ARGONAUTE1 (AGO1) protein, that binds siRNA duplexes resulting from the DICERLIKE4/2 (DCL2/4) cleavage activity, and acts by using one strand of the duplex to cleave and/or translationally repress the viral RNA in a sequence specific manner. In planta, AGO1 levels are modulated at both post-transcriptional and translational level, and our work as recently uncovered the importance of both ubiquitylation and autophagy in AGO1 turnover. This process is recapitulated upon infection by the Turnip Yellow Virus (TuYV), which harbors the P0 suppressor of silencing, carrying a F-box motif. During infection, K63 ubiquitylation of AGO1 is carried out by the SCFP0, which ultimately routes AGO1 to the vacuole. Using an inducible P0 transgenic line, we have generated a P0 suppressor screen that allowed us to identify mutants affected in the P0-dependent degradation of AGO1. Here we will present one of these mutants corresponding to an intragenic allele of AGO1, in a previously uncharacterized domain of the protein.

Andreas Bachmair, Professor, Dept. of Biochemistry and Cell Biology, **Max F. Perutz Laboratories, University of Vienna**, Vienna, Austria

Dr. Bachmair obtained his PhD in Biochemistry in 1984. Afterwards he was a Postdoctoral Fellow (EMBO) and Postdoctoral Associate at the Massachusetts Institute of Technology, Cambridge, USA, and from 1989 to 1991 he became an Alexander von Humboldt Fellow and Max Planck Foreign Fellow at the Max Planck Institute for Plant Breeding Research, Cologne, Germany. Between 1991 and 1996 he was an Assistant Professor, Institute of Botany, Univ. of Vienna, and in 1996 he got his habilitation in Genetics and Biochemistry. From 1997 until 2002 he was an Associate Professor, Institute of Botany, Univ. of Vienna. Afterwrads, he became a Group Leader at Max Planck Institute for Plant Breeding Research, Cologne, Germany. Since 2008, he is Associate Professor at Dept. of Biochemistry and Cell Biology, Max F. Perutz Laboratories, Univ. of Vienna.

Chair of SESSION 1



Erika Isono, Group leader, **Technical University of Munich,** Freising, Germany.

Dr. Erika Isono has studied Biology at the University of Tokyo in Tokyo, Japan, where she also stayed for her Master- and Doctoral thesis work on the biogenesis of the 26S proteasome in the yeast Saccaromyces cerevisiae under the guidance of Prof. Akio Toh-e. In 2006, after successfully obtaining her Ph.D., she moved to Germany to conduct her post-doctoral research, at the same time changing the topic to ubiquitin-dependent intracellular trafficking in the model plant Arabidopsis thaliana. With two JSPS-stipends, Erika first worked at the University of Tübingen and then moved in 2008 to the Technical University of Munich with Prof. Claus Schwechheimer as her post-doc mentor. In 2010, Erika started her own research group at the Technical University of Munich. Her group works on the molecular mechanisms of ubiquitin-dependent endocytic- and autophagic protein regulation that have important regulatory functions in plants.

Regulation of Protein Ubiquitination in Endosomal Trafficking

For proper growth and development, it is essential for the plants to be able to convert extracellular signals to intracellular signaling pathways via various transmembrane receptors. One of the mechanisms that allow a tight regulation of these processes is the ubiquitin-dependent selective protein degradation. My group is interested in the molecular and physiological function of deubiquitinating enzymes (DUBs) that hydrolyze ubiquitin chains and thereby can influence the degradation of key regulatory proteins. AMSH proteins are conserved metalloprotease DUBs that are involved in endocytic protein degradation. Our previous work has shown that the Arabidopsis AMSH proteins are important for the removal of ubiquitinated membrane proteins and are essential for plant growth and development. Moreover, AMSH proteins and its interacting ESCRT-III machinery are important for autophagy and also for autophagy-dependent pathogen defense in plants. Using genetic, biochemical and cell biological approaches, we identified multiple interactors of the AMSH proteins and aim to elucidate the molecular mechanisms of DUB regulation and to understand how these enzymes contribute to important aspects of pnt physiology.

