UV4growth

COST-Action FA0906
WG3 mini-conference
Copenhagen, Denmark, 2-3 February 2012

Plant responses to ultraviolet radiation - roles of antioxidants and pro-oxidants

Abstracts

UNIVERSITY OF COPENHAGEN

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About COST

COST- the acronym for European Cooperation in Science and Technology- is the oldest and widest European intergovernmental network for cooperation in research. Established by the Ministerial Conference in November 1971, COST is presently used by the scientific communities of 35 European countries to cooperate in common research projects supported by national funds.

The funds provided by COST - less than 1% of the total value of the projects - support the COST cooperation networks (COST Actions) through which, with EUR 30 million per year, more than 30 000 European scientists are involved in research having a total value which exceeds EUR 2 billion per year. This is the financial worth of the European added value which COST achieves.

A "bottom up approach" (the initiative of launching a COST Action comes from the European scientists themselves), "à la carte participation" (only countries interested in the Action participate), "equality of access" (participation is open also to the scientific communities of countries not belonging to the European Union) and "flexible structure" (easy implementation and light management of the research initiatives) are the main characteristics of COST.

As precursor of advanced multidisciplinary research COST has a very important role for the realisation of the European Research Area (ERA) anticipating and complementing the activities of the Framework Programmes, constituting a "bridge" towards the scientific communities of emerging countries, increasing the mobility of researchers across Europe and fostering the establishment of "Networks of Excellence" in many key scientific domains such as: Biomedicine and Molecular Biosciences; Food and Agriculture; Forests, their Products and Services; Materials, Physical and Nanosciences; Chemistry and Molecular Sciences and Technologies; Earth System Science and Environmental Management; Information and Communication Technologies; Transport and Urban Development; Individuals, Societies, Cultures and Health. It covers basic and more applied research and also addresses issues of pre-normative nature or of societal importance.

Introduction - UV4growth Action Chair

COST Action FA0906 – UV4Growth

Dear colleagues,

UV4Growth is a COST Action that brings together, coordinates and enhances the performance of nationally-funded research activities that are focused on understanding the effects of solar UV-B on plants (http://www.ucc.ie/en/uv4growth/). A key reason for the existence of UV4Growth is that significant new understanding of UV-B mediated processes has been generated during the last decade. Such scientific progress necessitates a reappraisal of earlier research findings, as well as exploration of future research directions. The COST-Action does so by bringing together scientists from different countries and by integrating molecular, physiological, metabolomic, organismal and environmental approaches.

A particularly intriguing topic concerns UV-B induced stress. While many older studies have reported widespread UV-induced damage, more recent studies indicate that UV-B mediated stress is a relatively rare event. Understanding under which conditions UV-B acts as a stressor is important from the perspective of plant ecology, but also in terms of the exploitation of UV-B as an environmental regulator of, for example, phytochemicals. Particularly intriguing are, of course, the role of Reactive Oxygen Species and anti-oxidants in UV-B photobiology, as these span the gap between stress and regulatory events.

Congratulations to the organizing committee for assembling a very interesting program of talks on such a topical issue,

I hope that during these days everybody will have an excellent possibility to meet colleagues, to develop new friendships and to establish fruitful collaborations.

Warm regards.

Marcel

Marcel Jansen
Chair UV4Growth
University College Cork
Ireland

Introduction - Organizers

Dear Colleagues,

As organizing committee we have the pleasure of welcoming you to the University of Copenhagen, Denmark, to attend the UV4growth Mini-Conference on ‘Plant responses to ultraviolet radiation - roles of antioxidants and pro-oxidants’.

UV4Growth is a COST-funded network of researchers with interests in the effects of UV-B radiation on plants (http://www.ucc.ie/en/uv4growth/). Within the UV4Growth network, our workgroup, WG3, studies UV effects on plant organisms. This diverse field requires multidisciplinary methodology and research strategies of which measurements of antioxidants and pro-oxidants (especially those of reactive oxygen species, ROS) are of importance.

For decades, plant stress physiology has been regarding ROS and other free radicals as boggarts: always malevolent but hardly ever caught. And luckily kept at bay by antioxidants. This traditional picture has been fine-tuned and modified. The advancement of measurement technology allows us to identify ROS chemical identities and primary production sites. Other, molecular biology innovations make connections between changes in amounts and activities of various antioxidants understandable by mapping stress and ROS inducible gene expression patterns. A new, advanced model of plant-environment interactions includes a dynamic balance between ROS and ROS scavengers, between pro-oxidants and antioxidants and thus allows researchers to distinguish between acute and chronic effects.

With the aim of taking the above concept into the research of plant responses to UV radiation, this mini-conference aims to explore the following topics;

- UV-B as a stressor
- Interconnections between tolerance to environmentally relevant UV doses, ROS and anti-oxidant systems
- Crosstalk intercession of UV-mediated changes in anti-oxidant status on different stressors, via molecular signalling or by altering anti-oxidant stress defenses
- UV-responses of transgenic plants with altered ROS-scavenging capacity
- Application of ROS-detecting spin-trap methods for newly developed UV-B exposure routines

Members of the Organizing Committee wish you all a very successful conference and a pleasant stay in Copenhagen:

Riitta Julkunen-Tiitto (Finland), WG3 leader
Eva Rosenqvist (Denmark), assistant WG3 leader, local organiser
Petra Majer (Hungary), junior assistant WG3 leader
Fernando Cebola Lidon (Portugal)
Éva Hideg (Hungary)

The financial support of COST for organising this mini-conference is gratefully acknowledged. UV4growth FA0906 is a COST Action and COST is supported by the EU RTD Framework programme.

Conference Program	
Thursday, 2 February 2012	
11:30-13:00	Registration desk and sandwich lunch in the Marble Hall, outside the meeting room A2-70.01 (3-11)
13:00-13:15	Welcome address **Marcel Jansen** as COST Action leader **Riitta Julkunen-Tiitto** as WG3 leader **Eva Rosenqvist** as local organizer
13:15-14:55	**Session 1** **Chair - Riitta Julkunen-Tiitto (Finland)** **13:15 – 13:55** - KEYNOTE LECTURE 1 **Fernando J. C. Lidon[1], José C. Ramalho[2], António E. Leitão[2], Maria Manuela A. Silva[3]** [1]Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Portugal. [2]Instituto de Investigação Científica Tropical, Oeiras, Portugal. [3]ESE Almeida Garrett, Grupo Univ. Lusófona, Lisboa, **Portugal**. ***UV-induced antioxidant responses based on biochemical and physiological interactions*** **13:55 – 14:15 –** Short talk 1 - **Petra Majer [1], Éva Hideg[2]** [1]Institute of Plant Biology, Biological Research Center, Szeged; [2]Biology Institute, University of Pécs, **Hungary** ***Preceding high light acclimation promotes toleration of supplemental UV-B radiation via enhancing base antioxidant levels*** **14:15 – 14:35 -** Short talk 2 - **Marija Vidovic[1], Jana Barbro Winkler[2], Andreas Albert[2], Filis Morina[1], Sonja Milic[1], Sonja Veljovic-Jovanovic[1]** [1]Institute of Multidisciplinary research, University of Belgrade, **Serbia**; [2]Research Unit Environmental Simulation (EUS), Helmholtz Zentrum München, Neuherberg, **Germany** ***Different intra-organ antioxidant defence strategies towards UV-B irradiation in white and green leaf parts of variegated Pelargonium zonale and Plectranthus coleoides*** **14:35 – 14:55 -** Short talk 3 - **G. Doupis[1], K. Chartzoulakis[1], A. Patakas[2]** [1]NAGREF, Institute for Olive Tree and Subtropical Plants, Crete; [2]Laboratory of Plant Production, School of Natural Resources and Enterprises Management, University of Ioannina**, Greece** ***Differences in enzymatic antioxidant mechanism in grapevines subjected to drought and enhanced UV-B radiation***
14:55 – 15:30	**Coffee break**
15:30 - 16:50	**Session 2** **Chair – Fernando Cebola Lidon (Portugal)** **15:30 – 16:10** - KEYNOTE LECTURE 2 **Éva Hideg** Department of Plant Physiology, Biology Institute, University of Pécs, **Hungary** ***Detecting ROS in UV-treated leaves – Problems, pitfalls, perspectives*** **16:10 – 16:30** - Short talk 4 - **Claudia Scattino[1], Cristina Sgherri[1], Matteo Iannone[1], Chiara Dall'Asta[2], Calogero Pinzino[3], Pietro Tonutti[4], Annamaria Ranieri[1]**

