International Conference

Plant Nutrition, Growth & Environment Interactions III

Programme and Abstracts

Vienna, Austria
February 20-21, 2017
Organizing Committee

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<td>Matsuo Uemura (Japan)</td>
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- other repairs
Dear Friends! Dear Colleagues!

Welcome to the International Conference “Plant Nutrition, Growth & Environment Interactions III”!

Welcome to Vienna!

Efficient plant production and yield is highly dependent on understanding of the basic principles underlying the three-way interaction between the plant development, its nutrition and its interaction with environment.

International Conference “Plant Nutrition, Growth & Environment Interactions III” will review the state of the art and progress in the knowledge of plant growth, plant responses to nutrition and environment and to set research priorities for the next era of research. The Conference program covers a broad spectrum of topics from plant growth, development and nutrition to plant - environment interactions.

The main aim of the International Conference “Plant Nutrition, Growth & Environment Interactions III” is to provide leading academy and industry scientists a platform to communicate recent advances in “Plant Growth, Nutrition & Environment Interaction”, and an opportunity to establish multilateral collaborations.

The program of the event combines plenary lectures, poster sessions, a unique Conference Dinner Party and sightseeing tours of Vienna.

Vienna is located in the heart of Europe on the banks of the Danube River, and considered as one of the most important economic, cultural and touristic large cities of central Europe. Apart from providing top science, the Conference will capture the spirit of the city thanks to the central location of the venue offering a multitude of cultural events.

Prof. Karl Mühling (Kiel University, Chair, Scientific Programme)
Prof. Alisher Touraev (VISCEA, Local Organizer)
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## SCIENTIFIC PROGRAMME

### February 20 (Monday)

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<td><strong>Opening</strong></td>
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<td><strong>Keynote Lecture:</strong></td>
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<td>10.30 - 11.00</td>
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<td>11.00 - 12.30</td>
<td><strong>Session I: Plant Nutrient: Acquisition, Homeostasis</strong></td>
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<td>Edgar Peiter &amp; Stanislav Kopriva</td>
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<td>11.00 - 11.20 (+5)</td>
<td>Gregory Vert (France): Integrated Control of the Root Iron Uptake Machinery in Arabidopsis</td>
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<td>11.25 - 11.45 (+5)</td>
<td>Edgar Peiter (Germany): Manganese Homeostasis in Plants - Balancing on the Ridge between Deficiency and Toxicity</td>
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<td>11.50 - 12.10 (+5)</td>
<td>Stanislav Kopriva (Germany): Control of Sulfate Accumulation in Arabidopsis</td>
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<td>12.15 - 12.35 (+5)</td>
<td>Carsten Richter (Conviron, Germany): Importance of Growth Chamber Conditions for Uniform Plant Growth</td>
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<td>12.40 - 14.00</td>
<td><strong>Lunch + Poster Session (all numbers)</strong></td>
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<td>14.00 - 15.30</td>
<td><strong>Session II: Plant Nutrition: Physiology and Mechanism</strong></td>
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<td>Patrick Bienert (Germany): Identification of Mechanisms Contributing to Boron Efficiency in Rapeseed and Arabidopsis Genotypes</td>
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<td>Ekaterina Yotsova (Bulgaria): Effect of Salicylic Acid on Photosystem II in Rice Plants</td>
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<td>15.30 - 16.00</td>
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16.00 - 17.30  Session III: Plant Nutrition: Symbiotic Interactions

Chairs  Martin Parniske & Karin Groten

16.00 - 16.20 (+5)  Martin Parniske (Germany): Correct Behaviour: How Plant Cells Respond Appropriately to Different Symbiotic Partners

16.25 - 16.45 (+5)  Karin Groten (Germany): Interaction with Arbuscular Mycorrhizal Fungi Alters Plant Phenotypes

16.50 - 17.10 (+5)  Caroline Gutjahr (Germany): Regulation of Arbuscular Mycorrhiza Development by GRAS Proteins

17.15 – 17.25 (+5)  Cristina Cruz (Portugal): The Soil Biotic Context Alters the Impacts of AMF on Plant Growth and Nutrient Acquisition

17.30 - 19.00  Welcome Reception + Poster Session (all numbers)

February 21 (Tuesday)

08.00 - 17.00  Registration

09.00 - 10.30  Session IV: Plant Nutrition: Fertilizers and Soil

Chairs  Karl H. Mühling & Hans-Werner Olfs

09.00 - 09.25 (+5)  Karl H. Mühling (Germany): Magnesium the Forgotten Element: Improving Photosynthesis, Nutritional Status and Protein Content of Crop Plants by Mg Foliar Application

09.30 - 09.55 (+5)  Hans-Werner Olfs (Germany): Slurry Injection in Maize Cropping: Enhancing Nutrient Use Efficiencies from Liquid Manure


10.15 - 10.25 (+5)  Muhammad Firdaus Abdul Karim (UK/Malaysia): Is it Carbon Derived from Plants or Soil Organic Matter that Drives Denitrification in Rice Cultivars?

10.30 - 11.00  Coffee break

11.00 - 12.30  Session V: Signalling & Hormones in Plant Growth and Development

Chairs  Gabriel Krouk & Yrjo Helariutta

11.00 - 11.20 (+5)  Gabriel Krouk (USA): A Systems View of Nitrogen Signaling Interactions

11.25 - 11.45 (+5)  Yka Helariutta (UK): Plasmodesmata-Mediated Intercellular Signaling During Plant Growth and Development

11.50 - 12.10 (+5)  Sandrine Ruffel (USA): Deciphering Cytokinin Dependent-Shoot Regulatory Network Controlling Root Response to Nitrate Heterogeneity
12.15 - 12.25 (+5) **Eveline Queiroz de Pinho Tavares (Brazil):** Unravelling Root Constitutive Aerenchyma Formation by Auxin-Ethylene Regulation within Sugarcane Starved Plants Supported by mRNA and miRNA Transcript

12.30 - 14.00 **Lunch + Poster Session (all numbers)**

**14.00 - 15.30 Session VI: Environmental Regulation of Plant Growth & Development**

*Chairs* Katrin Kahlen & Michael Frei

14.00 - 14.20 (+5) **Michael Frei (Germany):** Interactions of Iron as a Redox Active Transition Metal with Plant Antioxidants

14.25 – 14.45 (+5) **Katrin Kahlen (Germany):** Predicting Plant Performance under Simultaneously Changing Environmental Conditions

14.50 - 15.05 (+5) **Kaining Zhou (Israel):** Effects of Photo-selective Netting on Root Growth and Development of Young Grafted Orange Trees in the Field

15.15 - 15.25 (+5) **Xiaolin Chen (China):** Effect of Sulfated Polysaccharides from Enteromorpha profifera on Plants under NaCl Stress

**15.30 - 16.00 Coffee break**

**16.00 - 17.30 Session VII: Plant - Environment Interactions**

*Chairs* Philippe Vandenkoornhuyse & Matsuo Uemura

16.00 - 16.25 (+5) **Philippe Vandenkoornhuyse (France):** The Toolbox of Plant Holobiont for Phenotypic Adjustment to Environment

16.30 – 16.55 (+5) **Matsuo Uemura (Japan):** Interactions of Temperature and Light Signals in Plant Cold Acclimation for Survival in Changing Environment

17.00 - 17.15 (+5) **Cengiz Toker (Turkey):** Interaction Between Fe-Deficiency Chlorosis and Temperature in Chickpea (Cicer Arietinum L.)

**17.20 - 17.50 Closing Ceremony & Conference Photo**

**19.00 - 22.00 Conference Dinner Party**
OlChemIm was founded in 1991 in Czechoslovakia with the desire to produce the highest quality cytokinins and their immunoreagents. Now OlChemIm is a world supplier of Plant Growth Regulators such as cytokinins, gibberellins, auxins, jasmonates, strigolactones etc. For their detection OlChemIm also offers antibodies against them, labelled Plant Growth Regulators and immunoassay kits. Our broad-based experience in plant hormone chemistry makes our catalogue the most complete shopping centre for any plant growth regulator and our supply programme will be continuously expanded.
Abstracts of Oral Presentations
Nutrient Use Efficiency in Wheat and Prospects for Improvement

Malcolm J Hawkesford

Rothamsted Research, Harpenden, AL5 2JQ, United Kingdom. Correspondence to: malcolm.hawkesford@rothamsted.ac.uk

There is an overriding need for increased crop production, however a critical aspect is sustainability and the avoidance of negative impacts on the environment. It has been estimated that only a third of nitrogen inputs to cereal crop worldwide are recovered in grain for consumption resulting in a huge waste of resource, with major negative impacts on the environment. Nutrient use efficiency (NUE) is a complex trait comprising two key major components, uptake and utilization efficiency, both complex traits in themselves, each involving many physiological processes and biochemical pathways. Critically quality as well as yield are key targets. A deeper understanding of the processes involved in NUE has been a target of the Wheat Genetic Improvement Network (WGIN) project (http://www.wgin.org.uk/) in which both variety trials and genetic mapping populations have been assessed for performance for nutrient acquisition at varying N-inputs. This has enabled the breakdown of characteristics contributing to NUE and an assessment of the variation present predominantly in modern cultivars; a total of 13 years of data has been obtained to date. Significant but limited variation indicates a requirement for broader germplasm screening for high NUE traits, and which may include older varieties and landraces (see the WISP project: http://www.wheatisp.org). New approaches for phenotyping key traits in these large germplasm will also be presented.

Integrated Control of the Root Iron Uptake Machinery in Arabidopsis

Greg Vert

Institute for Integrative Biology of the Cell (I2BC), Gif-sur-Yvette (France). Correspondence to: Gregory.Vert@i2bc.paris-saclay.fr

Plants require metals for essential functions ranging from respiration to photosynthesis. Although critical for plant growth and development, these metals are highly reactive and toxic when found in excess in the cell, highlighting the necessity for a tight control of metal uptake by plants. The Arabidopsis IRT1 root iron transporter is responsible for iron uptake from the soil under iron-limited conditions. IRT1 however shows poor selectivity and also mediates transport of other non-iron metal substrates such as zinc, manganese, cobalt and cadmium. The spatial and temporal control of IRT1 gene expression in response to iron starvation and is driven by intricate transcriptional networks. We recently uncovered additional regulatory mechanisms targeting IRT1 at the post-translational level. The polar distribution of IRT1 at outer plasma membrane domain of root epidermal cells, its distribution in specific plasma membrane microdomains, and its dynamics between the cell surface and endosomes appears to be crucial for proper iron and metal uptake and homeostasis. Altogether, these multiple and multilevel regulatory mechanisms integrating both endogenous and exogenous cues fine tune IRT1 gene expression and plant metal uptake.
Manganese Homeostasis in Plants - Balancing on the Ridge between Deficiency and Toxicity

Edgar Peiter

Plant Nutrition Laboratory, Institute of Agricultural and Nutritional Sciences, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany. Correspondence to: edgar.peiter@landw.uni-halle.de

As an essential micronutrient, manganese (Mn) participates in a multitude of enzymatic processes in plants, including photosynthetic water splitting. Hence, Mn deficiency is frequently observed in crops growing on alkaline soils with low Mn availability. Conversely, acidic and waterlogged soil conditions provoke an excessive Mn availability. Recent work has addressed the question how plants avoid both deficiency and toxicity of Mn. Under high Mn load, the MTP11 transporter is at the core of a detoxification pathway in Arabidopsis that clears the cytosol of Mn by export of the metal. Another member of this protein family mediates root-to-shoot translocation of Mn, hence increasing Mn efficiency, in particular under Mn-limiting conditions. A third member, MTP8, was recently identified as a critical determinant of Fe deficiency chlorosis. It prevents a Mn-induced inhibition of ferric chelate reductase, providing a mechanistic explanation for the long-known interference of Mn in Fe nutrition. In addition, the MTP8 protein governs Mn and Fe allocation in developing and germinating seeds. Taken together, the CDF/MTP family has emerged as a cornerstone of plant Mn homeostasis under a variety of developmental and environmental circumstances.

Control of Sulfate Accumulation in Arabidopsis

Stanislav Kopriva

Botanical Institute and Centre of Excellence on Plant Sciences, University of Cologne, Zuepicher Str. 47b, 50674 Cologne, Germany. Correspondence to: skopriva@uni-koeln.de

Sulfur is an essential nutrient available to plants as an inorganic oxyanion, sulfate. Plants assimilate sulfate into cysteine but also store it in the vacuoles. Since many intermediates of sulfate reduction are toxic, sulfate homeostasis is tightly regulated. Sulfate accumulation is highly affected by its availability in the nutrition and by the demand of the plant. There is also substantial natural variation in sulfate levels in different accessions of the model plant Arabidopsis thaliana. We have exploited this variation to identify responsible genes using QTL analysis as well as genome wide association mapping. We found that in several Arabidopsis accessions activities of enzymes from the sulfate assimilation pathway are highly reduced. These data will be discussed in the context of the general regulation of sulfur metabolism.

