Workshop
Sharing Knowledge from EU FP7 Projects in Plant Systems Biology
Barcelona, April 15th, 2013
FP7 Project Invitees

Project	Focus	Coordinator	EC Scientific Officer
3TO4	Converting C3 to C4 photosynthesis for sustainable agriculture	Richard Leegood (Sheffield)	Tomasz Calikowski
ABSTRESS	Resistance ofcrops to combined abiotic and biotic stress (legumes)	Adrian Charlton (DEFRA)	Sebastien Crepieux
AENEAS	Impact of environmental conditions on epigenetic states (maize)	Serena Varotto (Padova)	Annette Schneegans
DROPS	Genetic yield improvement - drought conditions / water use efficiency (cereals)	François Tardieu (INRA)	Annette Schneegans
EUROOT	Making use of joint phenotyping and modelling platforms to enhance the cereal plant capability to acquire water and nutrients through their roots and maintain growth and performance under stress conditions.	Emmanuel Guiderdoni (CIRAD)	Annette Schneegans
METAPRO	Optimisation of secondary metabolites / isoprenoids (Solanaceae)	Paul D. Fraser (CSSB, U of London)	Tomasz Calikowski
RECBREED	Genetic and molecular tools for plant breeding (tomato and maize)	Prof. Holger Puchta (Karlsruhe)	Annette Schneegans
ROOTOPOWER	Understanding of root-to-shoot signalling and source-sink relationships; Exploitation of natural genetic variability and biotechnology to minimize negative impacts of abiotic stresses on crops.	Francisco Pérez-Alfocea (CEBAS-CSIC)	Annette Schneegans
-	Boosting the translation of FP projects' results into innovative applications in the field of agriculture, forestry, fisheries and aquaculture	-	Barna Kovacs / Hans Joerg Lutzeyer
TIMET	Circadian components linked to metabolism / growth	Andrew Millar (Edinburgh)	Annette Schneegans

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Industry Invitees

Company	Country	Focus	Contact
Advanced Technologies Cambridge	United Kingdom	Biotechnology R&D for crop improvement, product characterisation and toxicological evaluation	Kieron Edwards
Bayer Cropscience	Belgium	Crop protection, seeds, biotechnology and non-agricultural pest control	Matthew Hannah
Biogemma	France	Biotechnology R&D for field seeds, focused on maize, wheat and oil seed crops	Wyatt Paul
CropDesign NV	Belgium	Delivering agronomic traits for the global commercial seed markets	Yves Hatzfeld
KeyGene	Netherlands	Molecular genetics R&D for 6F (Food, Feed, Fiber, Fuel, Flowers and Fun) crop improvement	Herco van Liere
KWS	United Kingdom	KWS is one of the leading maize, sugar beet and cereal breeders in the world and operates in about 70 countries	Chris Tapsell
Metanomics	Germany	Metabolite profiling	Stefan Henkes
Nebion	Switzerland	Systems biology, biomarker discovery and curation of public high-throughput biology data	Philip Zimmermann
Photon Systems Instruments	Czech Republic	Professional Instruments for Plant Science, Biotechnology, and Agriculture	Ladislav Nedbal
Rothamsted Research	United Kingdom	Crop productivity and quality; environmentally sustainable food and energy production.	Martin Parry
SweTree Technologies AB	Sweden	Biotechnology R&D to improve productivity and performance properties of plants, wood and fibre	Adelina Trifonova
Syngenta	Switzerland	Increasing crop yields and quality in a sustainable way	Alain Gaume

Richard Leegood

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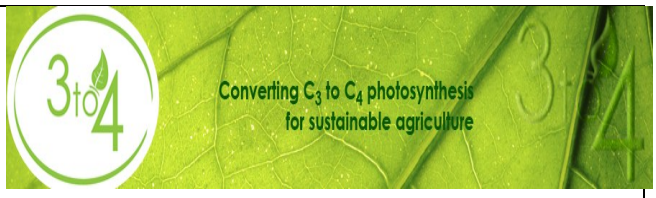
http://www.3to4.org/