	[1]University of Pisa, Pisa; [2]University of Parma, Parma, Italy; [3]Institute of OrganoMetallic Compounds Chemistry, CNR, Pisa, [4]Sant'Anna School of Advanced Studies, Pisa, **Italy** ***Free radical production induced by post-harvest UV-B irradiation in different cultivar of peaches: an EPR study*** **16:30 – 16:50** - Short talk 5 - **Vida Rančelienė, Regina Vyšniauskienė** Institute of Botany of Nature Research Centre, Vilnius, **Lithuania** ***Modification of UV-B effects on meristematic cells of model plants***
16:50 – 17:40	**Session 3 – Companies Presentations and Discussion** **Chair - <u>Eva Rosenqvist (Denmark)</u>** **16:50 – 17:05** - Company 1: **Lemna Tec GmbH, Germany** *Dirk Vandenhirtz* ***High throughput plant phenotyping for the development of better plants for the future*** **17:05 – 17:20** – Company 2: **Agilent Technologies, Sweden** *Peter Abrahamsson* ***New Software Tools For Facilitating Multi-omics Analysis Of The Rice Response To Bacterial Leaf Blight*** **17:20 – 17: 40**- *Looking at things with company 1 and 2*
19:00	**Social dinner at the University, Restaurant Lillebælt**
	Friday, 3 February 2012
9:15 – 10:35	**Session 4** **Chair** – **<u>Éva Hideg</u> (Hungary)** **9:15 – 9:55** - KEYNOTE LECTURE 3 **<u>Leif A. Eriksson</u>[1] and Åke Strid[2]** [1]Department of Chemistry, University of Gothenburg,; [2]Örebro Life Science Center, School of Science and Technology, Örebro University, **Sweden** ***Chemistry of vitamin B_6 under oxidative stress*** **9:55 – 10:15** - Short talk 6 - **<u>Sandy Vanderauwera</u>[1,2], Nobuhiro Suzuki[3,4], Gad Miller[3], Brigitte van de Cotte [1,2], Stijn Morsa[1,2], Jean-Luc Ravanat[5,6], Alicia Hegie[3], Christian Triantaphylidès[7], Vladimir Shulaev[8], Marc Van Montagu[2], Frank Van Breusegem[1,2] and Ron Mittler [4, 9]** [1]VIB, Technologiepark 927, Gent, **Belgium**; [2] Ghent University, Technologiepark 927, Gent, **Belgium**; [3]University of Nevada, Reno, **USA**; [4]Hebrew University of Jerusalem, **Israel**; [5]Commissariat à l'Energie Atomique, Institut Nanosciences et Cryogénie, Laboratoire des Lésions des Acides Nucléiques, Grenoble, **France** ; [6]Université Joseph Fourier, CNRS, Laboratoire de Chimie Inorganique et Biologique, Grenoble, **France** ; [7]CEA, Direction des Sciences du Vivant, Institut de Biologie Environnementale et Biotechnologie, Laboratoire de Ecophysiologie Moléculaire des Plantes, and CNRS, Unité Mixte de Recherche, Biologie Végétale et Microbiologie Environnementale, and Université d'Aix Marseille, Saint Paul lez Durance, **France** ; [8]Virginia Bioinformatics Institute, Blacksburg, **USA**; [9]University of North Texas, Denton, **USA**. ***Extranuclear protection of chromosomal DNA from oxidative stress*** **10:15 – 10:35** - Short talk 7 - **<u>Philip John Dix</u>** National University of Ireland Maynooth, Maynooth, Co. Kildare, **Ireland** ***Modification of reactive oxygen species (ROS) scavenging capacity of chloroplasts through plastid transformation***

10:35-10:50	**Session 5 – Companies Presentations** **Chair – Eva Rosenqvist (Denmark)** **10:35 – 10:50** – Company 3: **Force-A, France** *Laurent Florin* ***Optical markers for plant stress and infection (chlorophyll and polyphenolics)***
10:50-11:30	**Coffee break and instrument viewing time**
11:30 – 12:10	**Session 6** **Chair - Fernando Cebola Lidon (Portugal)** **11:30 – 11:50** - Short talk 8 - **Marcel Jansen** School of Biological, Environmental and Earth Sciences, University College Cork, Enterprise Centre Rm 106a, Distillery Field, Cork, **Ireland** ***UV-B adaptation; are some plants more UV-B protected than others?*** **11:50 – 12:10** – Short 9 - **Line Nybakken[1,2], T. Ruuhola[1], T. Randriamanana[1], R. Julkunen-Tiitto** [1]Natural Products Research Laboratories, Dep. of Biology, University of Eastern Finland, Joensuu, **Finland** [2]Department of Ecology and Natural Resource Management, Norwegian University of Life sciences, Ås, **Norway** ***Performance of the dioecious dark-leaved willow (Salix myrsinifolia) under combined enhancements of UV and temperature***
12:10 – 12:40	***General Discussion of Sessions 1-6*** **Chair – Fernando J. C. Lidon - Portugal**; **Repporteurs** - **Riitta Julkunen-Tiitto – Finland; Eva Rosenqvist – Denmark; Éva Hideg - Hungary**
12:40 – 14:00	**Lunch** in the Marble Hall
14:00 – 15:00	***WG 3 Meeting*** **Chair** - **Riitta Julkunen-Tiitto – Finland,** as WG3 leader
15:00 – 15:30	"*Diffusion time, farewell, see you next time*"
16:00 – 18:00	**MC Meeting** **Chair** – **Marcel Jansen – Ireland**, as Chair of the Action

Abstracts of Presentations

Fernando José Cebola Lidon

Professor Dr.
Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa

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Short biography

Graduated in Biology and Geology, by the University of Evora - Portugal (1979-1984) and in Biochemistry, by the University of Lisbon - Portugal (1985-1989). Master in Biology / Scientific area – Plant Biology and Ph D in Biology /Scientific area – Plant Biochemistry, by the New University of Lisbon - Portugal (1992 and 1994, respectively). Ph D equivalence by the ECE, Milwaukee, Wisconsin, USA in 1998.
Professor in the University of Évora – Portugal (1982-1984) and Faculty of Sciences and Technology / New University of Lisbon (since 1988) and researcher in the Environmental Biotechnology Unit (since 2001). Publication of more than 100 scientific works in specialized journals.

Short institution presentation

Faculdade de Ciências e Tecnologia (Faculty of Science and Technology; FCT) is one of the nine academic units of Universidade Nova de Lisboa (UNL). The FCT/UNL campus is located in Monte de Caparica and covers approximately 30 ha, with additional capacity expansion to 60 ha.
Founded in 1977, FCT/UNL is one of the most prestigious Portuguese public schools of science and engineering today, with a total enrolment of ca. 7500 students, of which nearly 1400 are postgraduate students (MSc and PhD).
Since its foundation, FCT/UNL has given priority to the promotion of research in its areas of activity. Today FCT/UNL hosts 16 research centres acknowledged by Fundação para a Ciência e a Tecnologia (of which 3 are rated “excellent” and 6 ”very good”), as well as 2 Poles of research centres (both rated “very good”).
An important measure of academic quality at FCT/UNL is provided by growing employer satisfaction and successful job market insertion of FCT/UNL graduates and postgraduates. In particular, all the programs in engineering have been accredited by the Portuguese Board of Professional Engineers.
FCT/UNL keeps close links with many Portuguese and foreign universities with regard to the exchange of academic staff and students, as well as collaboration within research projects.
The scientific output of FCT/UNL includes a large number of publications in international journals with high impact, which has earned FCT/UNL recognition by its peers.
FCT/UNL has ca. 500 academic and research staff (320 PhD holders) and 220 administrative staff. It has 14 departments/sectors and 8 support services.
Through its departments and research centres, FCT/UNL also provides a range of services to public and private enterprises within its areas of expertise.
The governance model of FCT/UNL is defined in its statutes and comprises the following organs: Faculty Council, Dean, Executive Council, Management Council, Scientific Council, and Pedagogical Council.

UV-induced antioxidant responses based on biochemical and physiological interactions

Fernando J. Cebola Lidon[1], José Cochicho Ramalho[2], António Eduardo Leitão[2], Maria Manuela Abreu da Silva[3]

[1]DCTB, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Quinta da Torre, 2829-516 Caparica, Portugal.
[2]Centro de Ecofisiologia, Bioquímica e Biotecnologia Vegetal, Instituto de Investigação Científica Tropical, Quinta do Marquês, 2784-505 Oeiras, Portugal.
[3]ESE Almeida Garrett, Grupo Univ. Lusófona, COFAC, Palácio de Santa Helena, Largo do Sequeiro nº 7, Lisboa, Portugal.

Abstract

Ultraviolet-B (UV-B) radiation constitutes a minor part of the solar spectrum and most of UV solar radiation is absorbed by the UV-screening stratospheric O_3 layer. Yet the parcel that reaches Earth's surface is known to elicit numerous responses at the molecular, cellular and whole-organism level in higher plants.
As UV-B radiation is readily absorbed it can provoke photoexcitation of a large number of biomolecules, namely in proteins and lipids, resulting in changes of biochemical and physiological functions within cells, that is, implicating significant impacts on many biological processes, both with damaging or regulatory importance. Amongst the major UV-B targets are the photosynthetic structures. The impact in a wide number of photosynthetic components has been reported, including the suppression of chlorophyll synthesis, the inactivation of oxygen evolution and negative impacts on the light-harvesting chlorophyll a/b complex II, photosystem II reaction centres and thylakoid electron flux. Furthermore the decrease of ribulose-1,5-bisphosphate carboxylase/oxygenase (rubisco) content and activity, that affects the maximal velocity of carboxylation, accompanied with a large reduction in the expression and abundance of both large and small subunits of rubisco, would contribute to depress photosynthesis, with severe consequences to crops yield. The most common UV-B impairments/damages are related to proteins (cross-linking, aggregation, denaturation and degradation) and membrane lipids, namely, through photooxidation or by the action of highly reactive molecules (free radicals and reactive oxygen species, ROS) overproduced during photosensitization. However, in order to cope to UV-B exposure, plants have the ability to trigger a range of protective mechanisms that includes the synthesis of UV-screening phenolic compounds (as hydroxycinnamic acids and flavonoids), the up-regulation of ROS scavenging molecules (as ascorbate, glutathione and α-tocopherol and enzymes from the ascorbate-glutathione cycle), improved repair systems and changes in plant morphology.
Focusing on higher plant studies, this study will summarize on UV-B induced responses at biochemical and physiological levels.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

Focusing on higher plant studies, this study will summarize on UV-B induced responses at biochemical and physiological levels.