Importance of Growth Chamber Conditions for Uniform Plant Growth

Carsten Richter

Conviron Germany GmbH, Berlin, Germany. Correspondence to: crichter@conviron.com

Generation of comparative data e.g. for different cultivars, genotypes, or different experimental treatments very often requires growth of plants in uniform environments. Plants in growth chambers need highly specific conditions e.g. for evaporation of water, heat dissipation of irradiant energy, and gas exchange to achieve normal and consistent growth and physiological performance. Meeting these demands requires a growth room design very different e.g. from ordinary cooling rooms. Design factors crucial for achieving homogeneous and consistent plant growth as well as examples of plants showing non-uniform growth will be presented and discussed.
Improving Crop Mineral Nutrition: Exploiting Knowledge of Uptake and Utilisation Efficiencies

Timothy S George and Philip J. White
The James Hutton Institute, Invergowrie, Dundee, DD2 5DA, UK. Correspondence to: tim.george@hutton.ac.uk

Plants require 14 mineral elements for their nutrition. These include the macronutrients nitrogen, phosphorus and potassium, which often limit crop production and are routinely applied as fertilisers. This talk will focus on the potential gains from exploiting our current understanding of nutrient utilisation and uptake efficiencies. The agricultural use efficiency of a nutrient is the product of the efficiency of acquisition (UpE) and the efficiency by which it is then utilised to generate yield (UtE). Crops with greater UpE have optimised root architectures, greater nutrient uptake capacity, release compounds to increase the phytoavailability of nutrients in the rhizosphere, and increase water uptake through transpiration. Crops with greater UtE have faster canopy establishment, greater photosynthesis, larger harvest index, reduced critical nutrient concentrations, better nutrient redistribution between tissues, and can replace nutrients in non-essential functions. There are many interactions and trade-offs between these traits and most are genetically controlled in a quantitative fashion. Breeding a single genotype for improved mineral nutrition in all situations is likely to be impossible and an approach which targets specific genotypes for specific environments is recommended.

Identification of Mechanisms Contributing to Boron Efficiency in Rapeseed and Arabidopsis Genotypes

B. Pommerrenig, A. Diehn, M.D. Bienert, A. Junker, T. Altmann and Gerd Patrick Bienert
Leibniz Institute of Plant Genetics and Crop Plant Research, 06466 Gatersleben, Germany. Correspondence to: bienert@ipk-gatersleben.de

Boron (B) is an essential micronutrient for plants. We screened 599 Brassica napus cultivars for B deficiency tolerance. Three highly B deficiency tolerant cultivars have been identified. Elemental analysis revealed significant differences in B contents and B compartmentalization of B deficiency tolerant and sensitive plants when grown under B-deficient conditions but not under standard conditions. These results indicate that the B deficiency tolerant cultivars can grow with a very limited amount of B. Nodulin26-like Intrinsic Proteins (NIPs) and Boron transporters (BORs) are essential for plant B uptake and distribution. The systematic focus on the characterization of BnaNIPs and BnaBORs will clarify their role in the B response network and in transport processes to and within the highly B-demanding reproductive organs.

In a 2nd high throughput phenotyping experiment B deficiency tolerant Arabidopsis accessions have been identified and are currently analysed for the expression of B transport protein-encoding genes and root system architecture traits under B deficient conditions. We compare these parameters in both species in detail and aim for identifying the genes being responsible for the B deficiency tolerance.
Effect of Salicylic Acid on Photosystem II in Rice Plants

Ekaterina Yotsova, A. Dobrikova, M. Stefanov, E. Apostolova

Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria. Correspondence to: katya13@bio21.bas.bg; ekaterina_yotsova@abv.bg

The goal of this investigation was to estimate the impact of exogenous application of salicylic acid (SA) through the rooting medium on the photosynthetic apparatus in rice plants under physiological conditions. The effects of different concentrations of SA (10, 50, 100 µM) on the donor and the acceptor side of photosystem II (PSII) were assessed by the absorption spectroscopy, the chlorophyll fluorescence, the PSII mediated electron transport and oxygen evolution. This study revealed that SA influences the energy transfer between pigment-protein complexes in PSII, the time of re-oxidation of QA, the interaction between QB and plastoquinone as well as the kinetic parameters of the oxygen-evolving reaction. All these alterations depend strongly from the concentration of SA. Data suggest that one of the possible reasons for the protective role of the low concentration of SA in photosynthetic membranes is a modification of the Mn clusters of oxygen-evolving complex by influence on the initial S0–S1 state distribution in the dark and also a decrease of the misses and the rate constant of the turnover time of Si states. This study is supported by the project №137/12.05.2016 of Program for career development of young scientists, BAS

Nitric Oxide-Mediated Regulation of Growth, Salt Accumulation and Nutrient Homeostasis in Mangrove Species, Kandelia obovata Grown in Saline Soil

Mirza Hasanuzzaman1,2, Masashi Inafuku1, Masayuki Fujita3 and Hirosuke Oku1

1Molecular Biotechnology Group, Center of Molecular Biosciences (COMB), Tropical Biosphere Research Center, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa 903-0213, Japan;
2Department of Agronomy, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh;
3Laboratory of Plant Stress Responses, Faculty of Agriculture, Kagawa University, Miki-cho, Kita-gun, Kagawa 761-0701, Japan.
Correspondence to: mhzsauag@yahoo.com

Enhancement of salt tolerance in glycophytes is already well reported. However, the physiological role of nitric oxide (NO) in mangrove is yet to be elucidated. In this study, we investigate how NO take part in enhancing plant growth and nutrient homeostasis in a mangrove halophyte, Kandelia obovata seedlings. The propagules collected from surface of soil or seawater were raised in plastic pot under non-saline condition for two months. The seedlings were then grown under 1.5 and 3.0% NaCl solution for 2 months. To observe the role of NO, 100 µM sodium nitroprusside (SNP) was used as NO donor, while same dose of hemoglobin (Hb) and N-nitro-L-arginine methyl ester hydrochloride (L-NAME) was used as NO scavenger and NO synthase (NOS) inhibitor, respectively. The results showed that 1.5% salinity did not affect the seedling growth but 3.0% salt decreased root length and shoot length. Both salt concentrations markedly increased the Na+ content but decreased the K+ and therefore the ratio of K+/Na+ decreased. The content of Ca2+ and Mg2+ decreased only at 3.0% salinity. Exogenous NO increased root and shoot length and kept the Na+ content lower under stressful condition with higher K+/Na+ ratio. Importantly, these effects of NO were reversed by specific scavenger and NOS inhibitor which confirmed the role of NO in growth regulation and maintenance of Na+ and other nutrient ions homeostasis in K. obovata plant.
Correct Behaviour: How Plant Cells Respond Appropriately to Different Symbiotic Partners

Martin Parniske

LMU Munich, Martinsried, Germany. Correspondence to: parniske@lmu.de

The agricultural application of the nitrogen-fixing root nodule symbiosis of legumes such as soybean has a major impact on global nitrogen cycles. However, legume roots can not only engage in beneficial intracellular symbioses with nitrogen-fixing bacteria but also with nutrient-delivering fungi. One question is how roots distinguish bacterial from fungal symbionts and ensure the activation of appropriate responses. This question is intriguing because plants utilize a common signal transduction system for both symbioses and the rhizosphere microbiome potentially exposes plant cells both partners at the same time. The talk will illuminate two possible mechanistic decision points in the signalling process, the perception of the microorganism and transcriptional responses.


Interaction with Arbuscular Mycorrhizal Fungi Alters Plant Phenotypes

Karin Groten, Julia Wilde, Felipe Yon, Ian T. Baldwin

Department of Molecular Ecology, Max Planck Institute for Chemical Ecology, Hans-Knoell-Str. 8, 07745 Jena. Correspondence to: kgroten@ice.mpg.de

Our long-term goal is to experimentally explore if and how root colonization with arbuscular mycorrhizal (AM) fungi affects plant communities under natural conditions. We use the ecological model plant Nicotiana attenuata, a wild tobacco species native to the Great Basin Desert in Utah (USA), silenced in the expression of calcium and calmodulin-dependent protein kinase (CCamK) and impaired in the interaction with AM, to study the whole-plant and ecological consequences of AM colonization. irCCamK and empty vector (EV) plants were grown individually and in communities in the greenhouse and in the field in the plant’s native habitat. The overall fungal community of field-grown roots did not differ significantly among EV and the transgenic line, while the bacterial communities showed higher alpha-diversity parameters in EV plants compared with two of three independently transformed irCCamK lines, though beta-diversities did not show a clear difference. Further analyses of growth and fitness parameters as well as herbivore presence and damage suggest that AM colonization affects the plant phenotype and community dynamics when plants have to compete for limited resources or are challenged by stress factors such as herbivory.
**Regulation of Arbuscular Mycorrhiza Development by GRAS Proteins**

Priya Pimprikar, Samy Carbonnel, Michael Paries, Katja Katzer, Verena Klingl, Monica Bohmer, Leonhard Karl, Martin Parniske, Caroline Gutjahr

Faculty of Biology, Genetics, University of Munich (LMU), Biocenter Martinsried, Großhaderner Str. 2-4, 82152 Martinsried, Germany. Correspondence to: caroline.gutjahr@lmu.de

Arbuscular mycorrhiza (AM) symbiosis with glomeromycotan fungi is a widespread strategy of plants to acquire mineral nutrients from soil. Root colonization by AM fungi culminates in the formation of highly branched structures called arbuscules that release the mineral nutrients to the plant. Arbuscule formation requires DELLA proteins and is accordingly inhibited by gibberellin. However, it remained unknown how DELLA promotes arbuscule formation mechanistically. During colonization perception of fungal signals triggers nuclear calcium spiking, which is decoded by a nuclear localized calcium and calmodulin dependent kinase (CCaMK). CCaMK interacts with and phosphorylates the transcription factor CYCLOPS that activates downstream AM signaling. We found that DELLA physically interacts with CYCLOPS to regulate target genes specifically involved in arbuscule formation such as RAM1, which is required for arbuscule branching. CYCLOPS directly binds to a cis-element in the RAM1 promoter and likely recruits DELLA to the DNA. Ectopic expression of degradation resistant DELLA-delta17 induces RAM1 and other genes involved in arbuscule formation in the absence of the fungus. Furthermore, ectopic RAM1 expression supports arbuscule formation in a cyclops mutant and in presence of GA placing RAM1 downstream of the CYCLOPS-DELLA complex. We reveal a transcription factor complex, which integrates symbiosis and GA signaling possibly to adjust symbiosis development with the plants nutritional state.

**The Soil Biotic Context Alters the Impacts of AMF on Plant Growth and Nutrient Acquisition**

Teresa Dias, Patrícia Correia, Luís Carvalho, Cristina Cruz

Centre for Ecology, Evolution and Environmental Changes, FCUL, Portugal. Correspondence to: ccruz@fc.ul.pt

Plants ‘culture’ the soil biota, which potentially affects their own growth and demography as well as that of other plant species through feedbacks. But key soil organisms, such as arbuscular mycorrhizal fungi (AMF) can modulate the direction and magnitude of that feedback. We tested the hypotheses that it is the interaction between the soil biotic context and the identity of the AMF that determines the direction and magnitude of the feedback. In a greenhouse experiment, we applied the negative feedback of maize mono cropping to this framework and examined the impacts of soil biotic context (sterilized versus non-sterilized) and inoculation with 5 AMF species on maize growth and nutrients. Since the plants grown on non-sterilized soil grew less and acquired fewer nutrients than those grown on sterilized soil, the soil biotic context exerted a negative impact on maize. But inoculation with C. claroideum, F. mosseae, Gigaspora sp cancelled these negative impacts of maize mono cropping, while plants inoculated with R. intraradices and Scutellospora sp. were still subjected to negative feedback. Thus it is the combination of AMF species and soil biotic context that determines the feedback, which has practical implications for inoculants’ design.
Magnesium the Forgotten Element: Improving Photosynthesis, Nutritional Status and Protein Content of Crop Plants by Mg Foliar Application

Karl H. Muehling

Institute of Plant Nutrition and Soil Science, Kiel University, Hermann-Rodewald-Str. 2, 24118 Kiel, Germany. Correspondence to: khmuehling@plantnutrition.uni-kiel.de

Despite the well-known role of Magnesium (Mg) for a number of key functions in plant metabolism there is surprisingly little research activity on the function of Mg nutrition in plant production and quality. Hence, Mg is often considered a “forgotten element” although Mg deficiency is increasingly becoming an important limiting factor in intensive crop production systems especially in soils fertilized with ammonium and potassium.

Mg-chelatase is the enzyme incorporating Mg into the chlorophyll precursor molecule and the transcript abundance is important for the regulation of this enzyme. The transcription of these enzymes might give information about their role in the formation of deficiency symptoms under the influence of Mg deficiency and foliar Mg application. In addition, this study revealed that the transcription of the plasmalemma H+ATPase isoforms is differentially regulated under Mg deficiency.

Mg foliar application resulted in a significant increase of seed yield of plants growing in Mg deficient nutrient solution. In addition, the quality of the seeds was raised due to Mg foliar application as significantly higher protein concentrations could be found.

Slurry Injection in Maize Cropping: Enhancing Nutrient Use Efficiencies from Liquid Manure

Hans-Werner Olfs

University of Applied Sciences Osnabruceck, Am Kruempel 31, D-49090 Osnabrueck, Germany. Correspondence to: h-w.ols@hs-osnabrueck.de

Intensive livestock farming and biogas production resulting in high amounts of organic manure and an increasing acreage of maize characterize agriculture in north-west Germany. Although broadcast slurry application already covers the nutrient demand of maize, most farmers use a side dressed mineral nitrogen (N) and phosphorous (P) fertilizer (“starter fertilizer”) to ensure proper early growth development. This regularly leads to nutrient surpluses at field level, which are at risk to be lost into non-agricultural ecosystems. Slurry injection below the maize seeds might be an option to replace NP starter fertilizer without impairing maize yields and quality.

In a field trial series (2013-2015, 8 sites per year) slurry injection (with/without addition of a nitrification inhibitor) resulted in at least equal yield and slightly higher N uptake compared to slurry broadcast application with starter fertilizer indicating an increased N use efficiency.

In an additional 2-year field trial (2014-2015) the spatial and temporal soil mineral nitrogen (SMN) dynamics for four treatments (unfertilized control, broadcast application + NP starter fertilizer, injection and injection + nitrification inhibitor) were investigated. The risk of nitrate leaching is reduced when slurry is injected (especially when supplemented with a nitrification inhibitor), because the applied nitrogen is located in a soil zone with better spatial availability for plant roots.