Marisa S. Otegui, Professor, **University of Wisconsin,** Madison, USA.

My research to date has focused on the mechanisms that regulate membrane and protein trafficking and degradation in plants and how they control plant development. We have combined multiple approaches to understand the regulation of endosomal trafficking and degradation of membrane proteins, and the delivery of proteins and membranes to vacuoles. My research program relies heavily on cell imaging. We use both fluorescence–based imaging and transmission electron microscopy and electron tomography of high-pressure frozen cells. Electron tomography allows us to reconstruct three-dimensional features of the cell at ~6nm axial resolution. I devote part of my time and effort to optimize techniques for performing electron tomography and cryofixation of biological samples. This helps us to overcome some of the major current limitations in imaging endosomal trafficking and enable us to visualize directly protein coats on membranes, measure membrane curvature during vesicle formation, and perform structural characterization of membrane trafficking mutants.

Endosomal Sorting of Membrane Proteins For Degradation

Endocytosis and endosomal trafficking control the turnover of plasma membrane proteins, which is a critical process for development, physiological responses, and cell survival. Ubiquitinated plasma membrane proteins (cargo) are internalized by endocytosis and delivered to endosomes, where they are sorted by the ESCRT (Endosomal Sorting Complex Required for Transport) machinery into endosome intralumenal vesicles (ILVs) for their final degradation in vacuoles/lysosomes. We have analyzed ILV formation in plant endosomes by electron tomography and identified membrane-bending intermediates in wild type and ESCRT mutants. To understand how membrane geometry affects the sequestration of membrane cargo proteins, we ran simulations based on experimentally derived diffusion coefficients of a plant ESCRT cargo protein and electron tomograms of Arabidopsis thaliana endosomes with multiple ILV budding events. These results allowed us to estimate important parameters such as the escape time of cargo proteins from forming ILVs, the predicted strength of additional barriers to prevent cargo escape during ILV formation, and the role of ESCRT proteins in these processes.

Wednesday, September 28th, 2016

Session 2: Industrial crops research and applications

Peter Bozhkov, Professor of Biochemistry, Dept Chemistry and Biotechnology, **Swedish University of Agricultural Sciences and Linnean Centre for Plant Biology**, Uppsala, Sweden.

See his CV at Session 1.

Chair of the SESSION 2

Ari Sadanandom, Professor of Plant Molecular Sciences, **University of Durham**, Durham, UK.

Ari Sadanandom gained considerable experience studying plant-environment interactions whilst developing his group at the Universities of Glasgow, Warwick and now Durham. Ari Sadanandom's research group wants to understand how protein modifications control plant growth and adaptation to their environment. Proteins can be modified by the addition of chemical groups and this changes the way they work. An example is the DELLA protein, which underpins crop productivity as part of the green revolution in wheat. The stability of the DELLA protein is controlled by ubiquitination (a type of protein modification). Increased DELLA protein stability produces dwarfism in wheat-the essence of increased yields we see today. The current focus of Ari's research is to understand how protein modifications influence plant disease. When plants are under attack by pathogens, lots of yield processes are halted and this has a big impact on productivity. If we understood more about how regulatory mechanisms like protein modification influence this yield arrest, this would enable us to develop crops with better productivity without compromising crop immunity. Ari Sadanandom is also director of the Durham Centre for Crop Improvement technology, a multi-disciplinary research centre that works with Agriculture industry to develop technology that is effective in field conditions.

Exploiting protein modification systems to boost crop productivity

The productivity of crops worldwide is both a challenge and a real threat to the world population, which will reach 9 billion by 2050. Rice is the major crop for the world's poorest and therefore have the greatest impact on food security. Up to 75% of rice yields are lost due to lack of water and high salt levels. In order to combat these threats new rice varieties equipped to survive in these conditions needs to be urgently developed. The new rice varieties would overcome their natural response that is to stop growing when facing environmental stress.