Petra Majer

PhD student
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Short biography

Education
2006 MSc Degree in Horticultural Sciences, Corvinus University of Budapest, Hungary
2008- PhD student in Biology, University of Szeged
Positions
2006-2008 Research Assistant, Cereal Research Non-Profit Ltd., Szeged
2008- PhD student, Institute of Plant Biology, BRC, Szeged
2011- Staff Scientist, Institute of Plant Biology, BRC, Szeged
Studies and research abroad
2011 February (2 weeks): COST research grant, Institut für Gemüse- und Zierpflanzenbau Großbeeren/Erfurt e.V., Großbeeren, Germany
2005 (4 months): Erasmus grant, École Supérieure d'Agriculture d'Angers (ESA), Angers, France
Research interest
Reactive oxygen species, Antioxidant / pro-oxidant balance during acclimation to sunlight and various abiotic factors (high light, UV-B)
Scientific results
Number of publications: 7 (5 peer reviewed journal articles, 2 conference proceedings)
Cumulative IF: 9.23

Short institution/company presentation

BRC

The Biological Research Centre is the largest research facility of the Hungarian Academy of Sciences, founded in 1971. Its activity covers all areas of modern biology. It is organized into four institutes, corresponding to the diversity of the investigated fields: the Institutes of Biophysics, Biochemistry, Genetics and Plant Biology. The activities of the Center involve primarily basic science, but practical application of the results also represents a high priority. The research topics include several fields of molecular and cell biology from the industrial utilization of bacteria through controlled improvement of cultivated plants to the problems of human health and environmental protection. BRC is mainly a scientific basic research centre, but scientists of BRC play an initiative role in the foundation and promotion of biotechnological companies, as well as in educational duties. The successful activity and high-level scientific research pursued in BRC were also acknowledged by the European Molecular Biological Organization (EMBO) and in 2000 the European Union awarded the title of "Centre of Excellence" to BRC.
http://www.brc.hu/

Preceding high light acclimation promotes toleration of supplemental UV-B radiation via enhancing base antioxidant levels

Petra Majer, Éva Hideg

Institute of Plant Biology, Biological Research Center, Szeged, Hungary

Abstract

The aim of our study was to evaluate the effect of moderate (ca 60% of ambient) UV-B radiation on plant antioxidant status and to see whether the plants with higher basic antioxidant capacity (high light pretreated plants) had different responses to the same supplemental UV-B treatment. Green-house grown tobacco (*Nicotiana tabacum* L. cv. Petit Havana) plants were exposed to (5.3 µmol m^{-2} s^{-1}) UV-B radiation for 7 days (7hrs/day). Half of the plants were previously acclimated to high light (1000 µmol m^{-2} s^{-1} PAR) for 5 days while the other half were kept at growth light (200 µmol m^{-2} s^{-1} PAR). These two groups of plants are referred to as HL and LL plants.

In LL plants UV-B decreased photosynthesis and stomatal conductance as well as leaf chlorophyll and carotenoid contents, while total ROS neutralizing and specific superoxide scavenging capacities increased. HL leaves were able to maintain their photosynthesis under the UV-B treatment, although suffered a decrease in chlorophyll content. HL leaves had higher total antioxidant capacities and better hydroxyl radical scavenging than LL plants before the UV-B exposure which was maintained but not increased in response to UV-B.

In leaves of LL plants, the UV-B induced limitation of photosynthesis was confined to stomata cells, as the decrease in CO_2-fixation was not due to decreased effective photochemical quantum yields. High light pretreatment was capable of strengthening the antioxidant status of leaves and the higher levels of antioxidants at the onset of supplemental UV-B radiation protected the photosynthetic apparatus. When no pretreatment was applied (LL leaves) the basic antioxidant levels were lower and although these were elevated in response to UV-B, could not to protect photosynthesis efficiently.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

We continue our research with dissecting UV-B responses of tobacco plants having modified ROS scavenging capacities in their chloroplast (transplastomic lines).

Marija Vidovic

PhD student
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Short biography

Born in 1981, in Belgrade, Serbia.

2010. Employed in the Institute of Multidisciplinary Research, University of Belgrade on the project: *“Modulation of antioxidant metabolism in plants directed to adaptation improvement to abiotic stresses and identification of new oxidative biomarkers with application in monitoring and remediation of devastated areas”,* supported by Serbian Ministry of Science.

2008-2010. Scholarship from the Ministry of Science of the Republic of Serbia 2008/2010 for PhD students.

2008. Enrolled in PhD studies in Biochemistry at the Faculty of Chemistry, University of Belgrade. The title of doctorate thesis: “Different strategies in reactive oxygen species scavenging in photosynthetic and non-photosynthetic leaf’s tissue *Pelargonium zonale variegata*.”

2008. Graduated with average grade of 9.21 (on a scale of 6 to 10) at the Faculty of Chemistry, University of Belgrade, according to study program “Biochemist” (270 ECTS).

Practical experience:

2011. Research fellowship during five weeks in Helmholtz Zentrum München at the Dept. of Environmental Engineering (EUS), (Dr. Jana Barbro Winkler’s lab) as a part of STSM within the COST action “A specific regulator of plant growth and food quality in a changing climate (UV4growth)”.

2008. Practical experience during three months in the Dept. of Biotechnology, Faculty of Agriculture, University of Padua (prof. Antonio Masi’s lab) based on developing 2D electrophoresis and proteomics and determination redox state of ascorbate and glutathione by HPLC.

Short institution/company presentation

Institute for multidisciplinary research (IMSI) was founded in 1970 as a functional and organizational solution for researchers and students interested in the multilevel approaches to diverse scientific topics.

IMSI consists of three departments: Department of Materials Science, Department of Life Sciences and Department Natural Resources and Environmental Sciences.

The Department of Life Sciences gathers experts and young researchers interested in biochemistry, molecular biology, physiology and ecology of plants, fungi and microorganisms. Nevertheless, mathematical modeling of different levels of biological processes, as well as proteins are also on the list of interests of researchers in IMSI. Institute has developed following techniques: HPLC, GCMS, ICP-OES, electrophoresis of proteins and nucleic acids, PCR based techniques, EPR, UV-VIS spectrophotometry, spectrofluorimetry, immunochemisty, scanning electron and fluorescence microscopy and polarography.

Institute has been involved in different forms of collaboration with scientific institutions from European countries, USA, Japan and China. Institute has participated in few EU funded or EU supported projects (FP7, EUREKA initiative, bilateral collaborations, UN funded project, COST actions), and was leading partner in one EUREKA and one UN PACE project.

Different intra-organ antioxidant defense strategies towards UV-B irradiation in white and green leaf parts of variegated *Pelargonium zonale* and *Plectranthus coleoides*

Marija Vidovic[1], Jana Barbro Winkler[2], Andreas Albert[2], Filis Morina[1], Sonja Milic,[1]Sonja Veljovic-Jovanovic[1]

[1] Institute of multidisciplinary research, University of Belgrade (Serbia)
[2] Research Unit Environmental Simulation (EUS), Helmholtz Zentrum München, Neuherberg (Deutschland)

Abstract

Variegated plants, pelargonium (*Pelargonium zonale variegata*) and Swedish ivy (*Plectranthus coleoides variegatus)* were exposed to the high light (1300 µmol $m^{-2}s^{-1}$ PAR) without and with UV-B component (0.6 Wm^{-2}, the intensity on a sunny summer day) under the same temperature and humidity regimes for nine day/night cycles. The experiments were performed under controlled, ecologically relevant conditions, using sun simulators at Helmholtz Zentrum, München (combination of different lamp types which allows simulation of sun irradiance for the both spectral quality and quantity).

Beneficial effect of UV-B on photochemical yield of PSII and CO_2 assimilation was obtained in both species, being more pronounced in *P. coleoides*. Total ascorbate content and its redox status were not changed upon UV-B irradiation in either green or white parts of *P. zonale*. Contrastingly, although total ascorbate increased in the white portions of *P. coleoides* as well*,* its redox status decreased significantly due to UV-B light (from 75% to 15%). This was accompanied by decreased ascorbate peroxidase and catalase activity, while catalase activity increased in some cultivars of UV-B exposed *P. zonale*. UV-B exposure had no significant effect on peroxidase activity in either species, although constitutive differences in the activity of this enzyme were observed between them.