Weronika Czaban¹, Jim Rasmussen², Mogens Nicolaisen³, Inge Fomsgaard¹

¹Department of Agroecology, Faculty of Science and Technology, Aarhus University, Forsøgsvej 1, 4200 Slagelse, Denmark; ²Department of Agroecology, Faculty of Science and Technology, Aarhus University, Blichers Allé 20, 8830 Tjele, Denmark. Correspondence to: weronika.czaban@agro.au.dk

White clover (Trifolium repens) adds N from biological N2-fixation to soil. Due to increased dependence on N from white clover in sustainable agriculture, better knowledge of plant-soil N cycling is needed. A key issue is to understand the fate of amino acids secreted from clover roots. While most of the research has focused on clover amino acid exudation, only limited information is available on the reverse process. In that context, asparagine is of special interest as it is one of the most abundant amino acids in clover root extracts, a major product of N2-fixation, and the primary N transport molecule in many legumes. The existing information on amino acid uptake by clover comes from the sterile experiments. This warrants that not only studies on clover ability to take up asparagine, but also exploration of its potential to assimilate the amino acid from soil are needed. Different abiotic and biotic factors influence asparagine dissipation in soil. Among them are clover and microbial secondary metabolites, which can directly or indirectly influence plant and microbial performance and, thus, the cycling of asparagine in soil. Exploration of clover ability and opportunity to assimilate asparagine by elucidating clover-microbe interactions occurring in soil would greatly enhance the use efficiency of clover-derived N.

Our study is the first to establish that clover has the ability to assimilate asparagine at field-relevant concentrations from a sterile hydroponic solution both in the absence and presence of inorganic N. Furthermore, rapid fluxes of amino acids in the growth medium and clover tissues showed that the pre- and post-uptake processes have to be considered when interpreting the uptake rate. A fate study of asparagine in soil showed rapid dissipation, which highlights that fast turnover can potentially reduce clover opportunity to acquire intact asparagine form soil, but the detection of transformation compounds (aspartic acid and glutamic acid) revealed that other amino acids can be simultaneously available for the uptake. Moreover, exploration of clover and microbial secondary metabolites showed that flavonoids enhance amino acid fluxes and pools in soil via stimulation of microbial community structure and activity, whereas microbial metabolites can decrease clover uptake of asparagine by targeting multiple physiological traits in the plant. Finally, the finding of intact asparagine in clover tissues provides evidence of ecological relevance of amino acid uptake to clover even in the presence of competing microorganisms and other available N compounds in soil. These novel findings provide new insights into N flow in the clover rhizosphere, which can be used to optimize the N-use efficiency from clover.
Is it Carbon Derived from Plants or Soil Organic Matter that Drives Denitrification in Rice Cultivars?

Muhammad Firdaus Abdul Karim¹³, Elizabeth M. Baggs² & Nicholas J. Morley¹

¹School of Biological Sciences, Cruickshank Building (1.17,) Inst. of Biological & Environmental Sciences, University of Aberdeen, AB24 3UU, UK; ²Royal (Dick) School of Veterinary Studies, University of Edinburgh, EH25 9RG, UK; ³Faculty of Earth Science, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia. Correspondence to: r02mfa14@abdn.ac.uk; firdaus.fert@gmail.com

Carbon (C) in the rhizosphere is known to play a vital role in heterotrophic denitrification, a major source of the greenhouse gas N2O but knowledge on whether denitrification N2O and N2 fluxes are driven by C derived from roots or soil organic matter (SOM) is limited, especially how C preference is impacted by plant growth phases and SOM quantity. Here, two distinct rice cultivars (BRRI Dhan 28 & BJ1) were grown with 13C-CO2 to trace root derived C in two soils of contrasting SOM contents and amended with 15N-KNO3 to quantify denitrifier 15N-N2O and N2 fluxes at three growth phases, hence distinguishing the predominant C source in fueling denitrification. The role of C from plants was more prominent and strongly correlated with N2O and N2 emissions during the later growth stages (flowering & maturity) while the highest mean N2O emissions was observed in the low grain yield cultivar (BJ1) grown in low SOM. Our results demonstrated that in low organic matter soils, cultivar selection plays an important role for N2O management.

A Systems View of Nitrogen Signaling Interactions

Gabriel Krouk


A drastic change in plant Nitrogen (N) nutrition results in systematic adaptations ranging from metabolic to growth changes. Interestingly, experimental evidences support the idea that it exists dedicated signaling pathways involved in the tuning of growth in response to nutritional status of the plant. On the other hand, growth can influence nutrition partly through hormones action. This constitutes a feed-forward loop that entangles nutrition and growth 1. This is our biological model.

We aim to get deeper insights into such signaling interactions. To this purpose, two experimental approaches will be presented. First, genome wide investigations have been made to understand the effect of combinatorial interactions between nitrogen and hormone treatments in the control of i) gene expression and ii) root development. Multi-dimensional networks have been built and functional validations of the predicted roles for the genes belonging to these networks are currently made.

Second, by studying the genome wide effect of nitrate regulated transcription factors [technique named TARGET2], we yielded several insights into i) gene regulatory network complexity in Arabidopsis (unpublished), ii) transcription factor dynamics 3, iii) potential connections between nitrate and phosphate signaling in the control of root growth control4. All these aspects will be presented and discussed.

Finally, since we now have some cues about the Arabidopsis gene regulatory network topology, I will introduce FRANK: a Fast Randomizing Algorithm for Network Knowledge. FRANK generates in silico, very large GRNs having the known characteristics of Arabidopsis transcriptional network (and very likely to other eukaryotic genomes) and simulates gene expression (experiments) at a genome-wide scale. In our endeavour to develop stable GRNs (“stable” means: gene expression should be constant or in oscillation) we have defined basic mathematical rules that find echo in network biology. FRANK now helps to train machine-learning algorithms in order to build GRNs on real transcriptomic data.
Plasmodesmata-Mediated Intercellular Signaling During Plant Growth and Development

Yka Helariutta

SLCU, Cambridge, United Kingdom. Correspondence to: yrjo.helariutta@slcu.cam.ac.uk

My group is investigating the morphogenesis of phloem, a long distance transporting tissue specified to transport the various products derived from the photosynthesis. Based on identification of the gain-of-function mutations in one of the callose synthase isoforms (responsible for formation of callose, b1,3-glucan polymer that plant uses to regulate symplastic trafficking through plasmodesmata nanochannels) we have recently developed a molecular tool, icals3m, with which we can regulate symplastic molecular trafficking in a time and space specific manner (Vaten et al. 2011). Using this tool we have identified a family of genes coding for transcription factors that are transcribed in the young sieve element position, and whose protein products move to the adjacent procambial cells to complete procambial/phloem patterning. We are also investigating phloem development (with a focus on sieve element differentiation) in high resolution as a paradigm for how a plant cell progresses from a stem cell to a fully differentiated state (Furuta et al. 2014). In the Arabidopsis root there are some 25 cells from the relatively isodiametric stem cell (touching the quiescent centre of the root) to the elongated cell that loses its nucleus as the final stage of sieve element cell differentiation. Finally, phloem transport is based on the interaction of the sieve element/companion cell unit with their neighbouring cellular domains (in the root culminating at unloading of organic substances to the meristem). We are now analysing other aspects of phloem morphogenesis (and also function) that may involve symplastic communication.

Deciphering Cytokinin-Dependent Shoot Regulatory Network Controlling Root Response to Nitrate Heterogeneity

Arthur Poitout, Gabriel Krouk, Benoit Lacombe and Sandrine Ruffel

B&PMP Biochemistry and Plant Molecular Physiology, CNRS, INRA, Montpellier SupAgro, Univ. Montpellier, 2 Place Viala, 34060 Montpellier, France. Correspondence to: sandrine.ruffel@inra.fr; sand.ruffel@gmail.com

Rapid adaptation of plant physiology and development to external fluctuations is critical for sessile organism, giving a singular interest to network signaling controlling these mechanisms. Among many adaptation processes, root plasticity is primordial to optimize nutrient acquisition but relies on a complex network integrating local and systemic (root <-> shoot) signaling. Locally, plants invest resource in soil area where nutrients are available and systemically they adjust nutrient acquisition to the whole plant demand. Our main goal is to decipher systemic signaling underlying the perception of nitrate heterogeneous provision, in Arabidopsis. Using the split-root system, in which physically isolated root systems of the same plant were challenged with different environments, we previously demonstrated that cytokinin biosynthesis constitutes one critical component of root-shoot-root communication. In a mutant affected in cytokinin root to shoot translocation, systemic responses to nitrate heterogeneity are clearly altered. Therefore, by combining transcriptomic, ionic and hormonomic approaches, we are trying to decipher cytokinin-dependent shoot regulatory network and to identify shoot to root messengers adapting root response to the internal and external nutritional environment.
Unravelling Root Constitutive Aerenchyma Formation by Auxin-Ethylene Regulation within Sugarcane Starved Plants Supported by mRNA and miRNA Transcript

Tavares Eveline Q. P., Lembke CG, Souza GM, Grandis A, Purgatto E, Souza AP, Piovezani AR, Buckeridge MS

Universidade de São Paulo, Brazil. Correspondence to: evelinetavares@gmail.com, evelinetavares@usp.br

Root aerenchyma formation results from the opening of gas spaces in the cortex and can be as part of a developmental program (constitutive) or due to abiotic stress (induced) such as flooding or nutrient starvation. This process relies on programmed cell death and cell wall modifications upon ethylene signalization. The aerenchyma development in sugarcane was monitored along 5 cm from the root apex under nutritional starvation. Its formation occurred in the cortex, despite nutrient availability or blockage of ethylene perception. However, nutrient starvation enhanced aerenchyma development and this process occurred while ethylene and auxin levels decreased. Within the aerenchyma formation zone, the ratio between both hormones was kept around 1:1. Several miRNAs targeting auxin-, ethylene- and cell wall-related mRNAs were identified from roots of starved samples. Transcription analyses from miRNA and mRNA expression patterns corroborate our conclusion that cell walls are not completely degraded. Altogether, results suggested that ethylene sensitivity and ethylene-auxin balance may play a role on the formation of aerenchyma. This is in accordance with the increased ethylene sensitivity as a result of nutrient starvation. These results shed light on hormone cross-talk underlying the constitutive aerenchyma regulation and how its regulation can rely on miRNA targeting hormone-related mRNAs.

Interactions of Iron as a Redox Active Transition Metal with Plant Antioxidants

Michael Frei, Lin-Bo Wu

INRES, Plant Nutrition, University of Bonn, Germany. Correspondence to: mfrei@uni-bonn.de

Iron (Fe) is an important plant micronutrient which occurs in different redox states. The oxidized form of Fe (ferric, Fe3+) is insoluble in water and is thus not plant available or mobile within the plant unless it is complexed with chelators. In contrast, the reduced form of Fe (ferrous, Fe2+) is soluble and thus mobile in the soil or plant. The redox activity of Fe plays important roles in many physiological redox reactions, for example in the electron transfer chains of the chloroplast. On the other hand, the oxidation of Fe2+ through ‘Fenton reactions’ with oxygen or H2O2 produces reactive oxygen species (ROS) such as the hydroxyl radical, which can cause significant oxidative stress. Such detrimental effects of Fe become evident when plants take up excessive Fe, which typically occurs only in plants grown on highly reduced, submerged soils, such as rice. In our previous studies on Fe toxicity in rice, we investigated the interplay of Fe and ascorbate (AsA), the most abundant water soluble antioxidant in plants. When rice plants were exposed to excess Fe, high levels of AsA or high rates of AsA recycling aggravated oxidative stress formation, which is counter-intuitive since AsA is considered as an antioxidant. This paradox was explained with the ability of AsA to reduce Fe3+ into Fe2+, thereby fueling the production of ROS via the Fenton reaction. In ongoing experiments we investigate rice plants engineered to be enriched or depleted in AsA, which are grown at different Fe supply levels. These experiments aim at shedding additional light on the role of AsA in Fe uptake and redistribution within the plant.
Predicting Plant Performance under Simultaneously Changing Environmental Conditions

Katrin Kahlen¹ and Tsu-Wei Chen²

¹Geisenheim University, Geisenheim, Germany; ²INRA, Montpellier, France. Correspondence to: katrin.kahlen@hs-gm.de; chen@gem.uni-hannover.de

There are increasing interests in the combined effects of two or more environmental factors on plant performance because that many environmental factors often occur together. To disentangle the effects of one environmental factor from the other, to some extent, is experimentally difficult and laborious. Here, we analyse the interplay between light, temperature and final internode lengths by using model approaches. We extended the light-sensitive virtual plant model L-Cucumber by implementing a common Arrhenius function for appearance rates, growth rates and growth durations. Evaluation experiments showed that the temperature-sensitive model approach resulted in accurate mean internode lengths and number of internodes, as well as in accurately predicted pattern of final internode length along the main stem. A detailed analysis clearly suggested that the model containing both, light and temperature, as predictors is superior to the model that only contains the predictor light. In addition, the system’s analysis revealed that even under moderately changing temperature conditions, the effective light signals perceived by an internode during its development can be influenced by temperature through its effect on the appearance rates of the internodes. Moreover, average environmental data during experiments may not allow accurate predictions of average contributions of each environmental factor on internode performance.