3to4: Converting C3 to C4 photosynthesis for sustainable agriculture

If photorespiration could be reduced in current C3 crops, or if they could be converted to use C4 photosynthesis, large economic and environmental benefits would ensue because of both their increased productivity and the reduced inputs of water and nitrogen per unit yield associated with the C4 pathway. It is important to note that the huge advances in agricultural production associated with the Green Revolution were not associated with increases in photosynthesis, and so its manipulation remains an unexplored target for crop improvement both for food and biomass. Even partial long-term success would have significant economic and environmental benefits. Efficient C4 photosynthesis is associated with alterations to leaf development, cell biology and biochemistry, and so transferring these traits into C3 crops is a long-term undertaking. Despite its complexity, C4 photosynthesis has evolved independently at least sixty times, and this argues strongly for it being a tractable system to understand. We will undertake fundamental research to uncover mechanisms underlying important aspects of the C4 leaf that so far have remained undefined. In the medium term this will allow these important C4 traits to be transferred into C3 crops. In addition, to complement this long term work we will also increase photosynthesis by introducing a synthetic bypass for photorespiration into European crops. We will build capacity for C4 research in Europe by the training of future generations of researchers.

Adrian Charlton

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Claudia Zabke

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I am the Project Manager of the Marie Curie Initial Training Network AccliPhot. AccliPhot is funded under the FP7 framework for 4 years from the 1st October 2012 to the 31st September 2016. AccliPhot stands for **Environmental Acclimation of Photosynthesis.** AccliPhot is dedicated to the interdisciplinary and cross-sectoral training of excellent young researchers in cutting-edge experimental technologies, modern modelling approaches, industrial applications and a wide spectrum of complementary and industry relevant skills. The unique composition of our network consisting of theoreticians, with a background in mathematics and physics, experimental biologists and biochemists and three partners performing industrial research enables us to obtain a systems-wide understanding of short-term acclimation mechanisms to changes in light conditions in photosynthetic organisms. We work with three model organisms: Arabidopsis thaliana, Chlamydomonas reinhardtii and the diatom Phaeodactylum tricornutum.
The investigated scales encompass the molecular signalling mechanisms inducing the responses, the implications for metabolism, and whole-organism behaviour, in particular growth and biomass yield. Our aim is to employ this understanding to optimise and upscale biotechnological exploitation of photosynthetic microalgae for the production of biofuels, nutritional supplements or pharmaceuticals.

Serena Varotto

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The project AENEAS (Acquired Environmental Epigenetics Advances: from Arabidopsis to maize) aims to explore environmentally-induced epigenetics changes as the new frontier of natural and artificial variability. More precisely, its goal is to assess the impact of environmental conditions on epigenetic states in the model plant *Arabidopsis thaliana* and then transfer knowledge to maize, an important European crop. The environmentally triggered formation of epialleles represents an important yet unexplored source of variation andadaptive power in plants.
The leading idea of AENEAS is to assess the effect of environmental cues on plant genome stability, focusing on the epigenetic mechanisms governing this stability. The first results were produced by the labs working with the model plant *Arabidopsis thaliana*. Information provided by the model was used to develop and apply stress protocols suitable for maize. We are now deciphering the effect of stress application on the stability of the maize genome, gathering data from both the B73 reference lines and some mutants of epi-regulators belonging to the three main epigenetic pathways – autonomous, small RNA and CpG methylation pathways.

Sebastien Crepieux

Arcadia International

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After obtaining a PhD in plant genetics in France and spending several years in the industry (Monsanto, Limagrain Group), Sébastien Crepieux created his company in 2007 at the interface between agronomy and architecture, allowing the integration of plants in sustainable construction through plant walls and green roofs. Its innovative company (www.plantdesign.be) quickly becomes a leader in the Belgian and Luxemburg market.