Accumulation of UV-absorbing compounds in both species and both leaf portions after the cleavage of glycoside bonds were measured. While *P. zonale* leaves predominately accumulated flavon-3-ols (quercetin and kaempferol) upon UV-B irradiation, leaves of *P. coleoides* accumulated flavones (apigenin, luteolin). Interestingly, we could not detect any of flavon-3-ols in *P. coleoides* leaves. Instead, cyanidin concentration was several times higher under UV-B irradiation itself, especially in the white part of the *P. coleoides* leaves, while in *P. zonale* leaves anthocyanins were induced only in the green part under the high light with and without UV-B component. Induction of some benzoic acids, like gallic acid and their derivatives as well as hydroxycinnamic acids, such as *p*-coumaric and caffeic acid and their derivatives were important in the adaptation to UV-B treatment in both species. Together, data show different responses to the UV-B exposure in green and white leaf portions of both species and suggest different type of stress and adaptation between this two variegated species.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

We find our results very inspiring and we are planning to continue with research and collaboration with EUS team and to look more closely into the mechanisms of flavonoids comparison to anthocyanins induction. This presents a challenge for using ecologically relevant doses of UVB irradiation as a beneficial agent for improvement of photosynthetic performances and induction of stress defense.

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Short biography

Ass. Prof. A. Patakas has been graduated from Aristotle University of Thessaloniki, School of Agricultural Sciences (1988). He continued his studies in the same University and completed his PhD studies in 1993. He performed post doctoral research in Institute of Forest and Resource Management, University of Edinburgh (1998) and in University of California, Davis, CA 95616, USA (2008-2009). From 1998 he is the Director of the Laboratory of Plant Production in the School of Natural Resources and Enterprise Management of the University of Ioannina. He has more than 16 years research and experimental experience in plant ecology, plant ecophysiology and especially in hydrodynamic physiology of plants. Particularly, in recent years his endeavour has been focused on plants responses to various abiotic stresses aiming to increase plant's performance and productivity under adverse environmental conditions. His specific interest in this work field resulted in the participation in more than 19 EC research projects (in seven of them as coordinator) and the publication of a significant number of research papers.

Short institution/company presentation

The Laboratory of Plant Production was founded in 1998 and belongs to the School of Natural Resources and Enterprise Management of the University of Ioannina (UOI). The main field of the research that is conducted in the Laboratory of Plant Production refers to the evaluation of adaptive responses of plants under abiotic stress conditions at physiological, biochemical, anatomical and more recently at molecular level using proteomics and metabolomics analysis. The specific interest on this work field resulted in the participation in many EC funded research projects, in many national research projects and the publication of a significant number of research papers. The laboratory is well equipped with the appropriate infrastructure for the implementation of abiotic stress research projects. In particular, the infrastructure consists of microclimatic sensors (temperature, PAR, UV, relative humidity, wind speed etc), data loggers, specific equipment for gas exchange measurements (open portable gas exchange system- chlorophyll fluorescence), leaf area meters, as well as plant water status, xylem sap flow and soil moisture sensors. Furthermore, there is specified section for biochemical analysis consisting of HPLC, Gas chromatography (GC-MS), atomic absorption and spectrophotometers. The laboratory is actively participating in the Laboratories Network of University of Ioannina having access to variety of instrumentation capable for metabolome analysis such as: nuclear magnetic resonance (NMR); LC-UV-SPE-NMR ; two-dimensional gel electrophoresis systems etc.

Differences in enzymatic antioxidant mechanism in grapevines subjected to drought and enhanced UV-B radiation

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2. Laboratory of Plant Production, School of Natural Resources and Enterprises Management, University of Ioannina, G. Seferi 2, 30100 Agrinio, Greece

Abstract

The differences in enzymatic antioxidant properties in grapevines (*Vitis vinifera* L. cv Romeiko) exposed to either drought, enhanced levels of UV-B radiation or to the combined application of the two abiotic stressors were studied. Two-year-old grapevines grown outdoors in 25 L pots containing peat:perlite:sand (3:1:1) were used. The following treatments were applied: i) well-watered (WW) control treatment, in which the plants were irrigated every day to soil capacity while being exposed to ambient UV-B radiation (WW-ambient UV-B treatment); (ii) water-stressed (WS) treatment, in which the plants were receiving daily 50% of the amount of irrigation water provided to well-watered plants, under ambient UV-B levels (WS-ambient UV-B treatment); (iii) well-watered treatment under enhanced UV-B, in which the well-watered plants were exposed to ambient plus 30% UV-B radiation (WW +30% UV-B treatment) and (iv) water-stressed treatment under enhanced UV-B, in which the water-stressed plants were exposed to ambient plus 30% UV-B radiation (WS + 30% UV-B treatment). Results indicated that predawn leaf water potential (Ψ_{PD}) decreased progressively in water-stressed treatments, irrespective of the level of the UV-B radiation applied. Both drought and enhanced UV-B radiation caused a significant increase in plants hydrogen peroxide concentrations (H_2O_2) and lipid peroxidation (TBARS). However, the accumulation of H_2O_2 was more pronounced in plants exposed to enhanced UV-B radiation. Independent of water supply, UV-B radiation significant increase the activities of superoxide dismutase (SOD, EC 1.15.1.1), ascorbic peroxidase (APX, EC 1.11.1.11), superoxidase dismutase (SOD, EC 1.15.1.1) and catalase (CAT, EC 1.11.1.6), while the expression of these antioxidant enzymes was lower in plants exposed to drought conditions.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

Increased levels of UV-B radiation have received much attention lately, because of their potential damage to many economically important plant species. Since predicted scenarios of climate change over the next decade include enhanced levels of UV-B radiation, there are great perspectives for further research in this field aiming in evaluating and deeper understanding of the mechanisms of different plant responses to UV-B.

Éva Hideg

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University of Pécs, Institute of Biology

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Short biography

education, degrees:
1983 – graduated as physicists, University of Szeged, Hungary
1986 – Dr. Univ. plant biochemistry, University of Szeged, Hungary
1989 – C.Sc. (Ph.D.), Hungarian Academy of Sciences
1997 – Prof. Habil., University of Pécs, Hungary
2003 – D.Sc., Hungarian Academy of Sciences
affiliations:
1983 – 2011, Biological Research Centre of the Hungarian Academy of Sciences, Szeged
2011 – professor
University of Pécs, Faculty of Sciences, Institute of Biology, Department of Plant Physiology
research interests:
1983 – 1989: charge separation and recombination in Photosystem II of photosynthesis
1988 – 1991: ultraweak light emission from plants (Inaba Biophoton Project, Japan)
1991 – 2000: photoinhibition of photosynthesis by excess PAR or UV-B radiation
1991 – : reactive oxygen detection in plants, EPR (1993 – 1998) and fluorescent (1996 –) ROS traps
2002 – : oxidative stress, abiotic stress in leaves
2008 – : antioxidant / pro-oxidant balance during acclimation to sunlight and various abiotic factors
list of publications:
http://mycite.szbk.u-szeged.hu/search/index.php

Short institution/company presentation

The modern **University of Pécs** (UP) was founded on 1 January 2000 through the merger of Janus Pannonius University, the Medical University of Pécs and the Illyés Gyula Teacher Training College of Szekszárd. However, its roots go back to 1367 when the Anjou king Louis I of Hungary established the first university of the country here (more at http://english.pte.hu/). At present, UP has ten faculties, more than 29,000 students and nearly 2,000 teaching and research staff.
One its ten faculties, the **Faculty of Sciences** (http://ttk.pte.hu/english/) was established on January 1, 1992. The seven institutes constituting the Faculty have around 3,000 students and ca. 140 full-time teaching and research staff. In addition to BSc and MSc training, the Faculty offers PhD studies at four Doctoral Schools (Biology, Chemistry, Geography and Physics).
The present **Institute of Biology** (http://ttk.pte.hu/biologia/biology.htm) consists of seven departments: Animal Ecology, Botany, General Zoology, Genetics, Microbiology, Neurology and Plant Physiology. Research at the **Department of Plant Physiology** includes phytochemistry (grapevine polyphenols), plant molecular biology (BABA-induced

priming, gene silencing in Arabidopsis) and leaf stress physiology (energy dissipation vs. antioxidant responses during stress and acclimation in tobacco and grapevine). The Department has several joint projects with the Institute of Viticulture and Oenology of UP.

Detecting ROS in UV-Treated Leaves – Problems, Pitfalls, Perspectives

Éva Hideg

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Abstract

In plants, reactive oxygen species (ROS), also known as active oxygen species (AOS), are associated with normal, physiologic processes as well as with responses to adverse conditions. ROS may be connected to plant responses in many ways: as primary elicitors, as products and propagators of oxidative damage, or as signal molecules initiating defense or adaptation.

While research during the past decades was focussed on the oxidatively damaging potential of ultraviolet radiation (specially of UV-B), recent studies indicate growth and development regulatory roles of UV. To understand and differentiate roles of ROS in plants under acute or chronic UV exposures it seems inevitable to find, chemically identify and quantify these short-lived molecules in plants.

ROS production can be presumed from a variety of parameters, ranging from changes in antioxidant potentials to detecting oxidatively damaged membrane molecules as well as from the alleviating effects of added antioxidants or similarities between the effects of artificial ROS sources and UV. Measuring ROS by special sensor molecules provide more direct information but these techniques are prone to artefacts and are frequently unable to identify low concentrations.