Effects of Photo-selective Netting on Root Growth and Development of Young Grafted Orange Trees in the Field

Kaining Zhou¹, Shimon Rachmilevitch¹, Jhonathan Ephrath¹

¹French Associates Institute for Biotechnology and Agriculture of Drylands, Ben-Gurion University of the Negev, Sede Boqer Campus, Midreshet Ben-Gurion, 84990, Israel. Correspondence to: zhoy@post.bgu.ac.il
²Albert Katz International School for Desert Studies, Ben-Gurion University of the Negev, Sede Boqer Campus, Midreshet Ben-Gurion, 84990, Israel. Correspondence to: yoni@bgu.ac.il

Photo-selective netting refers to covering crops by nets which have the capacity to selectively filter the intercepted solar radiation, in addition to their protective function. This approach is aimed at specifically enriching the intercepted light with productive parts of the spectrum and reducing the less-productive parts, thus allowing better utilization of the solar energy. While the effects of photo-selective nets on citrus trees on above ground parameters have been well investigated, a still open question is their effects on root system since roots are hidden in the soil. This research intends to evaluate effects of photo-selective netting on root growth and development therefore identifying the optimal photo-selective net that can significantly promote the performance of young grafted orange trees in ways such as shortening the juvenile phase and reducing the total time required to produce fruit. The experiment was performed in a three years old orange orchard. We examined both above ground and below ground parameters of grafted orange trees grown under three different photo-selective nets (red, white and yellow) and in a control plot without nets. Transparent tubes were installed to a depth of 200 cm at distances of 50 cm from the trunk. Root photographs were taken during different developmental stages of the year using a minirhizotron system. Interestingly, root length density with depth shows that roots under white net distribute evenly along observation tubes (each tube is 200cm long) whereas roots of control, red and yellow plots were mainly found at different locations: 60-100 cm, 80-120 cm and 100-140 cm respectively. Although the number of roots in the control plot is higher than that of other plots, the number of fruit per tree under all net-treated conditions is significantly higher compared to that of the control plot. Moreover, trees under the nets were taller compared to the control, indicating that roots of photo-selective netting plots may have higher water and nutrient use efficiency. These results demonstrate the potential of using photo-selective netting to improve the agro-economic performance of horticultural crops.
Effect of Sulfated Polysaccharides from Enteromorpha Prolifera on Plants under NaCl Stress

Xiaolin Chen¹, Bing Li², Song Liu, Pengcheng Li

¹Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China. Correspondence to: chenxl@qdio.ac.cn
²Marine Science and Engineering College, Qingdao Agricultural University. Correspondence to: pcli@qdio.ac.cn

Many study results showed that sulfated polysaccharides from Enteromorpha prolifera(SPEP) was a kind of bioactive substances, however there were little research in the literature is related to the agricultural utilization of them. In this paper, we obtained sulfated polysaccharides from Enteromorpha prolifera by microwave-assistance. The chemical compositions showed SPEP was a kind of heteropolysaccharide with huge Mw and the content of total sugar was 52.83%. The contents of sulfate and uronic acid in sulfated polysaccharide from Enteromorpha prolifera were respectively 21.98% and 26.46%. The major proportions of monosaccharide were rhamnose and glucose (almost 1:1) and there were also small amounts of xylose, mannose and galactose and trace amounts of fucose. We investigated the influences of SPEP on maize and wheat under slat stress and the result showed: 1mg/mL SPEP could increase plant and rootstock height both in maize and wheat under 100mmol/L NaCl stress. The contents of MDA and the membrane pemeability decreased. Compared to NaCl stress, the SOD, CAT, POD and APX activity were stimulated to higher levels under both SPEP and NaCl treatment. Those free radical scavenging enzymes could avoid the damage by accumulation of reactive oxygen species in maize and wheat. Also the degradation of chlorophyll was declined which implied the using of SPEP could protect chloroplast functions and sustain photosynthesis under salt stress.

The Toolbox of Plant Holobiont for Phenotypic Adjustment to Environment

Philippe Vandenkoornhuyse

Université de Rennes 1, CNRS, Rennes, France. Correspondence to: philippe.vandenkoornhuyse@univ-rennes1.fr

Plants can no longer be considered as standalone entities and a more holistic perception is needed. Indeed, plants harbor a wide diversity of microorganisms both inside and outside their tissues, in the endosphere and ectosphere, respectively. These microorganisms, which mostly belong to Bacteria and Fungi, are involved in major functions such as plant nutrition and plant resistance to biotic and abiotic stresses. Hence, the microbiota impact plant growth and survival, two key components of fitness. Plant fitness is therefore a consequence of the plant per se and its microbiota, which collectively form a holobiont. The classic understanding of organisms focuses on genes as the main source of species evolution and diversification. The concept of holobiont questions this genome centric view. The presentation will focus of recent understandings of the plant toolbox to adjust its phenotype to local environmental conditions and a novel comprehension of the plant phenotype will be discussed.
Interactions of Temperature and Light Signals in Plant Cold Acclimation for Survival in Changing Environment

Hiroyuki Imai¹, Maki Kanaya³, Mei Ogata², Yukio Kawamura¹,²,³ and Matsuo Uemura¹,²,³

¹United Graduate School of Agricultural Sciences, ²Department of Plant-Biosciences and ³Cryobiofrontier Research Center, Iwate University, Morioka 020-8550, Japan. Correspondence to: uemura@iwate-u.ac.jp

Temperate herbaceous plants sense environmental changes during fall and increase their freezing tolerance, which is critical for survival over winter. This process, called as cold acclimation (CA), has been known to be mainly regulated by changes in temperature in season. However, changes in air temperature has been unpredictable and often show sudden risings and/or drops these days because of global climate changes. Light conditions, in addition to lowering temperature, are known as another important factor to regulate CA and, in fact, shortening the day length as well as changes in red/far red light conditions affects the extent of CA. However, effects of light quality and the combination of temperature and light remain to be studied in detail. With Arabidopsis, we here report that blue light during CA influences freezing tolerance significantly probably through cryptochromes in complex ways and temperature conditions in day and night periods (constant vs fluctuated) also affect freezing tolerance. These results together imply that plants have elaborate systems to prepare for winter beforehand even under unpredictable climate conditions and develop survival ability in cold winter.

Interaction between Fe-deficiency chlorosis and temperature in chickpea (Cicer arietinum L.)

Cengiz Toker, Duygu Sari, Hatice Sari, Huseyin Canci, Nisa Ertroy Inci, Fatma Oncu Ceylan, Sahriye Sonmez

Akdeniz University, Faculty of Agriculture, TR-07070 Antalya-Turkey. Correspondence to: toker@akdeniz.edu.tr

Although iron (Fe) is available as ferrous and ferric ions and Fe chelates by plant from soil, its availability depends on environmental conditions. Yield of chickpea is considerably reduced due to Fe-deficiency chlorosis when susceptible chickpeas are grown in calcareous soils with high pH. In the present study, Fe-deficient and Fe-efficient chickpeas were compared for chlorophyll content and active Fe concentration in calcareous soil with high pH (7.96). Available Fe and zinc were found to be low. Active Fe concentration in the Fe-deficient chickpea was 36 mg per kg, whereas it is 40 mg per kg in the Fe-efficient chickpea. Chlorophyll content of the Fe-efficient chickpea was 60, whereas it was 13 in the Fe-deficient chickpea. Chlorophyll content was significantly correlated with Fe-deficiency chlorosis. Fe-deficiency chlorosis in chickpea was recovered when the maximum temperatures gradually increased 40 degrees during reproductive stages, depend on day length. Fe-deficiency chlorosis in chickpea was based on temperatures. Most efficient and economical solution to solve Fe-deficiency chlorosis in chickpea might be genetic resistance since Fe-efficiency was governed by a single dominant gene.
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Abstracts of Poster Presentations
**Poster № 1: The Role of Calcium in the Chitooligomers-Mediated Promotion Effect on Nitrogen Metabolism of Wheat Seedlings**

**Xiaoqian Zhang**

Key Laborotory Experimental Marine Biology, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China; University of Chinese Academy of Sciences, Beijing 100049, China. Correspondence to: zhangxiaoqian19912@163.com

Chitooligomers (COS) can significantly enhance the plant growth. To investigate the effect of COS on nitrogen metabolism and its action mechanism, we performed an experiment to explore the effect of COS on nitrogen metabolism of wheat seedlings cultured with different calcium (Ca) levels and varied exogenous Ca2+ inhibitors. The results showed that, at normal Ca2+ level, COS increased the glutamine synthetase (GS), glutamate synthase (GOGAT), and glutamate dehydrogenase (GDH) activities by 14.3%-71.4%, 16%-42.1% and 10.4%-20.5%, separately, while the promoting effects were weakened when Ca2+ was inadequate. Moreover, the chitooligomers-mediated promotion effect on key enzymes in nitrogen metabolism and the concentration of cytoplasmic free Ca2+ were also suppressed after adding varied Ca2+ inhibitors to cultural solution. Thus COS promoted the nitrogen metabolism of plants through the Ca2+/CaM signaling pathway, and further improved the growth of the plant.

**Poster № 2: Strawberry Cultivation in Recycling Hydroponic Systems; Monitoring Fertigation and Ion Strength**

**Irene Karoliussen, Mona Schiefloe & T. Hauan**

CIRiS, NTNU SF, Dragvoll Alle 38B, 7491 Trondheim, Norway. Correspondence to: irene.karoliussen@ciris.no

Strawberries (Fragaria X ananassa ELAN F1) were cultivated in a recycling hydroponic system 3 subsequent years, using pumice as both plant substrate and bio-filter. Seeds were sown and two week old seedlings were transferred to the recycling system. The treatments included two different strengths of a commercial nutrient solution, solution 1: 0.4-0.8 mS cm-1 and solution 2: 1.0-1.5 mS cm-1. The plants received water and nutrients via a trickle irrigation system and return water was treated in the biofilter before returned into the loop. Yield was registered and leaf samples collected once a month. A new handheld instrument (Multi-ion probe from Cleangrow) was used for measuring 6 ions (Ca2+, Mg2+, K+, Na+, NH4+, NO3-) in the nutrient solution on a weekly basis. Preliminary results indicate normal yield all 3 years with a significant higher yield for the highest nutrient concentration the second year. The individual ion levels varied in the nutrient solution throughout the seasons. Nitrate fluctuated more in the generative phase and mostly above recommended levels, indicating a buildup of nitrate in the system. Magnesium and calcium were below the expected levels in both growth phases, indicating a potential depletion. The Multi-ion probe can be a useful instrument for controlling the nutrient solution in addition to the commonly used electrical conductivity sensor, since the latter only provides information of the total ion strength. However, attention must be paid to the maintenance and operation of the instrument to assure reliable results.
**Poster № 3: Quantification of Karrikins in Smoke Water using UHPLC-MS/MS**

Jakub Hrdlička¹, Tomáš Gucký¹, Ondřej Novák¹, Johannes van Staden², Karel Doležal¹

¹Laboratory of Growth Regulators and Department of Chemical Biology and Genetics, Centre of Region Haná for Biotechnological and Agricultural Research, Faculty of Science, Palacký University and Institute of Experimental Botany ASCR, Šlechtitelů 27, 783 71 Olomouc, Czech Republic;
²Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa.

Correspondence to: jakub.hrdlicka@centrum.cz

Karrikins (KARs) are a family of butenolide lactones, that were identified in smoke water (SW) from burning vegetation (Flematti et al., 2004, Van Staden et al., 2004). SW contains a mixture of different substances from which KAR1 (3-methyl-2H-furo[2,3-c]pyran-2-one) is the most active and abundant (Flematti et al., 2015). In germination bioassay KARs showed activity at concentration below 10⁻⁹M (Light et al., 2009, Nelson et al., 2012). In nature they play a very important role in restoration and creation of habitat for new vegetation after wildfires (Light and Van Staden, 2016). However, to our knowledge, no method suitable for monitoring karrikins in biological matrices have been developed and published. Therefore, we employed a new analytical approach for quantification of KARs using UHPLC-MS/MS. Due to the separation by reverse phase and quantification by multiple reaction monitoring we developed a fast, specific and sensitive method which will give us the possibility to study the effect of these new interesting class of biostimulants in more detail. Results showing differences in levels of KARs in SW of different origin will be discussed.

**Poster № 4: Minor Nutrients Greatly Impact the in Vitro Growth of 'Voskhod' Apple**

Balnur Kabylbekova¹, I. Kovalchuk², T. Turdiyev², G. Madiyeva² and B. Reed³

¹Kazakh National Agrarian University, Abay ave. 8, 050010, Almaty, Kazakhstan; ²Institute of Plant Biology and Biotechnology, Timiryazev Str. 45, 050040, Almaty, Kazakhstan; ³USDA, National Clonal Germplasm Repository, 33447 Peoria Road, Corvallis, OR 97333. Correspondence to: k_b_zh@mail.ru

This study was designed using response surface methodology to model the plant response to mineral components required for propagation of the shoots of apple cultivar Voskhod. The factors evaluated were based on MS salts, NH₄NO₃, KNO₃, CaCl₂, KH₂PO₄, MgSO₄ and minor nutrients, ranging from 0.5-3x MS. Overall shoot quality, shoot length, shoot number and other physiological disorders were analyzed with ANOVA. The most significant factor was the minor nutrients that were always needed at high concentrations (2.7xMS). Most of the other factors were best at 0.5x. The subjective rating of overall quality for 'Voskhod' was the best factor for determining an optimal growth medium. This rating was highest when minor nutrients were at high levels and all other nutrients were low. These results indicate that changing the mineral nutrients alters in vitro plant growth, and that this type of experimental design can determine which specific mineral nutrients are causing specific responses or defects.
**Poster No 5: Changing Nitrogen Pulses Affects the Nitrogen Use Efficiency of a Mediterranean Dominant Shrub and its Ecological Partnerships**

**Teresa Dias, Maria Amélia Martins-Loução, Cristina Cruz**

Centre for Ecology, Evolution and Environmental Changes, Faculdade de Ciências, Universidade de Lisboa, Portugal. Correspondence to: mtdias@fc.ul.pt

Since Mediterranean ecosystems are nitrogen (N) limited, they constitute good models for understanding how changing N availability impacts photosynthetic N use efficiency (PNUE), ecological partnerships and ecosystem functioning. With this aim, we took advantage of an N-manipulative field experiment running in a Mediterranean shrubland, where three N pulses are applied per year. Following a spring pulse in 7th year of the experiment, we assessed the impacts of the N pulses on the dominant plant species and its ecological partnerships with ectomycorrhiza and N fixers; and on ecosystem functioning (mineral weathering, biological N fixation and soil protection). Despite promoting plant richness, the higher concentrations of ammonium pulses affected plant cover, PNUE, ecological partnerships and ecosystem functioning, thus setting the threshold for negative impacts. We showed how N inputs in a Mediterranean shrubland promote ecological independence and self-reliance with negative impacts on ecosystem functioning. Data highlight that species richness and ecophysiological parameters per se are not good indicators of the ecosystem’s conservation state.