This is a considerable challenge because rice production is water-intensive. If we can make the production of rice more efficient, then the impact on the water supply will be correspondingly less acute: a particular benefit in areas with unpredictable rainfall. To answer this problem Professor Sadanandom has gathered an inter-disciplinary team including geneticists, biologists and plant breeders with a main aim to identify protein modification mechanisms which control rice responses to adverse environments and develop a drought-resistant and less salt-sensitive strain of rice. If successfully developed, this new generation of crops has the potential to raise both yield and quality. More widely, the data generated by this project could provide the basis for the technology to be applied to other cereals varieties.

Federico Guillermo Witt Sousa, Production Director, **AlgaEnergy S.A.**, Madrid, Spain.

Federico Witt, Ph.D. in Biology, has over 25 years' experience on microalgae research and development. Currently, he is the Production Director of AlgaEnergy S.A., a Spanish Biotech company aimed to the production of microalgae biomass and a number of high value products extracted from it. He manages two industrial production facilities and also carries out R&D activities on the development of new, high value microalgae-based products. During 2013 and 2014 Dr. Witt was Technical and R&D Director of Blue Water Solutions, S.L. His activities there focussed on the development and implementation of a novel waste water treatment system that successfully combined filamentous macroalgae with a helophyte hydroponic culture.

Formerly, he had worked at the Spanish Scientific Research Council, the Autonomous University of Madrid, the University of Cordoba and the University of Darmstadt (Germany), where he had developed research on microalgae photobiology, ion transport systems, protein biochemistry, C and N plant metabolisms (enzymes, pathway regulatory processes), physiology of photosynthesis, cell ultrastructure and algae cultivation methods. He is co-author of four patents and, in general, he is familiarized with the implementation of ecophysiological concepts for optimized microalgal production. Moreover, he has experience on non-conventional wastewater treatment systems for small municipalities, communities, hotels and rural food industries.

Biofixation of CO2 from industrial flue gases by microalgae and its transformation into products of commercial interest

The CO2ALGAEFIX project (2011-2015), an initiative promoted and led by AlgaEnergy, was part of the portfolio approved by the European Commission and co-financed within the frame of the LIFE+ 2011 Program. Under the title CO2 CAPTURE AND BIO-FIXATION THROUGH MICROALGAL CUTURE, it was aimed to the biofixation of CO2 from industrial flue gases and its transformation into bio-based products of commercial interest.The Consortium set up included also Iberdrola, Exeleria, the Andalusian Energy Agency and Madrid Network, as well as the universities of Seville and Almería. This program involved the build-up and operation of a microalgae cultivation plant planned to occupy 10,000 m2, with 1,000,000 liters of microalgal culture volume and a capacity to produce 100 tons of dried biomass per year. The Plant is located alongside a Combined Cycle Power Plant in Arcos de la Frontera (Cádiz), the largest one in Spain and the second in Europe with 1.6 GW of installed potency.
AlgaEnergy still harnesses the built facilities, utilizing them as the main production plant of the company. Moreover, new photobioreactors are being installed that increase the production capacity of the plant. The biomass generated there is used for different sectors, including aquaculture, human food, animal feed, cosmetics and agriculture.

Simon Hawkins, Professor, **Université de Lille**, CNRS, UMR 8576 – UGSF - Unité de Glycobiologie Structurale et Fonctionnelle, Lille, France.