Focusing on plant leaf studies, the talk will summarize available detection techniques, attempt to identify difficulties and possible errors. Examples will be collected from past and present experiments from the author's laboratory, based on the following publications:

Hideg É, Vass I (1996) UV-B induced free radical production in plant leaves and isolated thylakoid membranes. Plant Science 115, 251-260.

Hideg É, Mano J, Ohno Ch, Asada K (1997) Increased levels of monodehydroascorbate radical in UV-B irradiated broad bean leaves. Plant Cell Physiology 38, 684-690.

Barta Cs, Kálai T, Hideg K, Vass I, Hideg É (2004) Differences in the ROS generating efficacy of various ultraviolet wavelengths in detached spinach leaves. Functional Plant Biology 31, 23-28.

Hideg É, Rosenqvist E, Váradi Gy, Bornman J, Vincze É (2006) A comparison of UV-B induced stress responses in three barley cultivars. Functional Plant Biology 33, 77-90.

Mayer P, Hideg É (2012) Developmental stage is an important factor that determines the antioxidant responses of young and old grapevine leaves under UV irradiation in a green-house. Plant Physiology and Biochemistry 50, 15-23.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

In connection to this meeting's topic:

- Can chemically more aggressive ROS (such as $^1O_2$ or $^{\bullet}OH$) act as signal molecules?
- Do chronic and acute UV-B treatments result in the same ROS: are these only different in flux or also in chemistry? Can we develop sensitive enough methods to study this question?

Claudia Scattino

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Short biography

Claudia Scattino was born in Orvieto (Italy) on June 1984.
In 2006 she received her bachelor's degree in Agricultural and Industrial Biotechnology at the Agriculture Faculty of the University of Pisa and she did an internship at the "Istituto Zooprofilattico" of Lazio and Tuscany in Pisa. In 2009 she obtained her master's degree in Food Biotechnology with a research thesis entitled "Response of secondary metabolism in grapes subjected to partial dehydration and post-harvest treatments with gaseous elicitors".
In 2009 she obtained a collaboration agreement to work at the project "Study of the secondary metabolism of Sangiovese and Trebbiano grapes subjected to partial dehydration and different post-harvest treatments with gaseous elicitors: ethylene and CO_2".
Since 2010 she is a student at the PhD School of Agricultural and Veterinary Sciences (Crop Sciences Program) of the University of Pisa. She is receiving a scholarship from Sant'Anna School of Advanced Studies of Pisa.
Her PhD research is focused on studying the effects of UV-B post-harvest treatments on the secondary metabolism and on cell wall enzymes in different peach cultivar.
She is conducting her activity under the supervision of Prof. Annamaria Ranieri and Prof. Pietro Tonutti at the Department of Crop Biology of the University of Pisa.

Short institution/company presentation

Facoltà di Agraria
Università di Pisa

The Agriculture Faculty of the University of Pisa was definitively established in 1871 and could be considered as the first academic institution in the world for agrarian studies.
Within the Agriculture Faculty, the Department of Crop Biology, established in 1987, has a number of laboratories, experimental facilities at the highest level of expertise in the disciplines of genetics, agricultural industries, chemistry and agricultural and ornamental crops that are used both for educational purposes and also to carry out research and analysis consulting services on behalf of private and public entities.

Free radical production induced by post-harvest UV-B irradiation in different cultivar of peaches: an EPR study

Claudia Scattino[1], Cristina Sgherri[1], Matteo Iannone[1], Chiara Dall'Asta[2], Calogero Pinzino[3], Pietro Tonutti[4], Annamaria Ranieri[1]

[1]Department of Crop Biology, University of Pisa, Pisa, Italy
[2]Department of Organic Chemistry, University of Parma, Parma, Italy
[3]Institute of OrganoMetallic Compounds Chemistry, CNR, Pisa, Italy
[4] Sant'Anna School of Advanced Studies, Pisa, Italy

Abstract

Electron paramagnetic resonance (EPR) is a spectroscopic technique able to directly detect chemical species with unpaired electrons. These species include, but are not limited to, free radicals and transition metal ions.
In order to evaluate the UV-B radiation ability to induce an oxidative stress on skin of peaches, we analyzed, by EPR, three different cultivar: Big Top (nectarine, melting flesh), Suncrest (fuzzy peach, melting flesh) and Babygold 7 (fuzzy peach, non melting flesh). Fruits were subjected by two different treatments: a continuous UV-B irradiation (20°C, 1,68 W/m2) for 36 hours, with sampling every 12 hours, and a 24 hours UV-B treatment followed by a storage at 10°C for 36 hours in dark conditions.
EPR measurements were performed on powder of skin samples lightly packed into quartz tubes using a Varian E112 X-band spectrometer interfaced to a PC and equipped with a standard cavity. Scan ranges of 100 Gauss were used to look closely at the free radical signal with 10 mW microwave power and 4 Gauss modulation amplitude. Free radical concentrations were obtained by double integration of the first derivative signals and comparison with the Varian Strong Pitch standard. Three replicates were analyzed for each material.
Spectra of all samples showed a sharp signal ascribable to organic free radicals. This signal was a single line without any fine structure characterized by a g value of 2.0045±0.0003 and a peak-to-peak line width of 8 Gauss.
This signal is commonly found in plant materials and has been assigned to carbon centred organic free radicals on a conjugated structure with oxygen containing functional groups.
Different kinetics of free radical production were observed in the three cultivar analyzed. Big Top, showed the highest content of radicals. In general, treated samples at 24 hours showed a lower level of organic radicals comparing with no treated fruits, independently of the cultivar. Concerning the storage at 10°C, we obtained opposite results for Big Top and Suncrest cv. Big Top peaches showed during the whole cold storage period a higher radical content in comparison with no treated fruits whereas Suncrest showed at 36 hours of storage a decrease compared to its control.
Concomitantly, we analyzed the evolution in the content of those molecules known for their ability to scavenge radicals, like polyphenols and ascorbic acid. These compounds showed a different trend and amounts depending on the cultivar analyzed.
Moreover, the oxidative stress due to the radical activity was not able to increase the emission of ethylene, both during the UV-B treatment and the cold storage.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

UV-B radiation could be used as an effective "environmental friendly" tool to manage the postharvest quality of fruit and vegetables. Our results suggest a significant effect of this radiation in limiting the loss of nutraceutical compounds during the first hours after the fruits collection and the storage.

Vida Ranceliene

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Short biography

Dr. Vida Ranceliene is a Senior research worker at the Institute of Botany of Nature Research Centre (http://www.gamtostyrimai.lt/). Dr. Ranceliene's PHD work "Induction of chromosome and DNA lesions in barley seedlings, irradiated with short-wave UV radiation" was conducted at the Laboratory of Cell Engineering of the Institute Botany (formerly) of the Lithuanian Academy of Sciences in 1990. Area of the research is the effect of solar, artificial UVB, UVA radiation on plants, the formation of chromosomal aberrations in the meristematic cells, antioxidant enzyme changes in model and cultivated plants. Publications in "Mutation Research", "Environmental Toxicology", "Biologija", etc. The author or co-author of about 80 publications, an executor of several National Projects.

Short institution/company presentation

The Institute of Botany, a State Research Institute, leads the research on plants, fungi and microorganisms in Lithuania. Since the establishment in 1959, the Institute conducts scientific studies in botany, mycology, virology, phytopathology, biodeterioration and bioremediation, phytosociology, vegetation science and vegetation mapping, plant physiology and genetics. The Institute also possesses the Field Experimental Station with extensive field collections of economic plants and Coastal Biological Station for ecological investigations of the Curonian Spit, Curonian Lagoon and the Baltic Sea. Research at the Institute deals with plants, fungi and microorganisms at organism, species, population, community and ecosystem levels answering challenges of modern changing environment. The Institute makes significant contribution to national ecological monitoring and environmental policy. The Institute maintains several collections: the largest national collection of fungi, second largest collection of vascular plants and bryophytes as well as living collections of economic plants and microorganisms.

Modification of UV-B effects on meristematic cells of model plants

Vida Rančelienė, Regina Vyšniauskienė

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Abstract

The recent increase of UV-B radiation at the Earth's surface requires the search of protective means against UV-B because plants are directly exposed to solar UV-B. The meristematic root cells of model plants *Crepis capillaris* and *Allium cepa* cv. 'Stutgarten Riesen' were used as sensitive plant system for modifying effect studies; the action of ascorbic acid and salicylic acid, as well as natural anthocyanins from matured fruits of the Lithuanian cherry cultivars was studied. Treatment of root tips with modifying factors differed. Seeds of *C. capillaris* were germinated in a thermostat in the dark either on distilled water or on 10^{-4} M solutions of ascorbic or salicylic acids. For anthocyanin-rich extract studies roots of onion bulbs or *C. capillaris* germinated seeds were rinsed in solutions of anthocyanins for 3 h. *C. capillaris* root tips were later irradiated with UV-B lamp (Vilber –Lourmat, max 312 nm). The dose for *C. capillaris* was 1500 J m^{-2}. Concentrations of anthocyanins in extracts were 125, 250, 500 mM for *A. cepa* and only 10 mM for very sensitive *C. capillaris*. Concentrations of the tested compounds and UV-B doses were selected in the preliminary tests. Mitotic activity was tested in both plants; in *C. capillaris* chromosome aberration (CA) induction was also analyzed. *C. capillaris* is a very suitable plant for such purposes, having only 2n=6 chromosomes. Salicylic and ascorbic acids significantly reduced the CA level. The effect was clearer when photoreactivating light was also applied, which is a common condition in natural environment. Anthocyanins from cherry fruits showed stimulating effect on cell division. Effect of anthocyanins on mitotic phases was also observed. They delayed mitosis on prophase. That effect may be also considered as protective.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

Effects of UV-B radiation on plants may be regulated by endogenous and exogenous factors; their effects are also influenced by other environmental factors (temperature, CO_2 concentration).