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**Poster No 6: Microdose Fertilization Increases Yields but Exacerbates Nutrient Mining in Maize Farming Systems in Benin**

**Pierre G Tovihoudji1,2, PBI Akponikpe2, EK Agbossou3, CL. Bielders1**

1Earth and Life Institute - Environmental Sciences, UCL, Croix du Sud 2, Boîte L7.05.02, 1348 Louvain-la-Neuve, Belgium; 2Environmental Soil Physics and Hydraulics Unit, University of Parakou, 03 BP: 351, Parakou, Benin; 3Laboratory of Hydraulics and Water Management, University of Abomey-Calavi, BP: 2819 Cotonou, Benin. Correspondence to: pierretovihoudji@yahoo.fr

Recently and in response to the limitations of conventional recommendations, microdose fertilization has been widely advocated. However, little is known regarding the effect on yields and nutrient mining for maize systems in western Africa. This paper assesses to what extent the application of fertilizer microdosing to maize crop in Bénin may contribute towards improved yields and nutrient use efficiency and whether it attenuates or exacerbates nutrient mining. Four fertilizer options [no fertilizer control, two microdosing options (2 g and 4g of NPK hill-1) and the recommended rate] were arranged in randomized complete block with three replications within each manure stratum (cattle coralling, transported manure and no manure). On average, fertilizer application increased grain yields by 64, 81 and 93 percent for MD1, MD2 and RR, respectively, compared to the control. Combining microdosing with manure significantly improved maize productivity and nutrient use efficiency. Both microdose and recommended fertilization increased the risk of soil nutrient mining, especially regarding K, both in unmanured and manured plots. This suggests a need to revisit current fertilization recommendations and that microdosing should not be used for extended periods. There is also a need to evaluate this technology in farmer’s fields to better assess and understand the magnitude of nutrient mining.
**Poster No 7: Short-Term Salinity Stress Response of Brassica Rapa Seedlings**

Iva Pavlovic¹, Ondrej Novak², Jiri Gruz², Valerija Vujicic³, Sandra Radic Brkanac³, Branka Salopek Sondi¹

¹Ruder Boskovic Institute, Zagreb, Croatia; ²Centre of the Region Hana for Biotechnological and Agricultural Research, Institute of Experimental Botany AS CR & Faculty of Science of Palacky University, Olomouc, Czech Republic; ³Faculty of Science, Zagreb, Croatia. Correspondence to: Iva.Pavlovic@irb.hr

Keywords: salinity, cabbage, ROS, stress hormones, phenolic acids

Salinity is one of the major abiotic stress causing significant losses in crops yield and quality. To understand stress response of commercially important cabbage, seedlings of B. rapa ssp. L. pekinensis were subjected to the short-term (24h) NaCl stress (50-200 mM). Significant inhibition of root growth and decrease in seedlings biomass, accumulation of sodium ions and proline were observed in a dose dependent manner. In vivo fluorescent imaging of stressed seedlings showed significant increase in levels of ROS (SO and H2O2) and glutathion, particularly in root in comparison to cotyledons. Changed redox potential of seedlings altered antioxidant enzymes activities and triggered hormonal response. The level of ABA was increased at higher salt concentrations while jasmonates (JA and Ja-Ile) were increased at the lowest. Increase in several hydroxycinnamic acids was observed in a dose dependent manner.

**Poster No 8: Salinity Tolerance Threshold in Wheat as Affected by Fe Application**

Payman Keshavarz¹ and Saeed Saadat²

¹Soil and Water Research Department, Agricultural and Natural Resource Research and Education Center, AREEO, Mashhad, Iran. Correspondence to: P.Keshavarz@areo.ir, pykeshavarz@yahoo.com
²Soil and Water Research Institute, Agricultural Research Education and Exiension Organization (AREEO), Tehran, Iran. Correspondence to: ssaadat@swri.ir

Crop salt tolerance is not only different among species but also is affected many soils and environmental factors. Therefore, plant response to a specific salinity normally is not predictable. A greenhouse experiment was conducted to evaluate the effect of Iron (Fe) on salinity tolerance threshold to wheat (Var. Falat) using a sigmoid response model. The treatments consisted of three Fe rates (0, 2.5, 5 and 10 mg Fe kg-1 as Fe-EDDHA) and five levels of soil salinity (1.1, 5.2, 10.4, 15.3 and 21.8 dS m-1). The results showed that grain weight in wheat decreased, as salinity increased. Application of 10 mg kg-1 Fe decreased the grain weight by 20% as compared with the absence of added Fe. According to the fitted function, in the absence of Fe, grain weight began to decline at ECe-values of 4.5 dS m-1. With application of 2.5, 5 and 10 mg kg-1 Fe rates, ECe threshold value decreased to 4.1, 1.7 and 1.2 dS m-1. The study found that application of Fe led to a decrease of salinity tolerance threshold in the wheat genotype.
**Poster № 9: Interaction of Strain Serratia Sp. Ent16, Pea Nodule Symbiont, with Phytopathogens and Rhizobium and its Colonization of Host Endorhizosphere**

Svetlana Garipova R.¹, Garifullina D.V.², Baimiev An.H.³, Khairullin R.M.³

¹Biology faculty, Ecology and Botany Dept. Bashkir State University, 450076, Ufa, ul. Zaki Validi, 32, Russian Federation. Correspondence to: garisveta@rambler.ru, garipovasvetlana@gmail.com;
²Russian Agricultural Centre, Bashkortostan Republic Branch, 450059, Ufa, ul. R. Zorge, 19/2, Russian Federation;
³Institute of Biochemistry and Genetics, Ufa Scientific Centre, 450054, Ufa, pr. Oktyabrja, 71, Russian Federation. Correspondence to: krm62@mail.ru

It is known that the nodules of legumes can maintain the microbiome of bacteria with different symbiotic affiliation and properties. The endophytic strain of Serratia sp. Ent16, isolated from pea nodule, inhibited in vitro growth of both plant pathogens Fusarium oxysporum, Bipolaris sorokiniana and model strain Rhizobium leguminosarum bv viciae 1078, but the antagonism against the rhizobia strain Rh16 from its own nodule was considerably weaker. To detect the pathway of endorhizosphere colonization by the strain Ent16, it was labeled by gene of green fluorescent protein (gfp). The cells of Ent16-gfp strain were not visualized in the endorhizosphere of pea when plants were grown in rich culture medium, but the development of symbiosis promoted in conditions of plant germination in filter paper. Confocal microscopy showed that individual cells of Ent16-gfp strain were attached to the outer side of root hairs cell wells. Accumulation of fluorescent bacterial cells was located in the exoderm zone of lateral roots formation and in root vessels. The series of scanning sections of pea root revealed the presence of Ent16-gfp strain in primordia of lateral roots, through which bacteria penetrated in the endorhizosphere.

**Poster № 10: In Situ Monitoring of AMF Functionality by the Root Capacitance Method**

Imre Cseresnyés, Kálmán Rajkai, Anna Füzy, Tünde Takács

Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of Sciences; H-1022 Budapest, Herman Ottó út 15., Hungary. Correspondence to: cseresnyes.imre@agrar.mta.hu

Measurement of root electrical capacitance (REC) is a rapid method to assess the absorbing root surface area in situ. We first applied the technique in pot experiments for monitoring the functionality of arbuscular mycorrhizal fungi (AMF) in various crops without intrusion into plant structure and functions. REC significantly increased by AMF colonization, indicating an enhanced absorption surface area caused by the growth of external fungal hyphae. Changes in REC were strongly associated with the increased root water uptake (transpiration) rate of host plants. Studied AMF strains differed in their colonization time and effectiveness, detected by monitoring REC. The significance of our findings is that we provide a simple non-destructive technique to investigate the infectivity, effectiveness and functional diversity of separated AMF strains. On the one hand, REC measurement may partially substitute or complete the intrusive techniques commonly used in mycorrhizal research. On the other, it proved to be an adequate method for monitoring plant growth and studying plant responses to various cultivation and environmental conditions. Research was fund by NKFIH (K-115714).
**Poster № 11: Measuring the Effects of Drought on Root Functions of Wheat Cultivars by Electrical Capacitance**

Tünde Takács, Kálmán Rajkai, Anna Füzy, Ramóna Kovács, István Parádi, Zsófia Tischner, Imre Cseresnyés

Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of Sciences; H-1022 Budapest, Herman Ottó út 15., Hungary. Correspondence to: takacs@rissac.hu, takacs.tunde@agrar.mta.hu

Reliable data on root growth and activity are essential to analyse plant functions related to the adaptation to environmental conditions. Measurement of root electrical capacitance (REC) is a rapid method to assess root activity in situ. Physiological parameters and REC of two wheat (Triticum aestivum L.) hybrids were investigated to reveal their response to limited water conditions. Plants were cultivated in a growth chamber, in pots filled with pumice medium. Half of the plants were treated with arbuscular mycorrhizal fungal (AMF) inoculum. Both AMF inoculations and drought stress resulted in less biomass than that of uninoculated or well-watered plants. AMF colonization initiated root morphological and functional alterations that were detected by REC and root vitality (TTC) test. The response of the two cultivars to drought or AMF was different and it was reflected by photochemical efficiency, REC and stomatal conductance parameters, as well. It was concluded, that REC measurement can be an adequate in situ test for monitoring plant responses to stress factors. Research was funded by NKFIH (K-115714).

**Poster № 12: Selenium-Influenced Root Growth: the Involvement of Ethylene**

Zsuzsanna Kolbert, Árpád Molnár, Gábor Feigl

Department of Plant Biology, University of Szeged, Hungary. Correspondence to: kolzsu@bio.u-szeged.hu, kolbert.zsuzsanna@gmail.com

Low concentrations of selenium (Se) can exert beneficial effects like induction of lateral roots (LR). The stress hormone ethylene (ET) has been shown to regulate root system growth; therefore it is a potential modulator during Se-induced root growth responses. Our goal was to compare the effect of Se forms on root system growth, and to evaluate the possible involvement of ET in Se-influenced root growth. The Arabidopsis thaliana (Col-0 and ethylene insensitive etr1-1) was treated with 0, 5, 10 or 15 µM sodium selenite or selenate for 7 or 14 days. Primary root (PR) length and the number of LR primordia (LRP) and emerged LRs were determined under microscope. The ET levels were visualized in selenite-treated ACS8::GUS plants. Selenite decreased LRP induction but intensified LR emergence. The ACS8::GUS activity was induced by selenite in the whole root system. In etr1-1 mutants, selenite caused altered root growth compared to Col 0. Selenate promoted LRP initiation, and it positively affected PR elongation. Results show that selenium forms differently influence stages of LR development: selenite induces LR emergence with the possible involvement of ET, while mild selenate exposure positively influences not only LRP initiation but also the growth of the whole root system.

This work was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences and by the National Research, Development and Innovation Fund (NKFI-6, K120383).
**Poster № 13: Various Environmental Factors Affect the Transcription Levels and Splicing Patterns of Chloroplast Genes in Arabidopsis and Cabbage**

Su Jung Park and Hunseung Kang

Department of Plant Biotechnology, College of Agriculture and Life Sciences, Chonnam National University, Gwangju 500-757, Korea. Correspondence to: parksj0820@hanmail.net

Chloroplasts are essential for the growth and development of plants. Expression of chloroplast genes is mainly regulated at posttranscriptional levels. Although several recent studies have demonstrated that posttranscriptional RNA metabolism in chloroplasts is affected by developmental and environmental cues, the effects of environmental stresses on the splicing of chloroplast introns are largely unknown. To obtain insight into the significance of chloroplast RNA metabolism during stress responses, we carried out comprehensive analysis of the splicing of chloroplast introns in Arabidopsis and cabbage under different environmental conditions, such as application of DCMU, DBMIB and environmental stresses. To determine the roles of selected cabbage chloroplast genes in stress responses, the cabbage chloroplast genes whose intron splicing were affected by environmental stresses were introduced into Arabidopsis, and their functional roles during stress response were determined using the transgenic Arabidopsis plants. The results showed that expression of the cabbage genes in Arabidopsis resulted in increased thermo-tolerance and growth as well as much better seedling growth under normal growth conditions. Taken together, our results demonstrate that expression and intron splicing of chloroplast transcripts are affected by various environmental factors, which points to the importance of proper splicing of chloroplast genes during plant response to environmental stresses.