In 2009, he joins the Directorate General for Research and Innovation at the European Commission in the Direction E "Agriculture, Food and Biotechnologies" where he deals with agronomy, plant improvement and breeding related issues, agricultural production and food safety (production aspects). He manages also a portfolio of 15 projects from the 7th Framework Programme for Research representing a total budget of 50 million euros.

After three years spent in the European commission, he becomes associate of Arcadia International, a multidisciplinary consultancy dedicated to the food and the feed value chain, headquartered in Brussels. Arcadia (http://www.arcadia-international.net) is well known to disseminate information from research to different stakeholders and from its location in Brussels and its long participation to European studies to reach the different policy levels.

He develops in Arcadia the participation to FP7 and future Horizon2020 research programs. Arcadia provides services and advices for proposal and consortium building but also participates directly to proposals to lead and reinforce the work-package on dissemination and technology transfer, and develops socio-economics and market studies.

Sébastien Crepieux also gives training on future Horizon 2020 programme, and how to get prepared.

Kieron Edwards

Advanced Technologies Cambridge Ltd.

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Advanced Technologies Cambridge (ATC) Ltd. is a wholly owned subsidiary of British American Tobacco and carries out plant biotechnology research. Tobacco is an important plant biology model and played a key role in the early development of molecular plant biology. More recently it has attracted interest from both academia and industry for its potential in biopharmaceutical farming applications and an abundance of research is being supported by the tobacco industry as it faces renewed challenges to reduce the toxic constituents in cigarette smoke. My group has adopted a systems biology approach - combining genomics and metabolomics - in an effort to reduce the potential for formation of toxicants following the combustion of tobacco.

Matthew Hannah
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Matthew Hannah researched plant physiology, biochemistry and molecular biology before moving into the emerging field of systems-level biology, particularly transcriptomics and metabolomics. His academic research focussed on plant environment responses, particularly to temperature and light, and made important contributions to understanding the interplay between cold acclimation and the circadian clock. In 2008, he moved to applied research at Bayer CropScience, but retains close links with academia. He currently leads a research program on abiotic stress tolerance and is a Program Manager of emerging research topics in the fields of trait discovery and enabling technology development.

Rocío Sánchez-Fernández
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I am part of the Technology Acquisition and Innovation Management team. We are responsible for scouting, identification of new technologies, in-licensing, and setting up collaborations on research topics and technologies that are of interest for BASF Plant Science. The team consists of 14 members with local presence in Europe, Americas and Asia. Together with two other colleagues I am responsible for Europe.

BASF Plant Science company– a BASF group company – is one of the world's leading companies providing innovative plant biotechnology solutions for agriculture. Today, about 840 employees are helping farmers meet the growing demand for improved agricultural productivity and healthier nutrition. BASF Plant Science has developed an unparalleled gene discovery platform focusing on yield and quality traits in crops such as corn, soybean and rice. Jointly with leading partners in the seed industry BASF Plant Science is commercializing its products. Current projects include higher yielding row crops or higher content of Omega-3 fatty acids (EPA / DHA) in oil crops for preventing cardiovascular diseases**.**

Jeroen Wilmer
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Biogemma is a European biotech company fully funded by agriculture: its shareholders are three seed companies, Limagrain, Euralis and RAGT, and two levy boards. Our main mission is to provide new tools to our shareholders to improve their plant breeding efforts, both in methods and in traits and to be a bridge between fundamental research and plant breeding. In this context Biogemma is a regular partner in collaborative projects with academic groups across Europe.

Biogemma is a partner in 6 projects in the current research programme, FP7, covering the full range from fundamental plant biology (Recbreed, Aeneas) via genome analysis (Triticaegenome, Transplant) to traits (Drops, Sunlibb). In these projects we bring a focus on crop species and help drive to the market those results that translate from model species to crops.

Sermin Onenc
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The DOMMRS has been in operation since 1991 originally as part of the Aquaculture and Development Centre (ADC), University College Cork. However in late 2005 it was established as an independent research station with a hatchery. It has sister companies with commercial scale shellfish and finfish farms (60ha) which are organically certified by Naturland. Research at the station has focussed on aquaculture husbandry, biofuel production, minimising waste in the aquaculture and fisheries production process, developing new products from waste and environmental monitoring.