Dirk Vandenhirtz

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Short biography and company presentation

Dipl. Biol. Dirk Vandenhirtz
28/12/1971 Aachen / Germany
Married two Children

Dirk Vandenhirtz is currently CEO of LemnaTec GmbH. Mr. Vandenhirtz has founded the company in 1998.
He obtained his degree in Biological Sciences at the RWTH Aachen working at optimization of ecotox. test systems like the *Duckweed* Test and the *Daphnia* test.
In 1998 he founded the LemnaTec spin off together with Matthias Eberius and Prof. Dr. Schuphan. (chair of Biology V for Ecology, Ecotoxicology and Ecochemistry at RWTH Aachen University)
Since 1993 LemnaTec starts to develop the so called Scanalyzer 3D Plant Phenomic platform which has been successfully installed in many research areas.
Dirk Vandenhirtz is head of research and development LemnaTec developing leading image analysis and plant measurement units for worldwide research purposes in high throughput screening, plant phenotyping, stress research for breeding and basic research.

Education	RWTH Aachen
	1991 – 1998 Studies of Biology at RWTH Aachen
Degree	Dipl. Biol / Master Biol. Ecotoxology
Develop	First Plant Phenotyping Platform
Work	Founder of LemnaTec GmbH 1998
Position	CEO LemnaTec
	Member of the Board Phenofab

Meeting / Publications

- DE 100 14 345.8 Owner LemnaTec GmbH
  Title: Automatic assessment of biological objects on the basis of dynamically color analysis together with size and morphological analysis.
- DE 198 45 883 A1 Owner: LemnaTec GmbH
  Title: Apparatus for the performance of bio-tests
- DE 198 50 154 A1 Owner: LemnaTec GmbH
  Title: Procedure for the performance of lab-testing , especially bio-tests
- The LemnaTec patent application No. 10 2008 039 456.4 with priority 24.8.2007
  Owner: LemnaTec GmbH pending
  Title: Apparatus and procedure to measure root growth (NIR measurements to assess root performance in soil)

High throughput plant phenotyping for the development of better plants for the future

Dirk Vandenhirtz

LemnaTec GmbH

Abstract

Due to the development of highly automated genetic analysis, plant genomics has immensely enlarged our understanding of the genetic structure of plants over the last two decades. The fast evolving need to identify interactions between genes and environmental factors (biotic and abiotic) that brings about a certain plant phenome made it necessary to develop quantitative, reproducible and highly automated plant phenotyping systems for large plant numbers. Phenotyping systems such as these have to integrate reproducible plant management (randomization, watering) and comprehensive imaging of root and shoot far beyond human vision (visible light, fluorescence, near infrared, infrared, X-rays, THz) as well additional chemical analysis methods. Immediate and automated image analysis of the stored images and further data transformation using plant shape and plant growth models are the important intermediate steps before undertaking statistical data analysis of the phenotyping results to characterize plant phenotypes quantitatively. Such quantitative data contributes in a decisive way to the further analysis of gene functions (tilling, QTL etc.), especially under fluctuating or stress-induced environmental conditions with a special focus on complex traits like yield or drought tolerance. This presentation will provide a survey on phenotyping technology and the close interaction between phenotyping technologies, modeling approaches and the new opportunities of fast and automated high-throughput genomics.

Leif A. Eriksson

Professor
University of Gothenburg

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Short biography

B.Sc. in Chemistry, Stockholm university, Sweden, 1988.
Ph.D. in Quantum Chemistry, Uppsala university, Sweden, 1992.
Professor (Biophysical and Theoretical Chemistry) at Örebro university, Sweden, 2006-2009, and National University of Ireland, Galway (NUIG), Ireland, 2009-2011.
Professor of Physical Chemistry at University of Gothenburg, Sweden, since Sept 2011.
217 published peer reviewed papers, and 25 book chapters; >3500 citations; h-index 34.
Scientific throughput: Main supervisor to 7 PhD's, and assistant supervisor to 9 more. To date, 16 postdocs have worked in research group.
Have participated in 65 international conferences; invited speaker in approximately 30 of these.
Co-organizer of 7 international workshops/symposia, and initiator of 2 int'l conference series.
Initiator to, and Chair (2006-2009) of new Section for Theoretical Chemistry of the Swedish Chemical Society.
Co-founder of drug development company Swedish Pharma AB in 2007.
1 patent (new drug for photodynamic skin cancer therapy).
Main research field: Theoretical biochemistry/biophysics, especially catalytic processes of (radical) enzymes, reactive oxygen species, photochemistry and UV-induced damage processes, homology modelling and drug design (anti-tumour drugs, anti-inflammatory drugs and photodynamic compounds). Current focus on different aspects of Cancer, Protein modelling, Drug design and Aptamers. Research is based on density functional theory, molecular dynamics, multiscale modelling, homology modelling, pharmacophores and docking against large databases.

Short institution/company presentation

The University of Gothenburg has approximately 39,000 students and 5,000 employees. It is one of the major universities in northern Europe. We are also one of the most popular universities in Sweden – the University of Gothenburg has the highest number of applicants to many programmes and courses. The University's roughly 40 different Departments cover most scientific disciplines, making it one of Sweden's broadest and most wide-ranging higher education institutions. From an international perspective, the University of Gothenburg is unusually comprehensive, with cutting-edge research in a number of dynamic research areas and often strengthened through close collaboration with Chalmers University of Technology, Sahlgrenska University Hospital, and regional trade and industry.

Chemistry of vitamin B_6 under oxidative stress

Leif A. Eriksson [1] and Åke Strid[2]

[1]Department of Chemistry, University of Gothenburg, 412 96 Göteborg, Sweden
[2]Örebro Life Science Center, School of Science and Technology, Örebro University, 701 82 Örebro, Sweden

Abstract

Vitamin B_6, or pyridoxine, is the precursor of the biologically active derivatives pyridoxal-5'-phosphate and pyridoxamine-5'-phosphate (Fig.1), with functional roles in a number of different enzymes. Pyridoxine itself is a cofactor of several enzymes that catalyze decarboxylations, transaminations, and racemations of amino acids. Bacteria, fungi, and plants produce their own vitamin B_6, whereas parasitic organisms and higher animals have to acquire vitamin B_6 through nutrient intake.

Lately, pyridoxine biosynthesis-deficient mutants of fungi and yeast have been shown to be sensitive to reactive oxygen species (ROS) such as singlet oxygen and hydrogen peroxide. This suggests that vitamin B_6 and its derivatives are also involved in stress tolerance in living organisms, especially in alleviating oxidative stress. In eukaryotes, stress resistance has been implied to involve pyridoxine-dependent singlet oxygen quenching, whereby the pyridoxine itself would react with and quench the singlet oxygen. The oxidative stress-protective effect of pyridoxine has also been described both in red blood cells and in lens cells in animals. Pyridoxine itself was found to be the most effective of the vitamin B_6 species, twice as effective as pyridoxal-5'-phosphate, and as effective as vitamin E.

Knowledge about this novel mechanism of reaction between pyridoxine or its derivatives (cf. Figure 1) and singlet oxygen and other ROS is however very limited. However, since both the aldehyde (pyridoxal) and the amino (pyridoxamine) derivatives only to a small extent influence the rate of reaction, these moieties are probably not involved. Also, since the heteroaromatic absorbance peak at 323 nm disappears during the reaction, at least one of the targets for singlet oxygen is most likely the core of the aromatic ring, leading to ring opening.

In order to shed more light on the possible role of pyridoxine in stress tolerance / protection we herein report on computational studies of possible reaction mechanisms between pyridoxine and different ROS (singlet oxygen, superoxide and hydrogen peroxide) by means of density functional theory (DFT) based methods. It is concluded that the compound has an extremely high quenching power towards hydroxyl radicals. We furthermore explore the explicit UV-induced photolysis pathways of the compound, as well as enzymatic degradation (ring-opening) by bacterial flavoprotein monooxygenases.

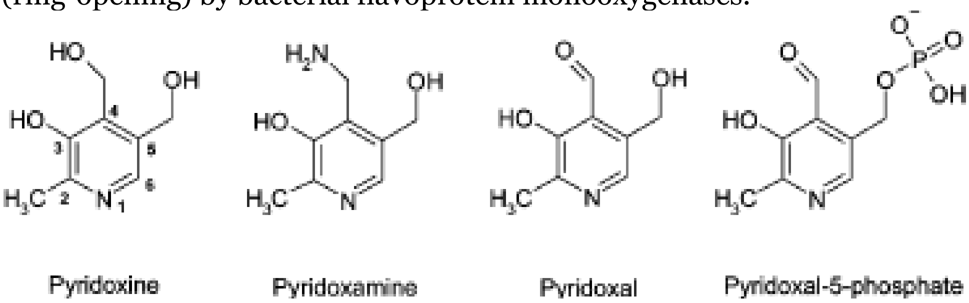

Figure 1. Vitamin B_6 (pyridoxine) and its main derivatives.