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**Poster № 14: Chestnut-Fungus-Virus Interactions for Biocontrol of Chestnut Blight**

Mirna Curkovic-Perica, Marin Jezic, Ljiljana Krstin, Zorana Katanic, Lucija Nuskern, Igor Poljak, Marilena Idzotic

Division of Biology, Faculty of Science, University of Zagreb, Croatia; Department of Biology, University of J. J. Strossmayer in Osijek, Croatia; Department of Forest Genetics, Dendrology and Botany, Faculty of Forestry, University of Zagreb, Croatia. Correspondence to: mirna.curkovic-perica@biol.pmf.hr

Chestnut blight is a disease caused by the fungus Cryphonectria parasitica which can be controlled by Cryphonectria hypovirus 1, CHV1. In this study, three-lateral interactions of chestnut, fungus and hypovirus were studied. It was found that genotypes of the fungus and virus as well as chestnut genotype are important for successful biocontrol. Further, we found out that marrons, chestnut cultivars, are especially vulnerable to chestnut blight and recover with much lower frequency than naturally growing chestnut. However, there is a difference in susceptibility of naturally growing trees as well, and certain hypovirulent fungal strains harboring specific virus isolates are more or less efficient against disease depending on chestnut genotype. Furthermore, as opposed to previously published results that imply higher virulence of French than Italian CHV1 subtypes towards chestnut blight fungus, our results reveal that some virus isolates of Italian subtype have equal effect on fungal host as strong French isolate CHV1/EP713.
**Poster № 15: Improvement of Mungbean Drought Tolerance via Root Architectural Modification**

Michael Dodt\(^1\), Yash Chauhan\(^2\), Rex Williams\(^2\), Brett Williams\(^1\), Sagadevan Mundree\(^1\)

\(^1\)Centre for Tropical Crops and Biocommodities, Queensland University of Technology, Brisbane, Queensland Australia; \(^2\)Queensland Department of Agriculture and Fisheries, Queensland Australia.

Correspondence to: michaeldodtt@gmail.com

Agriculture accounts for in-excess of 70% of the world’s freshwater usage and this figure is set to increase by another ~19% by 2050. Lack of freshwater availability has been described as the single biggest problem in meeting the ever-increasing global food requirement.

Vigna radiata (mungbean) is one of the most important pulse crops in the world. They are one of the most economical sources of protein (24%) available, high levels of dietary fibre, essential amino acids including methionine and lysine, vitamins, minerals and contain only a small amount of oil.

The present study investigates morphological, physiological and molecular responses of differentially drought tolerant varieties of mungbean under regulated deficit irrigation. Seed pre-treatment with a novel chemical referred to as ATW1124 was investigated for its potential as a novel method of enhancing root systems architecture and drought tolerance. Another pillar of the study was in simulating the effects of ATW1124 on mungbean in APSIM to determine potential impacts on production. Finally, RNA-Seq transcriptome analysis will reveal molecular mechanisms underpinning these responses.

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**Poster № 16: New Compounds Introduced to Seed Treatment Preparation Influence Measured Traits Degree of Homogeneity – Pot Experiment on Barley (Horodeum Vulgare) s**

Sebastian Żmudzki

Intermag, Olkusz, Poland. Correspondence to: sebastian.zmudzki@intermag.pl

The aim of the study was to investigate how new compounds introduced to seed treatment influence barley (Horodeum vulgare) germination and seedlings development. Intermag Primus® B preparation was enriched with amino acids, humic and fulvic acids and titanium. The experiment was conducted in pots in a high tunnel between 10th June and 1st of July. Barley seeds were treated with mixture of Primus® B and Primus® B enriched with new compounds and commercially used fungicide Kinto® Duo by BASF according to recommendations. After 21 days from seeds sawing chosen traits were investigated: leaf chlorophyll content, the number of leaves, number of tillers, summary leaves length, wet shoot mass and dry root mass. Primus® B enriched with new compounds did not influence traits values (in comparison with Primus® B), but increased investigated traits homogeneity. It means that seed treatment improved plants evenness and the rate of plants development. The product property can be a crucial advantage to the farmers. More even plants in the field make fieldworks easier and more efficient. Plants also mature more in the same time what can increase harvested yield.
**Poster № 17: The Relationships between Genotype, Yield and Temperature on Protein Distribution in the Wheat Endosperm**

**George Savill**

Rothamsted Research, Harpenden, United Kingdom. Correspondence to: george.savill@rothamsted.ac.uk

Distinct gradients exist in the concentration and composition of storage proteins within the central storage tissue of the wheat grain - the endosperm [1]. During milling, these gradients result in the production of mill streams differing in quality [2]; any changes in the gradients impact on the milling properties of the grain. Changes in temperature have a large effect on the process of grain filling in wheat, and alter the levels of storage protein accumulation [3]. The effect temperature has on storage protein gradients within the wheat endosperm is yet to be investigated. This study aims to identify the relationships between temperature, nitrogen supply, genotype, and the accumulation of storage protein within the wheat endosperm.

A novel image-analysis technique has been developed, this will be used to analyse light microscopy images, and describe the distribution of storage protein in the developing grain of wheat grown under both field and controlled-environment conditions. Developing grain has been sampled from wheat grown under two post-anthesis temperatures in controlled-environment, and from four varieties grown under four levels of nitrogen fertiliser in the WGIN diversity field trial at Rothamsted Research, UK. Analysis of samples collected to date is ongoing.

This study will increase our understanding of how temperature, nitrogen nutrition, and genotype interact to determine the accumulation patterns of storage protein within the wheat grain endosperm.


**Poster № 18: The Characterization of EMS57 Uncovers the Link between Plant Nutrition and Plant Response Mechanical Stimuli**

**Hanna Lasok¹, Patrick Metzger², Melanie Börries², Hauke Busch², Klaus Palme¹ and Franck Ditengou¹**

¹Institute of Biology II, University of Freiburg, 79104 Freiburg, Germany; BIOSS Centre for Biological Signalling Studies, University of Freiburg, 79104 Freiburg, Germany; Centre for Biological Systems Analysis (ZBSA), University of Freiburg, 79104 Freiburg, Germany;
²Institute of Molecular Medicine and Cell Research. Albert-Ludwigs-University Freiburg.
Correspondence to: hanialasok@gmail.com, hanna.lasok@biologie.uni-freiburg.de

Lateral root (LR) development is a common marker of the interaction of plants with their biotic and abiotic underground environment(1). It was shown that LR development can be induced by gravistimulation or by manual bending of the root tip (2). To better understand the mechanisms regulating LR initiation when triggered by a mechanical stimulus, we conducted a EMS-mutagenesis using Arabidopsis thaliana seeds and screened for mutants impaired in LR initiation and development. We isolated EMS57, a mutant unable to develop LR when mechanically stimulated. Interestingly EMS57 is hypersensitive to mechanical stress, but resistant to phosphorus starvation. Transcriptomic and physiological analyses revealed a functional link between LR formation, mechanical stimuli and phosphor starvation.

**References**

**Poster No 19: The Effect of Fusarium Culmorum Infection and Deoxynivalenol (DON) Application on Proteome Response in Barley Cultivars Chevron and Pedant**

**Klára Kosová**

Crop Research Institute, Drnovská 507, 161 06 Prague 6 - Ruzyně, Czech Republic. Correspondence to: kosova@vurv.cz

Fusarium head blight (FHB) disease adversely affects grain quality and final yield in small-grain cereals including barley. In the present study, the effect of an artificial infection with Fusarium culmorum and an application of deoxynivalenol (DON) on barley spikes of cultivars Chevron and Pedant during flowering was investigated at grain mid-dough stage (BBCH 73) 10 days after pathogen inoculation (10 dai). Proteomic analysis using a two-dimensional differential gel electrophoresis (2D-DIGE) technique coupled with LC-MS/MS investigated 98 protein spots revealing quantitative or qualitative differences between the experimental variants. Protein functional annotation of 93 identified protein spots revealed that most affected functional groups represent storage proteins (globulins, hordeins), followed by proteins involved in carbohydrate metabolism (α-amylase inhibitor, β-amylase, glycolytic enzymes), amino acid metabolism (aminotransferases), defence response (chitinase, xylanase inhibitor, serpins, SGT1, universal stress protein USP), protein folding (chaperones, chaperonins), redox metabolism (ascorbate-glutathione cycle), and proteasome-dependent protein degradation. The obtained results indicate adverse effects of infection on plant proteome as well as an active plant response to pathogen as shown by enhanced levels of several inhibitors of pathogen-produced degradation enzymes (α-amylase inhibitor, xylanase inhibitor, serpins), chaperones, and other stress-related proteins (SGT1, USP). Genotypic differences were found in hordein abundance between Chevron and Pedant.
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Fax: (00351) 219 154 960

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PM H+-ATPase is a Potential Target of Hormone Signaling in Petunia Pollen Tube Growth

Kovaleva Lidia, Voronkov Alexander, Zakharova Ekaterina, Timofeeva Galina

Timiryazev Institute of plant physiology RAS, 127276 Moscow, Botanicheskaya st., 35, Russian Federation. Correspondence to: kovaleva_l@mail.ru, voronkov_as@mail.ru

Pollen tube growth is the best known example of highly polarized plant cell expansion. The effects of exogenous plant hormones, indole-3-acetic acid (IAA), abscisic acid (ABA), gibberellin A3 (GA3), and cytokinin (kinetin) on the growth, PM polarization of in vitro germinating petunia (Petunia hybrida L.) pollen grains and growing pollen tubes were investigated. Growth-stimulated effects of IAA, ABA and GA3 were accompanied by orthovanadate-sensitive hyperpolarization of PM suggesting possible involvement of PM H+-ATPase activation in this process. Fluorescent labeling the enzyme with H+-ATPase antibodies exhibited IAA- and ABA-induced lateral membrane redistribution of it into the subapical zone of pollen tube PM. The results show that the hormone-induced stimulation of PM H+-ATPase activity might be involved in promoting pollen tube polar growth by applied hormones. One more hormonal effect related to their action on pollen PM H+-ATPase is expressed in the change of its lateral membrane allocation in pollen tube PM. The revealed hormonal effect contributes to the polarization of pollen tubes as a condition required for growth process. Results indicate the potential target of hormone signaling in pollen tubes, PM H+-ATPase, related to the hormone-induced modulation of the above mentioned characteristics of this proton pump.

Potassium Silicate Differently Interferes with Sodium and Chloride Homeostasis of Wheat (Triticum Aestivum L.) Cultivars Differing in Salt Tolerance

M. T. Javed1,2, Sylvia. Lindberg2 and M. Greger2

1Dept. of Botany, Government College University, Faisalabad, Pakistan; 2Dept. of Ecology, Environment and Plant Sciences, Stockholm University, Stockholm, Sweden. Correspondence to: sylvia.lindberg@su.se

Salinity is a serious problem to crop plants as it causes reduced plant growth and development. To investigate the potassium silicate effect on Na+ and Cl- in leaves under salinity stress, two wheat cvs., S24 (salt tolerant) and Vinjett (salt sensitive) were grown in a nutrient solution with 0, 50 or 100 mM NaCl for 2 weeks with, or without, 1 mM K2SiO3. Protoplasts were isolated enzymatically and NaCl was added to protoplasts in the presence or absence of 1 mM Si. To measure the cytosolic [Na+] and [Cl-] changes upon NaCl addition we used protoplasts loaded with the sodium-specific dye, SBFI, and the Cl-- sensitive dye MQAE, and 2-wavelength fluorescence microscopy. The cultivars exhibited different response to salt stress in terms of [Na+]c uptake. [Na+]cyt significantly increased only in cv. Vinjett, while in the tolerant cv. S24, it was low even at high NaCl. Na+ uptake patterns into cytosol were differently affected by pretreatment of protoplasts with TEA, Ba2+ and La3+ (channel inhibitors). The pharmacological experiments indicate that Na+ uptake in cv. Vinjett is mediated by both non-selective cation channels, NSCCs, and K+-specific channels, but mainly by NSCCs in cv. S-24. Si negatively affects both these channels. It is concluded that the cultivar’s salt tolerance depends on differential Na+ and Cl- uptake. Further studies are needed to clarify the role of Si inhibition of ion channels.
Yield and Chemical Composition of Cichorium Spinosum L. in Relation To Nitrogen Rate

Andri Ioannou1, Spyridon Petropoulos1, Ângela Fernandes2, Anestis Karkanis1, Vasilios Antoniadis1, Lillian Barros2, Isabel C.F.R. Ferreira2

1University of Thessaly, Fytokou Street, 38446, Volos, Greece; 2Polytechnic Institute of Bragança, Campus de Santa Apolónia, 1172, 5301-805 Bragança, Portugal. Correspondence to: spetropoulos@uth.gr

In the present study, the effect of nitrogen (N) application rate on plant growth and quality of Cichorium spinosum L. was examined. Four nitrogen rates were applied, namely: a) Control (no added N), b) 200 mg L-1 of total N, c) 400 mg L-1 of total N, and d) 600 mg L-1 of total N. Plant growth (rosette diameter, number of leaves, SPAD index, and fresh and dry weight) and chemical composition of leaves (sugars, organic and fatty acids, tocopherols, minerals and nitrates content) were recorded. Fresh weight increased up to 400 mg L-1, whereas dry weight was not affected by N rate. Plants treated with N formed larger rosettes and more leaves comparing to control treatment, except for the rate of 600 mg L-1 where number of leaves did not differ from control. SPAD index was higher at the rate of 600 mg L-1. The application of N resulted in higher content of sugars, whereas tocopherol showed a significant decrease. In conclusion, the application of nitrogen rates up to 400 mg L-1 is suggested for high yields without compromising the quality of the final product.