(See his CV at the Scientific Committee Section)

Cell wall research in fiber plants

Flax (Linum usitatissimumum L.) plants are a source of high quality cellulose-rich bast fibers that have been traditionally used in textiles (linen) and are now being increasingly exploited in the composite materials and construction industries as a more environmentally-friendly alternative to glass fibers and mineral wool thermal insulation. One of the biggest challenges to a more widespread utilization of flax and other plant fibers (e.g. hemp) in these developing markets is a better understanding of the different factors underlying the observed variability in fiber quality. Fiber quality not only depends upon post-harvest processing (retting, mechanical extraction, spinning, incorporation into composites etc.) but is also intimately associated with the remarkable cell wall structure of these cells, rich in crystalline cellulose and containing only very low amounts of lignin. Recent advances in genomics, transcriptomics, proteomics, functional approaches and imaging techniques are currently allowing us to make significant advances in our knowledge about flax cell wall biology, and the different genetic and environmental factors that can impact on fiber structure. Different examples will be rapidly presented to illustrate this point.

Chair of the SESSION 2

Hannele Tuominen, Associate Professor, **Umeå Plant Science Centre**, Umeå, Sweden.

Hannele Tuominen received a PhD at the Swedish University for Agricultural Sciences in Umeå, Sweden and is, after a post doc period at the Insitute of Biotechnology in the University of Helsinki in Finland, active as an associate professor at Umeå Plant Science Centre (UPSC) in Umeå, Sweden. She has a long-term interest in wood formation in forests trees and in the herbaceous model system Arabidopsis thaliana which also makes quite a bit of "wood" after prolonged growth periods. Her research focuses on cell death in xylem elements and how this impacts on wood properties and biomass production of forest trees. Her current interests include comparative studies on cell death signaling and function of proteases in Arabidopsis, Populus and Norway spruce. She has coordinated the research program BioImprove which aimed at improving bioprocessing properties of Populus trees, and is currently coordinating a research program on natural variation in wood properties and saccharification of Populus trees.

Improved biomass and bioprocessing properties of lignocellulosic forest feedstocks

Forest tree lignocellulose is an attractive feedstock for production of second generation bioethanol due to its high abundance and the fact that it does not interfere with food production. Unfortunately the lignocellulosic rawmaterial is poorly susceptible to pretreatment and enzymatic hydrolysis during saccharification due to complex structure and chemical composition of the lignocellulose. We have taken a large-scale approach to identify molecular mechanisms that control biomass production and chemical composition of the wood in forest trees, and how this knowledge can be utilised to improve saccharification potential and production of materials, biofuels and green chemicals from the lignocellulosic raw material. We have produced a large number of genetically modified hybrid aspen trees (Populus tremula x tremuloides) and characterized them in greenhouse conditions for biomass production, wood chemistry as well as susceptibility to pretreatment and enzymatic hydrolysis during saccharification on a laboratory-scale. Some of these lines are also tested for their performance in field conditions. The various transgenic lines show a wide span in wood chemical composition and biomass production as well as saccharification potential. These analyses have given us information about the function of individual genes, including a few proteases, as well as pinpointed the important role of not only wood chemical composition but also xylem anatomy in control of saccharification potential. The collection of the transgenic Populus lines will form a source of improved Populus feedstocks as well as a knowledge platform for future efforts to tailor forest feedstocks with improved properties during bioprocessing.

Moderator of the open debate of **Session 2.**

Luisa M. Trindade, Group Leader, Associate Professor, **Wageningen University**, Wageningen, The Netherlands.

Luisa Trindade is an Associate Professor of Plant Breeding at Wageningen University in The Netherlands. She is a plant geneticist, and molecular biologist, and conducts research on genetic improvement of biobased crops, in particular fibre crops such as maize and miscanthus, for biobased products. She is Associate Editor of the Bioenergy Research Journal.

Developing crops for a biobased economy

As we enter the third millennium, it seems difficult to ignore the societal and environmental consequences of our reliance on finite fossil fuels. Alongside the quest for energy security, climate change and its detrimental effects on the environment and agriculture have instigated a global pursuit for sustainable alternatives. With the advent of biorefinery technologies enabling plant biomass to be processed into industrial products, many researchers set out to study and improve candidate biomass crops. Many of these candidates are C4 grasses, characterized by a high productivity and resource use efficiency. In this talk the suitability of lignocellulosic biomass from different grasses, including miscanthus, for biofuels and other industrial applications will be discussed. The genetic diversity available for biomass quality in grasses and how can this be used to develop optimized crops will also be presented.