Sandy Vanderauwera

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Short biography

After graduating in Biotechnology at Ghent University (Belgium) in 2002, Sandy Vanderauwera obtained her PhD in Science (Biotechnology) at the VIB Department of Plant Systems Biology of Ghent University in 2007. During her PhD, Sandy studied hydrogen peroxide signaling in *Arabidopsis*. As a post-doctoral researcher, she obtained two grants funded by FWO (Science Foundation Flanders) to study potential candidate genes for modulating abiotic stress tolerance and yield stability and to identify molecular mechanisms that are underlying altered growth performance under abiotic stress.

Short institution/company presentation

Created in Belgium in 1995 at the initiative of the Flemish government, VIB (Vlaams Instituut voor Biotechnologie) is a unique example of a non-profit support structure for a particular scientific domain working towards both excellence in research and transformation of the results of such research into economic growth. The Department of Plant Systems Biology is at the forefront of plant sciences and our mission is to integrate **genetics, genomics** and **biocomputing** to unravel the biology of plants and to further explore the potential of plants to build a sustainable world.

Extranuclear protection of chromosomal DNA from oxidative stress

Sandy Vanderauwera[1,2], Nobuhiro Suzuki[3,4], Gad Miller[3], Brigitte van de Cotte [1,2], Stijn Morsa[1,2], Jean-Luc Ravanat[5,6], Alicia Hegie[3], Christian Triantaphylidès [7], Vladimir Shulaev[8], Marc Van Montagu[2], Frank Van Breusegem[1,2] and Ron Mittler [4,9]

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Abstract

Eukaryotic organisms evolved under aerobic conditions subjecting nuclear DNA to damage provoked by reactive oxygen species (ROS). Although ROS are thought to be a major cause of DNA damage, little is known about the molecular mechanisms protecting nuclear DNA from oxidative stress. Our results show that protection of nuclear DNA in plants requires a coordinated function of ROS scavenging pathways residing in the cytosol and peroxisomes, demonstrating that nuclear ROS scavengers such as peroxiredoxin and glutathione are insufficient to safeguard DNA integrity. Both catalase (*cat2*) and cytosolic ascorbate peroxidase (*apx1*) play a key role in protecting the plant genome against photorespiratory dependent hydrogen peroxide (H_2O_2)-induced DNA damage. In *apx1/cat2* double mutant plants, a DNA damage response (DDR) is activated suppressing growth via a WEE1 kinase-dependent cell cycle checkpoint. This response is also correlated with enhanced tolerance to oxidative stress and DNA stress causing agents, as well as suppressed programmed cell death.

Philip John Dix

Professor
National University of Ireland Maynooth

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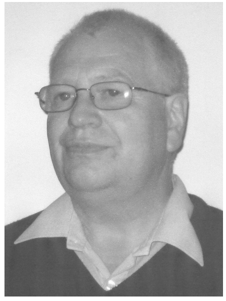

Short biography

***Qualifications and career**:* B.Sc. (1972), Ph.D (1975), University of Leicester, UK. Postdoctoral Research Fellow, Biological Research Center, Szeged, Hungary (1975-8), Postdoctoral Demonstrator, Genetics Dept. University of Newcastle-Upon-Tyne, UK (1978-80). Lecturer, Senior Lecturer, and Professor: Biology Department, National University of Ireland Maynooth (1980-present).

Research interests: Plant Cell Genetics, Tissue Culture and Biotechnology, with a strong emphasis on the chloroplast. Current or recent studies have involved genetic engineering of plastids for pharmaceutical protein (eg. HIV antigens) production or modified starch, fatty acid and amino acid (Cystine, methionine) metabolisism, and improved abiotic stress tolerance through manipulating ROS scavenging systems, or fatty acid desaturation

Recent Publications:

Valkov VT, Gargano, D, Manna C, Formisano G, Dix PJ, Gray JC, Scotti N & Cardi T.: High efficiency plastid transformation in potato and regulation of transgene expression in leaves and tubers by alternative 5' and 3' regulatory sequences. Transgenic Res 20, 137-151 (2011). Poage M, Le Martret B, Jansen MAK, Nugent GD & Dix PJ: Modification of reactive oxygen species (ROS) scavenging capacity of chloroplasts through plastid transformation. Plant Mol Biol 76, 371-384 (2011).

Le Martret B, Poage M, Shiel K, Nugent GD & Dix PJ: Tobacco chloroplast transformants expressing genes encoding dehydroascorbate reductase, glutathione reductase, and glutathione-S-transferase, exhibit altered anti-oxidant metabolism and improved abiotic stress tolerance. Plant Biotech J 9, 661-673 (2011).

Short institution/company presentation

Shortly after its bicentenary year, the National University of Ireland Maynooth was established under the 1997 Universities Act as an autonomous member of the federal structure known as the National University of Ireland. With approximately 8,400 registered students, NUI Maynooth has 26 academic Departments which are organized into three Faculties: Arts, Celtic Studies and Philosophy; Science and Engineering, and Social Sciences. Building on a tradition of scholarship and excellence in all aspects of its Teaching and Learning, and research activities, within the liberal arts and sciences tradition NUI Maynooth is committed to being a first class research-led centre of learning and academic discovery. It is located on a pleasant university campus in Ireland's only university town 20km west of Dublin and has recently undergone a major phase of expansion in research, teaching and service facilities. The spacious campus is laid out in its own extensive grounds in rural surroundings, and is divided between an older complex of fine nineteenth century buildings and a modern complex of teaching, research, accommodation, and support facilities.

Modification of reactive oxygen species (ROS) scavenging capacity of chloroplasts through plastid transformation

Philip John Dix

National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland

Abstract

Reactive oxygen species, including superoxide anions, hydrogen peroxide and hydroxyl radicals are generated through normal biochemical processes, such as respiration and photosynthesis. A range of enzymic and non-enzymic anti-oxidants has evolved to restrict the cellular damage caused by these toxic ROS. These defences can be overwhelmed by excessive levels of ROS induced by abiotic stresses. The prospects for enhancing ROS scavenging, and hence stress tolerance, by direct gene expression in a vulnerable cell compartment, the chloroplast, has been explored in tobacco. A total of four enzymes associated with ROS scavenging (superoxide dismutase [MnSOD], glutathione reductase [GR], dehydroascorbate reductase [DHAR] and glutathione-S-transferase [GST]) has been expressed, singly or in pairwise combinations, in tobacco chloroplasts, and the consequences for key metabolite production and for stress tolerance explored. In selected lines marked differences were found in levels of ascorbate and glutathione, as well as differences in the ratio of oxidised to reduced glutathione. In a number of cases improved stress tolerance has been observed. Examples include enhanced methyl viologen (Paraquat)-induced oxidative stress tolerance in Mn-superoxidase dismutase over-expressing plants, improved heavy metal tolerance in glutathione reductase expressing lines, and improved UV-B tolerance in both these lines. Altered tolerance to salinity and low temperature was also found and simultaneous expression of GR plus DHAR, or GR plus GST, resulted in marked improvement in methyl viologen tolerance. These lines are being further evaluated for response to several stresses, including a more rigorous exploration of their responses to UV.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

We believe our seedbank of tobacco lines with modified plastidic ROS scavenging capacity constitute a valuable resource for investigations into UV responses in plants, and we are seeking resources to generate a more extensive set of such lines.

Laurent Florin

Agricultural Engineer
FORCE-A

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Short biography

2009 - NOW FORCE-A. Orsay
Field Technical Support Engineer
Creation, establishment and development of the partners and customer network.
2005 – 2009 CHAMBRE D'AGRICULTURE DE L'AISNE.
Technician Agri-Environment
Communication about water quality to farmers and winemakers
2005 CIVC. Champagne.
Wine Technician
Monitoring plots and technicial advices to wine growers.
2004 BAYER CROPSCIENCE FRANCE. Lyon.
Development of a software to help to choose cereals herbicides
2003 Monitoring plots.
NORIAP (grain coopérative). Picardie
ETS LABOULET (seeds). Picardie
SERVICE DE LA PROTECTION DES VEGETAUX (french administration). Island of the Reunion.
CPB Twyford (seeds). England.SUPAGRO MONTPELLIER
2000-2004 SUPAGRO MONTPELLIER
Agronomic Engineering degree.

Short institution/company presentation

FORCE-A is a CNRS spin off (Centre National de la Recherche Scientifique), located at University Paris 11, Orsay.
The company has been the award-winner in 2002 and 2004 of the French Government contest for innovative company creation.
FORCE-A produces optical sensors based on fluorescence, the result of more than 15 years of previous R&D experience in the field of plant-light interactions, photosynthesis and optical remote sensing.

FORCE-A optical markers for plant infection and stress

Laurent Florin

Abstract

Thanks to more than 15 years of research, FORCE-A designs, develops and markets optical diagnosis tools for plants, based on fluorescence.
The Dualex® is a leaf clip and the Multiplex® a non contact instrument.