Effect of Salicylic Acid on the Phenolic Profile of Brassica Rapa Ssp. Pekinesis: Comparison Between Seedlings, Healthy and Infected Plants

Ivana Sola1, Jutta Ludwig-Mueller2, Simon Epperlein2, Janine Hoffmann2, Gordana Rusak1

1Department of Biology, Faculty of Science, University of Zagreb, Croatia; 2Institute of Botany, Technische Universitaet Dresden, Germany. Correspondence to: ivana.sola@biol.pmf.hr, ivsola@yahoo.com

The influence of salicylic acid (SA) applied in the range 10-1000 µM on the qualitative and quantitative profile of flavonoids and phenolic acids in seedlings, and leaves of healthy and Plasmodiophora brassicae-infected Brassica rapa ssp. pekinensis (Chinese cabagge) plants was investigated using a HPLC method. In seedlings the treatment induced, in a dose dependent manner, the synthesis of caffeic, chlorogenic, ferulic and sinapic acid, and kaempferol. In healthy plants SA treatment caused an increase in the phenolic acids concentration of identified compounds, but not in a dose dependent manner; and a decrease in kaempferol levels. Upon infection, the amount of phenolic compounds was increased compared to healthy plants, however the effect of SA on the phenolic profile of infected plants was variable and no unequivocal conclusion could be drawn. None of the SA concentrations was sufficient to reduce disease symptoms. This result indicates specific responses of Chinese cabagge on the level of flavonoids and phenolic acids, to SA depending on developmental stage and health condition.
The Hormonal Status and the Growth Reactions of Solanum Tuberosum in the Destruction of Actin and Tubulin Cytoskeleton

Puzina Tamara Ivanovna, N.S. Vlasova, I.Yu. Makeeva, V.L. Lantsev

Orel State University named after I.S. Turgenev, 95 Komsomolskaya str., Orel, 302026, Russian Federation. Correspondence to: tipuzina@gmail.com, inchik57@gmail.com

In this paper we consider the dependence of the content and the ratio of plant hormones from the integrity of the elements of the cytoskeleton. The destruction of tubulin cytoskeleton 1 mM solution of colchicine reduced three times the content of IAA and Zeatin, did not change the amount of gibberellic acid and by 45% increase the level of ABA. The depolymerization of actin cytoskeleton 0.1 mM solution of cytochalasin B had an even greater effect on cytokinins and abscisic acid: Zeatin content was reduced five times, and ABA doubled. At this hormonal background the growth activity of shoots decreased by 42%, plant productivity at the expense violations of the process of tuber initiation – by 34%. The work of phellogen in tubers slowed down, and it manifested in reducing the number of phellem layers. The antioxidant selenium (5.8∙10^-3 mM sodium selenite) completely eliminated the negative effect of colchicine on the content of indoleacetic acid and Zeatin, reduced the accumulation of abscisic acid. 0.1 mM caffeic acid mitigated the negative effect of colchicine on the level of auxin. Under these conditions, selenite ion and caffeic acid contributed to the restoration of plant growth reactions.

Auxin Redistribution during Lateral Root Primordia Formation in Butomus Umbellatus

Ivan V. Zhupanov

Institute of Botany of NASU. Tereschenkovska str, 2, 01004, Kyiv, Ukraine. Correspondence to: izhupanov@yandex.ua

A characteristic feature of B. umbellatus adventitious roots is the initiation of lateral root primordia (LRPs) in the apical meristem. To analyze the LRP growth dynamics, the size of individual primordia at the different distances from the parent root apex was measured. At the distance till 4 mm LRPs rapid growth is caused by the active cell division ending by the formation of histogens. After 4 mm LRPs growth significantly slowed. For further investigations mature plants were placed in the growing pots with the soil-water substrate. Rhizomes were observed every 24 h, and adventitious root number, their length and LRPs quantity were measured. LRPs do not emerge the root surface during its rapid growth. On the 4th–5th day, the activity of the apical meristem decreased, and the root growth gradually stopped. At the same time, “dormant” LRPs has renewed their activity and emerged from the parent root tissues. In our opinion these events are conditioned by the changes in the activity of apical meristem and its auxin attraction. The auxin concentration decreases significantly at the long distance from parent root apex, and the growth rate of the LRPs also decreases. When the apical meristem loses its activity, the auxin redistribution starts, mature LRPs becomes new attraction points of the auxin and resume its growth.
The Resistance of Photosynthetic Apparatus of Poaceae Plants to Zinc Excess

Natalia Kaznina, Y. Batova, G. Laidinen, A. Titov

Institute of Biology Karelian research centre RAS, Russian Federation. Correspondence to: kaznina@krc.karelia.ru

The aim of research was a comparative study of the zinc resistance of photosynthetic apparatus (PA) in various species of Poaceae. The objects of study were cereal Hordeum vulgare L. var. Zazersky 85 and wild grasses Elytrigia repens (L.) Nevski and Setaria viridis (L.) Beauv. Investigations were carried out in vegetation conditions with a sandy substrate. Zn²⁺ concentration in the control was 1 mg/kg, in the experimental – 160 mg/kg substrate. The studies have shown that zinc had no effect on leaf area of E. repens, whereas in S. viridis it decreased by 23% (compared with the control), and in H. vulgare – by 38%. Chlorophyll content (a+b) decreased slightly (about 10% relative to the control) in S. viridis and H. vulgare in the presence of metal, while in E. repens it increased (by 16%). Carotenoids concentration and parameters of the quantum efficiency of photosystem II (Fv/Fm and Y) practically didn’t change. However, the rate of photosynthesis in E. repens slowed by 10% relative to the control, in S. viridis – by 24% and H. vulgare – by 38%. Thus, the studied of Poaceae species are significantly different on resistance of PA to zinc excess: the most resistant is the wild perennial grass E. repens, less resistant wild annual grass S. viridis and cereal – H. vulgare – has the lowest resistance.

Root-Mediated Acidification and Better Nodal Root Growth Contributes to Phytoremediation Potential and Salt-Resistance of Wheat

Muhammad Saqib¹,², J. Akhtar³, G. Abbas³, H.A. Wahab⁴

¹Inst. of Soil and Environ. Sci., Uni. of Agriculture, Faisalabad, Pakistan; ²Inst. of Plant Nutrition, Justus-Liebig Uni., Giessen, Germany; ³Dept. of Environ. Sci., COMSATS Inst. of Information Tech., Vehari, Pakistan. Correspondence to: Muhammad.Saqib@ernaehrung.uni-giessen.de; drhmsab@yahoo.com

Salinity and sodicity are common soil and water problems reducing plant growth. This study explored the role of seminal and nodal roots and root-mediated changes in phytoremediation and salt resistance of two wheat genotypes, SARC-1 and 7-cerros (salt-resistant and sensitive, respectively). The experiments were conducted in solution as well as soil culture in addition to an experiment on agar plates. The plants were exposed to 120 mM NaCl. The salt-resistant wheat genotype showed higher shoot and root growth and nodal: seminal root ratio than the salt-sensitive genotype. There was low Na⁺ uptake particularly by the nodal roots, higher K⁺ and Ca²⁺ accumulation and, higher rhizosphere acidification and phytoremediation in the salt-resistant wheat genotype than the salt-sensitive one. Therefore, better nodal root growth and higher rhizosphere acidification potential of a wheat genotype leads to reduced Na⁺ uptake and higher phytoremediation, and salt-resistance of a wheat genotype.
Influence of Warm- and Cold-Acclimations on Molecular Species Composition of Monogalactosyldiacylglycerol from Saccharina Japonica and Ulva lactuca


Far Eastern Federal University, School of Natural Sciences, Vladivostok 690922, Russian Federation. Correspondence to: marybarkin@yandex.ru, barkina_my@students.dvfu.ru

Temperature adaptation of marine macrophytes and other ectothermic organisms mainly occurs due to changes in polar lipid composition to preserve the optimal liquid crystalline state of biomembranes. Monogalactosyldiacylglycerol (MGDG) is one of the major polar lipids of thylakoid membranes providing photosynthesis. This study was aimed to investigate changes in the composition of molecular species of MGDG from marine macroalgae Saccharina japonica (Ochrophyta) and Ulva lactuca (Chlorophyta) in the process of warm- and cold-acclimations. Algae were harvested in the Sea of Japan in winter (4 °C) and summer (20 °C) and acclimated to 20 °C and 4 °C, respectively. Analysis of molecular species compositions of MGDG of algae was carried out by HPLC-MS. We have obtained that percentage of molecular species with two polyunsaturated fatty acid residues increased with increasing ambient temperature and vice versa. More adequate, but less pronounced changes were observed in U. lactuca unlike to S. japonica. This is probably due to the adaptation of U. lactuca to more stressful conditions of the shallow zone.

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Phenotypic Plasticity and Coexistence of Plant Communities

Elizabeth L. Kordyum, D.V. Dubyna

Institute of Botany of NASU. Tereschenkivska str, 2, 01004, Ukraine. Correspondence to: cellbiol@ukr.net

Now there are a diversity for explanations of multispecies coexistence in plant communities. (Fargione and Tilman, 2002). We consider coexistence as the main mode of complicated cenobiotic interrelations of plants, which are immobile and autotrophs. Light and water, atmosphere CO2 and O2 are the primary critical factors for the existence of autotrophic plants providing photosynthesis. Soil mineral nutrition is important factor but it is secondary. Coexistence of plants in biocenoses is conditioned by the peculiarities of their biology and ecology (ontogenesis duration, reproduction systems, sequence of seasonal development) and by the level of phenotypic plasticity in the certain conditions of light intensity and spectrum, water supply, as well as by the soil type. Under the changes of environmental factors, plants reveal phenotypic plasticity at the structural, physiological, biochemical, and molecular levels that leads to appearance of numerous phenotypic variations adapted to the new conditions. Adaptive responses of a species vary depending on ecological peculiarities and a genetically determined reaction norm of its populations. Coexistence of species different on biology and ecology provides stability of a biocenosis and, thus, stability of the plant cover, without which life of the planet Earth is impossible.
Taraxacum Officinale Seed Germination under In Vitro Conditions

Maria Martínez¹², L. Jorquera², R. Chamy¹², P. Poirrier¹², D. Prüfer³⁴, C. Schulze Gronover⁴

¹Pontifical Catholic University of Valparaíso, School of Biochemical Engineering. Av. Brasil 2085, Valparaíso, Chile;
²Fraunhofer Chile Research Foundation. Mariano Sánchez Fontecilla 310, of. 1401, Las Condes, Santiago, Chile;
³Westphalian Wilhelms-University of Münster, Institute of Plant Biology and Biotechnology, Schlossplatz 8, D-48143 Münster, Germany;
⁴Fraunhofer Institute for Molecular Biology and Applied Ecology (IME), Schlossplatz 8, D-48143 Münster, Germany.
Correspondence to: maria.martinez@fraunhofer.cl