Gil Gorchs Altarriba, Tenure-track 2 lecturer, Departament d'Enginyeria Agroalimentaria i Biotecnologia, **Universitat Politècnica de Catalunya (UPC)**, Barcelona, Spain.

AE (Crop Sciences; Universitat de Lleida – UdL 1984), PhD (Agronomy; UdL 2006), currently he has a Tenure-track 2 lecturer (field crops) at the Department of Agro-food Engineering and Biotechnology at the Universitat Politècnica de Catalunya (UPC – Barcelona Tech, 2013-), in the area of Vegetal Production. He started his career as a technical responsible for field experiments in seed company Semillas Fitó (1985), focused on the improvement of new varieties to obtain agricultural products with higher yield and quality. He gained a place at the Escola Superior d'Agricultua de Barcelona – ESAB (UPC currently school; 1987 – 2006) to teach cropping systems and technical management of farms. His scientific career at ESAB has moved from being exclusively focused on agronomy of field crops (cereals, fodder, protein and fibre crops), in key sustainable aspects such as crop rotation, tillage, and cultivation technology, to non-food applications of biomass (i.e.: innovative technologies for comprehensive use of hemp) and different aspects of precision agriculture. Related to all these subjects, he has participated in nine research projects and supervised several undergraduate and master theses. At present he is currently working on the feasibility of using images acquired with a COTS camera for agricultural applications.

Actual and innovative cultivation techniques for comprehensive use of hemp

Hemp (Cannabis sativa L.) has long been a traditional crop in Europe. After the progressive decline in cultivated area experienced until the 1950s (except in France and to a lesser extend in Spain) the crop was reintroduced in many European countries in the late 1990s not always successfuly. Hemp is a multiuse as well as a multifunctional crop that shows a good adaptation to vast European areas. Hemp supplies not only food products but also raw material to a large variety of traditional and innovative industrial products including composites, paper, textiles, insulation and biofuel. The sustainability of hemp products and the benefits of the crop -considered a relatively simple, low input crop as well as an excellent precedent for cereals- might make hemp an important crop in the near future. Nonetheless, a better understanding of how agronomic factors affect yield potential and quality for each intended end use destination is needed to ensure the expansion of the hemp crop.

L. Maria Lois, CSIC Assistant professor, **Centre for Research in Agricultural Genomics (CRAG)** CSIC-IRTA-UAB-UB, Cerdanyola Del Vallès, Barcelona, Spain.

See his CV at the Scientific Committee section.

Chair of the SESSION 2

Aart Willem van Vuure, Associate Professor, **KU Leuven**, Leuven, Belgium.

Aart van Vuure holds a MSc degree in Chemical Engineering (U Twente) and a PhD in Materials Engineering (KU Leuven, 1997) and is an experienced senior researcher. He has substantial technical know-how in the field of natural fibre composites, composite design and composite sandwich structures. During his PhD he worked a.o. on the study of the vibrational behavior of sandwich structures with the Mechanical Engineering Department. He is the coordinator of the Natural Fibers and Bio-composites sub-group of the CMG group, and he has been active in this role now for more than 10 years. Before this he worked in industry for almost 8 years in scientific research roles. He e.g. worked for 5.5 years in the Unilever labs in Port Sunlight, UK on the rheology of structured fluids and on human hair fibres.