We currently co-ordinate three FP7 and one Atlantic INTERREG project, including:

- "MABFUEL "Marine Algae as Biomass for Biofuel" which investigates the feasibility of using colder water algal strains as a biomass for biofuel (FP7, Marie Curie).
- ASIMUTH "Applied Simulations and Integrated Modeling for the Understanding of Toxic and Harmful Algal Blooms" (FP7).
- NETALGAE which aims to create a European network of relevant stakeholders within the marine macroalgae sector (Atlantic INTERREG)

We also collaborate as a partner in

- ACCIPHOT "Environmental Acclimation of Photosynthesis" (FP7, Marie Curie ITN).
- IDREEM "Increasing Industrial Resource Efficiency in European Mariculture" (FP7 Environment theme) which involves the practice of Integrated Multi-trophic Aquaculture (IMTA).

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Joyce Tait

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The Innogen Institute is a dynamic collaboration between the University of Edinburgh and the Open University that explores the social and economic implications of innovation in the life sciences. Innogen scholars are pioneering approaches that connect people, policy and practice to innovative solutions for real world problems, in areas such as global health, food and energy security, emerging technologies, the environment and the bio-economy.

With an interdisciplinary background, covering both natural and social sciences, **Joyce Tait** has specialised in innovation-governance-stakeholder interactions in life science and related areas, including cell therapies and regenerative medicine, synthetic biology, GM technologies, drug development, stratified medicine, and biofuels, for example:

- strategic and management decision making in companies and public bodies
- policy analysis, risk assessment and regulation
- stakeholder attitudes, science and risk communication
- evaluation and application of interdisciplinary research
- sustainable development

Xavier Berthet

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My name is Xavier BERTHET, and I recently joined KeyGene N.V. as Director of Business Development Europe & Asia. I was trained as a molecular biologist but moved to business development and technology transfer. Over the last ten years I worked for biotechnology, pharmaceutical and plant biotechnology/ seed companies.

KeyGene is a molecular genetics R&D company with a primary focus on 6F crop improvement (Food, Feed, Fiber, Fuel, Flowers and Fun crops). KeyGene delivers sustainable molecular genetic responses to the world's need for stability in the yield, quality and health of crops. KeyGene assists breeding companies by providing cutting edge breeding technology and trait improvement platforms for their own crop development. KeyGene has its headquarters in Wageningen, the Netherlands, a subsidiary in Rockville, Maryland, USA and a Joint Lab at the Shanghai Institute of Biological Sciences in Shanghai, China.

Viktor Korzun

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KWS LOCHOW GMBH is a leading company in Europe for hybrid rye, barley and wheat breeding. There are excellent field trial, greenhouse, and genotyping facilities which allow integration of results from genomics and quantitative genetics into applied plant breeding (www.kws.com).

Dr. Viktor Korzun is the Head of Cereals Biotechnology. His main research interests and expertise is an implementation of genomics and biotechnology into cereals breeding.

As coordinator of KWS LOCHOW biotechnology activities V. Korzun is involved in many national, international and EU R&D projects related to applied genetics and genomics (GABI, EU FP6-BIOEXPLOIT, ERA-PG CEREHEALTH, EU FP7- TriticeaeGenome and AdaptaWheat). Since 2008 he is an Editor in Molecular Breeding and his scientific achievements include the publication of about 150 peer-reviewed publications.