The Dualex® Scientific assesses quickly and quantitatively flavonol contents in fruits and vegetables (leaves and skins) for polyphenolic antioxydants, nutraceutics and medicinal food, and colouring, but also fertilization monitoring, harvest quality assessment (proteins, eco-product development, etc.), light protection, low temperatures, burn prevention, colour (flavonols), and variety selection.

The Multiplex® is a hand-held multi-parameter optical remote sensor for the fast, easy, and non destructive measurement of constitutive and induced polyphenolics, as well as chlorophyll in plants. The Multiplex® uses fluorescence technology with multiple excitations to measure various compounds in berry skins, leaves, fruits and vegetable skins.
This specific device allows to measure anthocyanin contents, the epidermal visible absorbance by FER method, flavonol contents, the epidermal UV absorbance by FER method, chlorophyll contents, the chlorophyll fluorescence, the emission ratio and the UV-excited Blue-Green fluorescence (BGF).

All FORCE-A optical sensors provide simultaneous measurement of various compounds, remote and fast measurements (less than a second), an active sensing with measurements possible under any ambient light conditions (day or night), non destructive measurements, no preparation of the plant, portable device for field measurements (including an internal GPS).
They can be used in conjunction with other agronomical data as decision support systems concerning fertilisation requirements, crop quality forecast, weed infestation and presence of fungal pathogens.

Outlook of challenges and opportunities for ongoing UV-B research and for realization possibilities

FORCE-A fluorescence technology, based on UV excitation, would suit projects related to plant-light interactions and antioxidant quantification.
Besides, Dualex® and the Multiplex® are optical markers whose real time and non destructively polyphenolics measurements would help the users to save a huge amount of time.

Marcel Jansen

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University College Cork,
Enterprise Centre, North Mall Campus, Cork, Ireland
Tel: (353) 021 490 4558

Short biography

- 2003-present. University lecturer, School of Biological, Earth and Environmental Sciences (BEES), University College Cork, Ireland
- 2002-2003. University lecturer, Dept. Plant Physiology, University Antwerp, Belgium
- 1998-2002. Researcher, Dept. Biological Chemistry, John Innes Centre, Norwich, U.K.
- 1995-1998. Research fellow, Dept. Plant Physiology, Agricultural University of Wageningen, The Netherlands

Major research areas

Plant-ecophysiology with research interests in the functional plasticity of plants under stress, including UV-B radiation, organic pollutants and nano-materials. Research centres on elucidating molecular-physiological mechanisms underlying acclimation responses of plants to hostile environments. UV-B research centres on the mechanism, and ecological role of UV-B induced morphogenic changes, including possible trade-offs in terms of plant fitness. Toxicological work centres on the impacts of nanomaterials on various species of *Lemnaceae*.

Key UV-B papers

Marcel A.K. Jansen, Bénedicte Le Martret, Maarten Koornneef. Variations in constitutive and inducible UV-B tolerance; dissecting photosystem II protection in *Arabidopsis thaliana* accessions. Physiol. Plant (2009) 138, 22-34.

Kathleen Hectors, Eveline Jacques, Els Prinsen, Yves Guisez, Jean-Pierre Verbelen, **Marcel A. K. Jansen**, Kris Vissenberg, UV radiation reduces epidermal cell expansion in leaves of *Arabidopsis thaliana*. *J. Exp. Bot* (2010) 61, 4339-4349

Eveline Jacques, Kathleen Hectors, Yves Guisez, Els Prinsen, **Marcel A.K. Jansen**, Jean-Pierre Verbelen, Kris Vissenberg, UV radiation reduces epidermal cell expansion in *Arabidopsis thaliana* leaves without altering cellular microtubule organization. Plant Signaling & Behavior (2010) 6, 1-3.

Amandine Radziejwoski, Kobe Vlieghe, Tim Lammens, Barbara Berckmans, Sara Maes, Marcel Jansen, Claudia Knappe, Andreas Albert, Harald K Seidlitz, Günther Bahnweg, Dirk Inzé, Lieven De Veylder, Atypical E2F activity coordinates PHR1 photolyase gene transcription with endoreduplication onset. EMBO J. (2011) 30, 355-363.

M.A.K. Jansen (2012) 'UV-B radiation; from stressor to regulatory signal' In: *Plant Stress Physiology* (Shabala, S. ed.), CABI, Oxford.

Short institution/company presentation

UCC was established in 1845 as one of three Queen's Colleges at Cork, Galway and Belfast. The site chosen for the college is particularly appropriate given its connection with the patron saint of Cork, St Finbarr. It is believed his monastery and school stood on the bank of the river Lee, which runs through the lower grounds of the university. The University's motto is "Where Finbarr Taught, let Munster Learn." Some 750 academics, teach some 18.000 students in business and law, science engineering and food sciences, medicine and health, and arts, celtic studies and social studies. One of the University's most famous lecturers was Professor George Boole, (lecturer between 1849-1864) the great mathematician, who is best remembered for his development of Boolean algebra without which modern computer science would be impossible. University College, Cork is now one of four constituent universities of the federal National University of Ireland, and is a leading research institution in Ireland (http://www.ucc.ie/en/about/factsandfigures/).

UV-B adaptation; are some plants more UV-B protected than others?

Marcel A.K. Jansen, Dilip K. Biswas, and Bénedicte Le Martret

School of Biological, Earth and Environmental Sciences, University College Cork, Distillery Field, North Mall, Cork, Ireland

Abstract

UV-B levels in the biosphere vary considerable with altitude and latitude. High UV-B levels occur at low latitudes and/or high altitudes, and can potentially cause oxidative damage to plants. An intriguing question is whether plants from high UV-B areas posses enhanced UV-B protection. Several studies have shown that plants from high altitudes are typically more UV-B protected than those growing at lower altitudes and this has been associated with increased levels of UV-screening pigments and antioxidants and increased leaf thickness. It remains to be seen whether such enhanced protection comprises a stronger physiological acclimation response, or rather genetic adaptation. We have compared UV-B protection of 224 *Arabidopsis thaliana* ecotypes originating at latitudes between 16 and 67 °N and altitudes between -4 to +1650 m origin and found significant differences in UV-protection of the photosynthetic machinery in plants grown in growth rooms and/or glasshouses. Remarkably, significant differences in UV-protection were present among ecotypes originating in the same geographic area. This implies that, differences in UV-tolerance may have evolved in response to selection pressures other than UV-B. The notion that UV-B tolerance can be a secondary consequence of adaptation to another environmental parameter is supported by a range of studies that show that UV-B absorbing pigments can be induced by a broad range of unfavourable environmental conditions, such as wounding, herbivory, drought, low temperatures, and mineral deficiencies.

Outlook of challenges and opportunities for ongoing UV-B research

Understanding of UV-B responses, in order to assess potential for exploitation in horticulture.

Line Nybakken

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Short biography

M.Sc. Forestry, Norwegian University of Life Sciences 1998
Dr.scient (PhD), Norwegian University of Life Sciences 2003. Thesis title: UVB screening in arctic and alpine vascular plants and lichens
Post doc/project researcher, Norwegian University of Life Sciences, 2003-2008
University researcher, University of Eastern Finland, Joensuu 2009-2011
Associate professor, Forest Ecology, Norwegian University of Life Sciences 2011-

Short institution/company presentation

The project has been carried through at the University of Eastern Finland, Joensuu.

Performance of the dioecious dark-leaved willow (*Salix myrsinifolia*) under combined enhancements of UV and temperature

L. Nybakken[1,2], T. Ruuhola[1], T. Randriamanana[1] , R. Julkunen-Tiitto[1]

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[2]Department of Ecology and Natural Resource Management, Norwegian University of Life sciences, Box 5003, NO-1432 Ås, Norway

Abstract

The sex-ratio of dioecious species is often biased in nature, and the two sexes may have slightly different demands regarding abiotic factors. It is therefore possible that future climatic changes may impact differently on the sexes, and thus contribute to further sex-bias, by for example changing flowering intensity, seed set and the viability of seeds.
We set up a full-factorial field experiment with enhancements in UVA, UVB (lamps) and temperature (T) (infra-red heaters) in Joensuu, Eastern-Finland in 2009. Both climatic factors were modulated to follow the ambient conditions. Cuttings of eight clones, four of each sex, of dark-leaved willow were planted to the field in spring 2009. In the present study we investigated growth, flowering, seed set and seed secondary chemistry in the third growing season (2011). Elevated T enhanced all growth parameters, and growth was greatest in males. The majority of the individuals flowered, and the number of catkins was highest under elevated T, and males had more catkins than females. Elevated UV did not have any effects on growth or flowering, while seed weight and secondary chemistry were not affected by any of the treatments.
The study suggests that the dark-leaved willow is resistant to realistic enhancements in UVB even in combination with other environmental changes. Further implications of the results will be discussed.

Outlook of challenges and opportunities for ongoing UV-B research

The presented experiment with combinations of UVB and temperature treatments in the field will be continued with Populus tremula from the spring 2012.

List of Participants

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Title: Abstracts of the WG3 mini-conference of COST Action FA0906 UV4growth
“Plant responses to ultraviolet radiation – roles of antioxidants and pro-oxidants“,
2012