The potential of natural fibres in composites

As strengths of natural fibres for composites, usually the following elements are quoted: Renewability, low Carbon footprint, moderate cost, low abrasiveness, health aspects, good specific mechanical properties (normalised to density) in longitudinal direction, acoustic and vibrational damping, low CTE and design aspects like natural look and feel. On the other hand, as weaknesses are seen: Moisture sensitivity, supposed variability, not-optimized interfaces, thermal degradation, non-linear stress strain behaviour, low transverse and shear properties, difficulties associated with presence of water during processing, not optimized preforms and difficulties to extract fibres without damage. Research is logically focusing on the shortcomings, to allow these materials to fulfill their promise.

Ana María Lacasta, Associate Professor, **Universitat Politècnica de Catalunya (UPC),** Barcelona, Spain.

Dr. Ana Lacasta received her Ph.D. in Physics from the Universitat de Barcelona. She is Associate Profesor at the Physics Department of the Universitat Politècnica de Catalunya (UPC), head of the Fire Laboratory at the School of Building Constructions of the UPC and responsible of the research group GICITED (Interdisciplinary group on Building Science and Technology). Her main research interests and experience span a range of building performance themes such as thermal performance of building materials, fire behaviour, ventilation and acoustics. Usually she combines experiments in lab with in situ measurements and numerical simulations.
She is author of 57 papers (http://www.researcherid.com/rid/J-1063-2014) and has participated in more that 20 funded research projects. Currently, one of her main remarkable research lines is the development of thermal insulation materials based of vegetal pith. In this subject, she is leading the spanish project MEDULA "Use of plant pith to improve building higrothermal behaviour" and participates in the COST Action FP1404 "Fire safe use of bio-based building products".

Bio-based building materials

The building sector is moving towards new approaches to energy efficient design, which includes not only the decrease of the thermal transmittance of the building envelope but also the reduction of the embodied energy through the use of low embodied carbon and locally available building materials. By other hand, the expansion of the potential market for bio-based building materials and products could be a key opportunity for the European industry in the forestry, agricultural and biotechnological sector. Bio-based building projects are made from animal materials or plant materials. Some examples include pulp and paper, wood, and leathers along with crop based materials such as flax, hemp, bamboo and coconut fibres. Although bio-based materials can be found in a variety of applications in building construction, their use as thermal insulation products is becoming quite important. They offer numerous advantages in terms of environmental and even human health when compared to many fossil fuel based materials. Currently, there are several commercial examples of such materials, which are mostly based on industrial fibres (flax, hemp, kenaf, etc.), wood or sheep's wool. The use of food-crop by-products is less common, but might be an interesting alternative for some countries such as Spain, where industrial fibre production is very marginal.

José Pío Beltrán, President of **European Plant Science Organization,** Brussels, Belgium.

PhD in Chemistry Universidad de Valencia. He worked on plant-Pathogen interactions with Gary A. Strobel en la Montana State University, USA and molecular genetics of flower and fruit developmentdel at the Max-Planck-Institut für Züchtungsforschung in Köln with profs. Heinz Saedler and Hans Sommer. He isolated the Deficiens gen, the first homeotic regulator of floral organ identity described in higher plants. Prof. Beltrán is the Head of the Plant Reproductive Biology and Biotechnology at IBMCP. He has developed three patents to produce male sterility in plants, parthenocarpic tomato fruits and to increase the number of flowers in higher plants. He was Vicepresident of the Spanish Research Council. Elected Member "ad personam" del Advisory Life Sciences Working Group de la European Space Agency (ESA). He was Member of the Board of Governors of the Joint Research Centre of the European Union. He was President of the European Federation of Plant Biology Societies (FESPB). He is the President of the European Plant Science Organization (EPSO) since January 2014. He has published over one hundred research papers. He is the Director of different series of TV programs for the outreach of science, like "Trasfondo" and "Science in Our Lives" produced for the American Association of Educative Televisions.