Gerhard Ritte

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I am managing the Systems Biology group at Metanomics which is part of a global BASF Plant Science Systems Biology team. This team is composed of Trait experts, Plant Physiologists, Molecular Biologists and Bioinformaticians.
Metanomics, a BASF Plant Science Company, has pioneered the discipline of Metabolite Profiling, the parallel analysis and interpretation of thousands of metabolites in an organism.
The company applies its outstanding and worldwide leading technology platform to discover and deliver

- novel metabolic gene functions for high value traits in crops
- metabolic biomarkers
- agronomical performance traits
- solutions to accelerate commercial crop development

Our growth facilities lay the basis for successful metabolic research, as well as for the phenotypic and physiological analysis of plants. The facilities are suited to conduct high throughput screening as well as customized experiments. In addition, Data integration presents a core competency, as a bridge to convert data into knowledge.

Paul Fraser

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Dr Fraser has over 20 years experience working both in academia and industry within the UK and abroad (Germany and Japan). During this period Dr Fraser has worked on the analysis, biosynthesis, regulation and metabolic engineering of carotenoids and other isoprenoids, both in plant and microbial systems. Within FP7 he was the Deputy Coordinator, of the Colorspore (2008-2011) and a work package leader in the MultiBioPro project (2011-2015). Dr Fraser is also the coordinator of the FP7 METAPRO project (www.isoprenoid.com), the Vice-chair of FA1006 High value products from plants (www.plantengine.eu) and EU chair for the US/EU Taskforce on Plant Bioetchnology-added value plant products working group. He has also contributed and organised European outreach activities including metabolite profiling training schools for early stage researchers.

Philip Zimmermann

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CEO of the Swiss company Nebion AG.
P.Zimmermann worked as researcher and group leader in the laboratory of Prof. W. Gruissem at ETH Zurich from 2005 until 2011. The main focus of his team was the development of Genevestigator, a gene expression search engine, as well as methodologies to integrate expression data on a large scale. Currently, Nebion has exclusive rights to develop and commercialize Genevestigator for a variety of academic and commercial applications. Besides integrating public microarray data, Nebion currently works on integrating RNAseq and other data types. Nebion also participates in several public-private research partnerships, such as EU projects.

Francisco Pérez-Alfocea

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I am a research scientist at the Department of Plant Nutrition of the CEBAS-CSIC, where I have gathered more than 20 years of experience on research to minimize abiotic (salinity) stress impact on horticultural crops (tomato) and have pioneered the use of grafting to transfer salt resistance through roots derived-traits from wild species to commercial varieties. Currently, I am the Coordinator of the FP7 collaborative project entitled ROOTOPOWER ("**Empowering root-targeted strategies to minimize abiotic stress impacts on horticultural crops")**, which aims to develop new tools, targeted to roots, to enhance agronomic stability and sustainability of dicotyledonous crops under multiple and combined stress conditions. Central to its approach is the use of tomato as a model species, since its genome sequence is already available and it can be very easily grafted. This surgical technique attaches histologically shoot and root systems that are genetically different, allowing precise assessment of the effect of altering root genotype on crop performance of the grafted variety. This project will analyze and exploit the natural genetic variability existing in a recombinant inbred line population (RIL) from a cross between *Solanum lycopersicum* and *S. pimpinellifolium* and other selected mutants and functional lines (used as rootstocks) for their performance under multiple abiotic stresses and for their biotic interaction with natural soil microorganisms (mycorrhiza and rhizobacteria). ROOTOPOWER will obtain genetic information and physiological understanding of mechanisms vital for high-performing root systems.

Cristina Soriano Carpena

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I am the project manager of the 7FP collaborative project entitled ROOTOPOWER ("**Empowering root-targeted strategies to minimize abiotic stress impacts on horticultural crops")**. I am in charge of the financial, administrative, dissemination and IP related tasks of the project. With a duration of 4 years (2012-2015), ROOTOPOWER aims to develop new tools, targeted to roots, to enhance agronomic stability and sustainability of dicotyledonous crops under multiple and combined stress conditions. Central to its approach is the use of tomato as a model species, since its genome sequence is already available and it can be very easily grafted. This surgical technique attaches histologically shoot and root systems that are genetically different, allowing precise assessment of the effect of altering root genotype on crop performance of the grafted variety. This project will analyze and exploit the natural genetic variability existing in a recombinant inbred line population (RIL) from a cross between *Solanum lycopersicum* and *S. pimpinellifolium* and other selected mutants and functional lines (used as rootstocks) for their performance under multiple abiotic stresses and for their biotic interaction with natural soil microorganisms (mycorrhiza and rhizobacteria). ROOTOPOWER will obtain genetic information and physiological understanding of mechanisms vital for high-performing root systems.