A great amount of scientific research has been carried out focused on the medicinal properties of Taraxacum, but only few studies are aimed to understand the germination process of this plant for further plant propagation. In this research, in vitro T. officinale seed germination under different type and concentrations of carbon source (glucose and sucrose at 10, 23, 32 and 55 g/L) and plant growth regulators (NAA and BAP) was studied, measuring its germination capacity, uniformity and synchrony. Carbon source and PGR treatments had a combined effect, affecting the three parameters. Germination was promoted under low carbon source concentrations (≤ 23 g/L) while higher carbon source concentrations had a detrimental effect on this process. Glucose allowed slightly better germination capacity than sucrose, showing higher germination percentage, while uniformity and synchrony values seemed to be enhanced at 0.225-0.5 ppm NAA and 0.5-1.25 ppm BAP in combination. Therefore, best condition to assess T. officinale seed germination needs to be evaluated under different quality and velocity criteria.
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<tr>
<th>Name</th>
<th>Institution</th>
<th>Email/Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam Barrada</td>
<td>Aix-Marseille University, Marseille, France</td>
<td><a href="mailto:adam.barrada@etu.univ-amu.fr">adam.barrada@etu.univ-amu.fr</a></td>
</tr>
<tr>
<td>Anne Rossman</td>
<td>Rothamsted Research, Harpenden, United Kingdom</td>
<td><a href="mailto:anne.rossman@rothamsted.ac.uk">anne.rossman@rothamsted.ac.uk</a></td>
</tr>
<tr>
<td>Balnur Kabybekova</td>
<td>Kazakh National Agrarian University, Almaty, Kazakhstan</td>
<td><a href="mailto:k_b_zh@mail.ru">k_b_zh@mail.ru</a></td>
</tr>
<tr>
<td>Bamba Mbaye</td>
<td>Al-madina Import &amp; Export Company, Banjul, Gambia</td>
<td><a href="mailto:bambaye@hotmail.com">bambaye@hotmail.com</a></td>
</tr>
<tr>
<td>Caroline Gutmahr</td>
<td>LMU Munich, Martinsried, Germany</td>
<td><a href="mailto:caroline.gutmahr@lmu.de">caroline.gutmahr@lmu.de</a></td>
</tr>
<tr>
<td>Carsten Richter</td>
<td>Conviron Germany GmbH, Berlin, Germany</td>
<td><a href="mailto:crichter@conviron.com">crichter@conviron.com</a></td>
</tr>
<tr>
<td>Cengiz Toker</td>
<td>Akdeniz University, Antalya, Turkey</td>
<td><a href="mailto:toker@akdeniz.edu.tr">toker@akdeniz.edu.tr</a></td>
</tr>
<tr>
<td>Christine Fortin</td>
<td>Regent Instruments, Canada</td>
<td><a href="mailto:cf@regentinstruments.com">cf@regentinstruments.com</a></td>
</tr>
<tr>
<td>Cristina Cruz</td>
<td>Centre for Ecology, Evolution and Environmental Changes, Portugal</td>
<td><a href="mailto:ccruz@fc.ul.pt">ccruz@fc.ul.pt</a></td>
</tr>
<tr>
<td>Edgar Peiter</td>
<td>Martin Luther University Halle-Wittenberg, Halle, Germany</td>
<td><a href="mailto:edgar.peiter@landw.uni-halle.de">edgar.peiter@landw.uni-halle.de</a></td>
</tr>
<tr>
<td>Ekaterina Yotsova</td>
<td>Institute of Biophysics and Biomedical Engineering - Bulgarian Academy of Sciences (IBPhBME-BAS), Sofia, Bulgaria</td>
<td><a href="mailto:ekaterina_yotsova@abv.bg">ekaterina_yotsova@abv.bg</a></td>
</tr>
<tr>
<td>Eveline Tavares</td>
<td>University of Sao Paulo, Sao Paulo, Brazil</td>
<td><a href="mailto:evelinetavares@usp.br">evelinetavares@usp.br</a></td>
</tr>
<tr>
<td>Elizabeth Kordyum</td>
<td>Institute of Botany of Nasu, Kyiv, Ukraine</td>
<td><a href="mailto:cellbiol@ukr.net">cellbiol@ukr.net</a></td>
</tr>
<tr>
<td>Eva Goudsmit</td>
<td>Enza Zaden R&amp;d Bv, Enkhuizen, Netherlands</td>
<td><a href="mailto:m.cloos@enzazaden.nl">m.cloos@enzazaden.nl</a></td>
</tr>
<tr>
<td>Geert De Jaeger</td>
<td>Vib-Ghent University, Ghent, Belgium</td>
<td><a href="mailto:gejae@psb.vib-ugent.be">gejae@psb.vib-ugent.be</a></td>
</tr>
<tr>
<td>Evgeniukpo Pierre</td>
<td>Tovihoudji Université Catholique de Louvain, Louvain-la-Neuve, Belgium</td>
<td><a href="mailto:gbenoukpo.tovihoudji@student.uclouvain.be">gbenoukpo.tovihoudji@student.uclouvain.be</a></td>
</tr>
<tr>
<td>Franck Ditengou</td>
<td>University of Freiburg, Freiburg, Germany</td>
<td><a href="mailto:franck.ditengou@biologie.uni-freiburg.de">franck.ditengou@biologie.uni-freiburg.de</a></td>
</tr>
<tr>
<td>Gabriel Krouk</td>
<td>Cnrs, Montpellier, France</td>
<td><a href="mailto:gkrouk@gmail.com">gkrouk@gmail.com</a></td>
</tr>
<tr>
<td>George Savill</td>
<td>Rothamsted Research, Harpenden, United Kingdom</td>
<td><a href="mailto:george.savill@rothamsted.ac.uk">george.savill@rothamsted.ac.uk</a></td>
</tr>
<tr>
<td>Gerd Patrick Bienert</td>
<td>Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany</td>
<td><a href="mailto:bienert@ipk-gatersleben.de">bienert@ipk-gatersleben.de</a></td>
</tr>
<tr>
<td>Greg Vert</td>
<td>Cnrs, Gif-sur-Yvette, France</td>
<td><a href="mailto:Gregory.Vert@l2bc.paris-saclay.fr">Gregory.Vert@l2bc.paris-saclay.fr</a></td>
</tr>
<tr>
<td>Hanna Lasok</td>
<td>University of Freiburg, Freiburg, Germany</td>
<td><a href="mailto:hanialasok@gmail.com">hanialasok@gmail.com</a></td>
</tr>
<tr>
<td>Hans-Werner Olfs</td>
<td>University of Applied Sciences</td>
<td><a href="mailto:h-w.olfs@hs-osnabrueck.de">h-w.olfs@hs-osnabrueck.de</a></td>
</tr>
<tr>
<td>Greg Ver</td>
<td>Cnrs, Gif-sur-Yvette, France</td>
<td><a href="mailto:Gregory.Vert@l2bc.paris-saclay.fr">Gregory.Vert@l2bc.paris-saclay.fr</a></td>
</tr>
<tr>
<td>Ivery Karoliussen</td>
<td>NTNU Samfunnsforskning As, Trondheim, Norway</td>
<td><a href="mailto:irene.karoliussen@ciris.no">irene.karoliussen@ciris.no</a></td>
</tr>
<tr>
<td>Iva Pavlovic</td>
<td>Ruder Boskovic Institute, Zagreb, Croatia</td>
<td><a href="mailto:Iva.Pavlovic@irb.hr">Iva.Pavlovic@irb.hr</a></td>
</tr>
<tr>
<td>Imre Csernesnyes</td>
<td>Centre for Agricultural Research, Hungarian Academy of Sciences, Budapest, Hungary</td>
<td><a href="mailto:cseresnyes.imre@agrar.mta.hu">cseresnyes.imre@agrar.mta.hu</a></td>
</tr>
<tr>
<td>Ivan Zhupanov</td>
<td>Institute of Botany of NASU, Kyiv, Ukraine</td>
<td><a href="mailto:izhupanov@yandex.ua">izhupanov@yandex.ua</a></td>
</tr>
<tr>
<td>Ivana Sola</td>
<td>University of Zagreb, Zagreb, Croatia</td>
<td><a href="mailto:ivana.sola@biol.pmf.hr">ivana.sola@biol.pmf.hr</a></td>
</tr>
<tr>
<td>Jakub Hrdlička</td>
<td>University of Palacky Olomouc, Olomouc, Czech Republic</td>
<td><a href="mailto:jakub.hrdlicka@centrum.cz">jakub.hrdlicka@centrum.cz</a></td>
</tr>
<tr>
<td>Jan Martinec</td>
<td>Institute of Experimental Botany, Prague, Czech Republic</td>
<td><a href="mailto:martinec@ueb.cas.cz">martinec@ueb.cas.cz</a></td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Email Address</td>
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<tr>
<td>Kaining Zhou</td>
<td>Ben Gurion University of the Negev, Sede Boker, Israel</td>
<td><a href="mailto:zhoukaining89@163.com">zhoukaining89@163.com</a></td>
</tr>
<tr>
<td>Karin Groten</td>
<td>MPI for Chemical Ecology, Jena, Germany</td>
<td><a href="mailto:kgroten@ice.mpg.de">kgroten@ice.mpg.de</a></td>
</tr>
<tr>
<td>Karl Mühling</td>
<td>Kiel University, Kiel, Germany</td>
<td><a href="mailto:khmuehling@plantnutrition.uni-kiel.de">khmuehling@plantnutrition.uni-kiel.de</a></td>
</tr>
<tr>
<td>Katrin Kahlen</td>
<td>Geisenheim University, Geisenheim, Germany</td>
<td><a href="mailto:kathleen.kahlen@hs-gm.de">kathleen.kahlen@hs-gm.de</a></td>
</tr>
<tr>
<td>Klára Kosová</td>
<td>Crop Research Institute, Prague 6, Czech Republic</td>
<td><a href="mailto:kosova@vurv.cz">kosova@vurv.cz</a></td>
</tr>
<tr>
<td>Lidia Kovaleva</td>
<td>Timiryaziev Institute of Plant Physiology RAS, Moscow, Russian Federation</td>
<td><a href="mailto:kovaleva_l@mail.ru">kovaleva_l@mail.ru</a></td>
</tr>
<tr>
<td>Luca Di Nucci</td>
<td>Valagro S.p.A., Atessa, Italy</td>
<td><a href="mailto:l.dinucci@valagro.com">l.dinucci@valagro.com</a></td>
</tr>
<tr>
<td>Lucie Mikuliková</td>
<td>OlChemlm s.r.o., Olomouc, Czech Republic</td>
<td><a href="mailto:l.m@olchemim.cz">l.m@olchemim.cz</a></td>
</tr>
<tr>
<td>Luciel Fernandes</td>
<td>Mars Center for Cocoa Science, Barro Preto, Brazil</td>
<td><a href="mailto:luciel.fernandes@effem.com">luciel.fernandes@effem.com</a></td>
</tr>
<tr>
<td>Malcolm Hawkesford</td>
<td>Rothamsted Research, Harpenden, United Kingdom</td>
<td><a href="mailto:malcolm.hawkesford@rothamsted.ac.uk">malcolm.hawkesford@rothamsted.ac.uk</a></td>
</tr>
<tr>
<td>Maria Martinez</td>
<td>Fraunhofer Chile Research, Santiago, Chile</td>
<td><a href="mailto:maria.martinez@gmail.com">maria.martinez@gmail.com</a></td>
</tr>
<tr>
<td>Maria Yu Barkina</td>
<td>Far Eastern Federal University, Vladivostok, Russian Federation</td>
<td><a href="mailto:marybarkin@yandex.ru">marybarkin@yandex.ru</a></td>
</tr>
<tr>
<td>Martin Parniske</td>
<td>LMU Munich, Martinsried, Germany</td>
<td><a href="mailto:sekretariat.genetik@lrz.uni-muenchen.de">sekretariat.genetik@lrz.uni-muenchen.de</a></td>
</tr>
<tr>
<td>Matsuo Uemura</td>
<td>Iwate University, Morioka, Japan</td>
<td><a href="mailto:uemura@iwate-u.ac.jp">uemura@iwate-u.ac.jp</a></td>
</tr>
<tr>
<td>Michael Dodt</td>
<td>Queensland University of Technology, Brisbane, Australia</td>
<td><a href="mailto:michael.dodt1@gmail.com">michael.dodt1@gmail.com</a></td>
</tr>
<tr>
<td>Michael Frei</td>
<td>University of Bonn, Bonn, Germany</td>
<td><a href="mailto:mfre@uni-bonn.de">mfre@uni-bonn.de</a></td>
</tr>
<tr>
<td>Mirna Curkovic</td>
<td>University of Zagreb, Zagreb, Croatia</td>
<td><a href="mailto:mirna.crukovic-perica@biol.pmf.hr">mirna.crukovic-perica@biol.pmf.hr</a></td>
</tr>
<tr>
<td>Mirza Hasanuzzaman</td>
<td>University of the Ryukyu, Okinawa, Bangladesh</td>
<td><a href="mailto:mhzauag@yahoo.com">mhzauag@yahoo.com</a></td>
</tr>
<tr>
<td>Mona Schiefloe</td>
<td>NTNU Samfunnsforskning As, Trondheim, Norway</td>
<td><a href="mailto:mona.schiefloe@ciris.no">mona.schiefloe@ciris.no</a></td>
</tr>
<tr>
<td>Muhammad Firdaus Abdul Karim</td>
<td>University of Aberdeen, Aberdeen, United Kingdom</td>
<td><a href="mailto:r02mfa14@abdn.ac.uk">r02mfa14@abdn.ac.uk</a></td>
</tr>
<tr>
<td>Muhammad Saqib</td>
<td>Justus-Liebig University, Giessen, Germany</td>
<td><a href="mailto:muhammad.saqib@ernaehrung.uni-giessen.de">muhammad.saqib@ernaehrung.uni-giessen.de</a></td>
</tr>
<tr>
<td>Natalia Kaznina</td>
<td>Institute of Biology Karelian Research Centre RAS, Petrozavodsk, Russian Federation</td>
<td><a href="mailto:kaznina@krc.karelia.ru">kaznina@krc.karelia.ru</a></td>
</tr>
<tr>
<td>Payman Keshavarz</td>
<td>Khorasan Razavi Agricultural and Natural Resource Research and Education Center, Areeo, Mashhad, Iran</td>
<td><a href="mailto:pykeshavarz@yahoo.com">pykeshavarz@yahoo.com</a></td>
</tr>
<tr>
<td>Philippe Vandenkoornhuyse</td>
<td>Université de Rennes 1, CNRS, Rennes, France</td>
<td><a href="mailto:philippe.vandenkoornhuyse@univ-rennes1.fr">philippe.vandenkoornhuyse@univ-rennes1.fr</a></td>
</tr>
<tr>
<td>Sebastian Żmudzki</td>
<td>Intermag, Olkusz, Poland</td>
<td><a href="mailto:sebastian.zmudzki@intermag.pl">sebastian.zmudzki@intermag.pl</a></td>
</tr>
<tr>
<td>Spyridon Petropoulos</td>
<td>University of Thessaly, N. Ionia/ Volos, Greece</td>
<td><a href="mailto:fangio57gr@gmail.com">fangio57gr@gmail.com</a></td>
</tr>
<tr>
<td>Stanislaw Kopriva</td>
<td>University of Cologne, Cologne, Germany</td>
<td><a href="mailto:skopriva@uni-koeln.de">skopriva@uni-koeln.de</a></td>
</tr>
<tr>
<td>Su Jung Park</td>
<td>Chonnam National University, Gwangju, South Korea</td>
<td>parksj0820 @hanmail.net</td>
</tr>
</tbody>
</table>
Svetlana Garipova  
Bashkir State University, Ufa, Russian Federation  
garisveta@rambler.ru

Sylvia Lindberg  
Stockholm University, Stockholm, Sweden  
sylvia.lindberg@su.se

Tamara Ivanovna Puzina  
FSBEI HE "Orel State University named after I.S. Turgenev", Orel, Russian Federation  
tipuzina@gmail.com

Teresa Dias  
Universidade de Lisboa, Portugal  
mtdias@fc.ul.pt

Timothy George  
The James Hutton Institute, Dundee, United Kingdom  
tim.george@hutton.ac.uk

Tünde Mária Takács  
Centre for Agricultural Research, Hungarian Academy of Sciences, Budapest, Hungary  
takacs.tunde@agrar.mta.hu

Ulrike Baumann  
ARALAB, Rio De Mouro, Portugal  
office@riege-iv.at

Vera Isabel Martínez-Barradas  
Universidad Nacional Autónoma De México, Ciudad De México, Mexico  
veramtzb@gmail.com

Weronika Czaban  
Aarhus University, Slagelse, Denmark  
weronika.czaban@agro.au.dk

Xiaolin Chen  
Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China  
chenxl@qdio.ac.cn

Xiaoqian Zhang  
Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China  
zhangxiaoqian19912@163.com

Yka Helariutta  
SLCU, Cambridge, United Kingdom  
yrjo.helariutta@slcu.cam.ac.uk

Yuri Gleba  
Nomad Bioscience GmbH, Halle, Germany  
prochaska@nomadbioscience.com

Zsuzsanna Kolbert  
University of Szeged, Szeged, Hungary  
kolzsu@bio.u-szeged.hu