Role of Plant Research in European Bioeconomy

Plant science can help to address societal challenges such as food and nutritional security and human health, mitigate and adapt to climate change, reduce energy use and contribute to renewable energy and to use more efficiently scarce resources. Plant research is central to develop a biobased economy. Fundamental, applied and translational plant research needs to be an intrinsic part of solutions given to the Societal Challenges in the research and innovation cycles such as the European Horizon H2020 and beyond. For these reasons EPSO supports science and scientists through our Working Groups, events and briefings on research programmes. Most importantly EPSO provides science advice to policy. The general strategy of EPSO to promote plant research in Europe will be presented.

PRACTICAL INFORMATION

Venue: CosmoCaixa Barcelona

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Conferences
Agora room on -2 floor

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SUGGESTED READING

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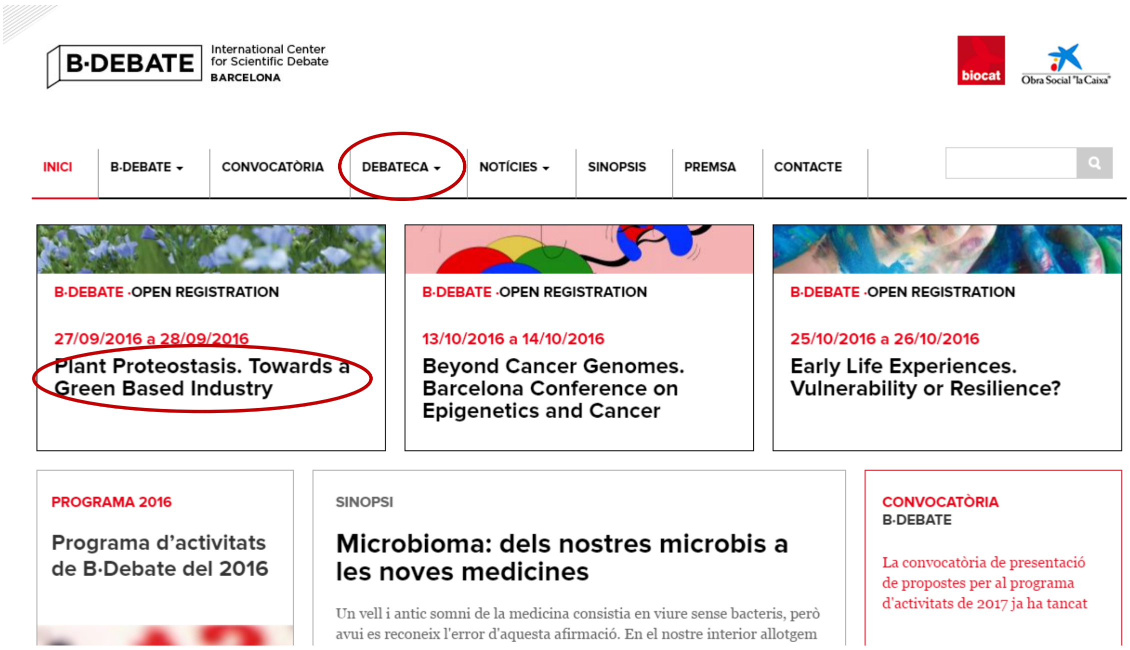
OUTCOMES

B·Debateca

On the website of **B·Debate**, you will find all the information related with the celebration of the meeting that includes reports, conclusions, scientific documents, interviews with the experts, speaker's CVs, videos, images, press documentation and other related materials. We invite you to visit the section **B·Debateca** on www.bdebate.org

Contents of the meeting "Plant Proteostasis. Towards a Green Based Industry"



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ORGANIZERS

B·Debate International Center for Scientific Debate Barcelona is a **Biocat** initiative with support from **"la Caixa" Foundation**. It drives first-rate international scientific debates, to foster dialogue, collaboration and open exchange of knowledge with prestigious national and international experts, to approach complex challenges of high social interest in life sciences. B·Debate sees debate as a powerful, effective way to generate knowledge and strives to help position Barcelona as a benchmark in generating knowledge a nd Catalonia as a country of scientific excellence.