TiMet	**TiMet seeks to advance understanding of the regulatory interactions between the circadian clock and plant metabolism, and their emergent effects on whole-plant growth and productivity.**

Andrew Millar (Coordinator)	**andrew.millar@ed.ac.uk**

Andrew Millar holds a Chair of Systems Biology in SynthSys (Centre for Synthetic and Systems Biology) at the University of Edinburgh, UK. He was previously involved in the Scottish Universities Life Sciences Alliance (SULSA) and in GARNet, the UK's Arabidopsis research network, and was a founding Director of SynthSys' predecessor, the Centre for Systems Biology at Edinburgh (CSBE).

Oliver Ebenhoeh	**ebenhoeh@abdn.ac.uk**

Oliver Ebenhoeh is Reader in Systems Biology, a joint position of the Institute for Complex Systems and Mathematical Biology and the Institute of Medical Sciences, at the University of Aberdeen, UK. An overall goal of his research is to link physical sciences to biology to derive a theoretical understanding of living systems.

Wilhelm Gruissem	**wgruisse@ethz.ch**

Wilhelm Gruissem, Professor of Plant Biotechnology at ETH Zurich, is a world expert in isoprenoid metabolism and chloroplast biology. He and his group use a systems biology approach to modelling biochemical pathways and regulatory processes that affect plant function and development.

Dirk Husmeier	**dirk.husmeier@glasgow.ac.uk**

Dirk Husmeier holds a Chair in Statistics in the School of Mathematics and Statistics at the University of Glasgow, UK. His current research focuses on improved Bayesian hierarchical models for the prediction of molecular regulatory networks subject to adaptation, the inference of species interaction networks in ecology, and Bayesian inference in mechanistic models of molecular pathways.

Manuel Rodríguez-Concepcion	**manuel.rodriguez@cragenomica.es**

Manuel Rodríguez-Concepcion is an expert in isoprenoid metabolism. He and his group at the Center for Research in Agricultural Genomics (CRAG), in Barcelona, Spain, are using forward and reverse genetic as well as biochemical approaches in Arabidopsis to understand how plants regulate the metabolic flux through the MEP pathway and the cross-talk with downstream pathways for the production of isoprenoid end-products, with a main focus on carotenoids.

Alison Smith	**alison.smith@jic.ac.uk**

Alison Smith is Head of the Department of Metabolic Biology at the John Innes Centre in Norwich, UK. She is an expert in primary metabolism in plants, particularly the interconversion of sucrose and starch. Together with colleagues in her laboratory, Alison uses biochemical, genetic and molecular biological techniques to study starch synthesis and turnover in potatoes, peas, cereals and Arabidopsis.

Mark Stitt	**mstitt@mpimp-golm.mpg.de**

Mark Stitt and his group at the Max Planck Institute of Molecular Plant Physiology (MPIMP) in Golm, Germany, are developing user-friendly data visualization tools, sensitive high-throughput assays for enzymes and metabolites, and a suite of growth conditions to reveal the impact of changes in the carbon and nutrient status on metabolism, growth and development. *Arabidopsis thaliana*, tomato and maize are the main plants used in these investigations.

Samuel C Zeeman	**szeeman@ethz.ch**

Sam Zeeman is Professor of Plant Biochemistry at ETH Zurich. He is an expert in photosynthetic carbon metabolism, particularly the biosynthesis and degradation of leaf starch. Together with his team, he uses biochemical, molecular genetic and plant physiological techniques to study starch biosynthesis and degradation in Arabidopsis, revealing the importance of the daily turnover of starch in leaves for plant growth.