B·Debate sees debate as a powerful, effective way to generate new knowledge. The debates are top-notch international scientific meetings featuring a selection of experts of renowned international prestige and scientists that work in Barcelona and Catalonia, moderated by scientific leaders. Since 2009 B·Debate has invited about 1200 recognized speakers and over 7.000 attendees. B·Debate seeks out answers to the challenges and needs of society in the field of life sciences, taking into account the complex, ever-changing conditions of this global world. The debates foster the integration of different disciplines of science and deal with such diverse topics as ageing, new therapeutic approaches to various diseases, innovative technology to improve knowledge of the human genome, food resources, new tools to integrate knowledge management, clinical genomics, neurosciences, climate change, and new energy sources, among others. The knowledge and results obtained through these events is spread throughout both the scientific community and general society through the various **B·Debate** channels and instruments.

More info: www.bdebate.org

The **Centre for Research in Agricultural Genomics (CRAG)** is an independent research institution located in the area of Barcelona (Spain), and devoted to leading-edge research in the molecular basis of genetic characters of interest in plants and farm animals and in the applications of molecular approaches for breeding of species important for agriculture and food production. Research at CRAG spans from basic science to applied studies in close collaboration with industry.
The CRAG forms part of the CERCA system of research centers of the Government of Catalonia, and is established as a partnership of four institutions: the Spanish National Research Council (CSIC), the Institute for Agri-Food Research and Technology (IRTA), the Autonomous University of Barcelona (UAB) and the University of Barcelona (UB). CRAG has been recognized as "Centro de Excelencia Severo Ochoa 2016-2019" by the Spanish Ministry of Economy and Competitiveness.

More info: www.cragenomica.es

The **COST Action PROTEOSTASIS** BM1307 is an European network that includes 28 European countries and collaborators in the USA. Its main objective is to facilitate research and collaborations in the fields of Ubiquitin/Proteasome, Ubiquitin-likes, autophagy and lysosomal systems in health and diseases. The Action coordinates and integrates the efforts made by more than 200 research teams to better understand protein homeostasis and to translate novel discoveries into products of clinical and/or economical value.

More info: www.cost-proteostasis.eu

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities. It allows researchers, engineers and scholars to jointly develop their own ideas and take new initiatives across all fields of science and technology, while promoting multi- and interdisciplinary approaches. COST aims at fostering a better integration of less research intensive countries to the knowledge hubs of the European Research Area. The COST Association, an International not-for-profit Association under Belgian Law, integrates all management, governing and administrative functions necessary for the operation of the framework. The COST Association has currently 36 Member Countries.

More info: www.cost.eu

COLLABORATORS

This B-debate counts with the financial support of the Spanish Ministry of Economy and Competitiveness, through the "Severo Ochoa Programme for Centres of Excellence in R&D" 2016-2019, awarded to the Centre for Research in Agricultural Genomics (SEV-2015-0533). This award given by the Spanish Government recognizes institutions from all areas of knowledge that perform cutting-edge research at global standards.

More info: www.mineco.gob

Agrisera is a Swedish company committed to serving the plant science community. We are developing catalog and custom antibodies and kits for proteins, hormones and other compounds. Our goal is to provide most comprehensive plant antibody catalog. One of our products, The Plant Cell Compartment Antibody Marker Set contains loading control antibodies as well as compartment markers for a wide range of plant species. Your scientific success is our focus.

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CosmoCaixa offers interactive, enjoyable science and an open door for anyone who is eager to learn and understand and who never stops wondering why things are the way they are. **CosmoCaixa Barcelona** boasts the Geological Wall and the Amazon Flooded Forest, which features more than 100 plant and animal species that convince visitors they have been transported from the Mediterranean to the very heart of the tropical jungle. In addition to its permanent facilities and its open areas, CosmoCaixa offers a scientific and educational programme that includes exhibitions, workshops, conferences, courses and debates involving experts from all over the world.

More info: www. obrasocial.lacaixa.es

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