W05 – Mineral nutrition of plants – implication for human health

Time: Friday February 11th 2022 10:00-15:40

Location: ULB Campus Plaine, Salle Solvay, building NO, 5th floor or online *via* **Teams**

Organizer: Christian Hermans
christian.hermans@ulb.be

Schedule:

10:00-10:10 Welcome

10:10-10:50 Frits Heinrich, Vrije Universiteit Brussel, Belgium
Eating like an Egyptian. Exploring the nutritional composition of ancient cereals and pulses

10:50-11:30 Michela Sciavon, University of Turin, Italy
Selenium and sulfur interactions in higher plants: case studies

11:30-12:10 Elizabeth Pilon-Smits, Colorado State University, USA
Selenium metabolism in hemp – Potential for phytoremediation and biofortification

12:10-13:30 Break

13:30-14:10 Antony Van der Ent, the University of Queensland
X-ray Fluorescence Microscopy for unravelling the secrets of selenium hyperaccumulator plants

14:10-14:50 Mark Aarts, Wageningen University, the Netherlands
Exploring the genetics underlying the Arabidopsis zinc deficiency response

14:50-15:30 Vanessa Minden, Vrije Universiteit Brussel, Belgium
Within-generational and transgenerational plasticity to nutrient stress in endangered, non-endangered and invasive plants

15:30-15:40 Closing remarks

The number of onsite participants is limited. Please confirm participation by e-mail (christian.hermans@ulb.be) before Monday February 7th 2022. The Covid Safe Ticket (CST) is required to access the event. Wearing a mask is mandatory while seated in the theater.

About BrIAS - *The newly founded Brussels Institute for Advanced Studies (BrIAS), co-founded by the Université libre de Bruxelles (ULB) and the Vrije Universiteit Brussel (VUB), aims to expand upon the mission of other IASes as an incubator of ideas and research by focusing on current and urgent themes with a great societal impact.*
Located in the heart of Brussels, it aims to attract the very best scientists, artists or designers, coming from various fields or countries and with no philosophical or political restriction, and provide the opportunity to work in an atmosphere of complete freedom, collaboration, mutual emulation and cross-fertilisation. In this context, BrIAS aims to facilitate collaborations with countries facing critical challenges pertaining to sustainability.
For more information and updates about BrIAS, our upcoming events, and our current research theme ***The past, present and future of food, climate and sustainability****. Follow us on our* ***webpage****, on* ***LinkedIn****,* ***Facebook*** and ***Youtube****.*

The event is organized in junction with the Ecole doctorale thématique (EDT) Plant Science, F.R.S.-FNRS.

Dr **Frits Heinrich**

Analytical, Environmental and Geo-Chemistry, Department of Chemistry, & the research group Social and Cultural Food Studies, Department of History, Vrije Universiteit Brussel, Belgium

Eating like an Egyptian. Exploring the nutritional composition of ancient cereals and pulses

Cereals and pulses have been important staples in most human diets since the Neolithic. Despite being recognized as energy suppliers in the diet, their nutritional appraisal by historians has been rather grim, as they have long been held responsible for the alleged poor nutritional status of the Romans. This talk challenges this view and presents new nutritional evidence from a unique collection of perfectly preserved archaeological plant remains from the Greco-Roman town of Karanis in Egypt.

Prof **Michela Sciavon**

Dpt of agricultural, forest and food sciences, University of Turin, Italy

Selenium and sulfur interactions in higher plants: case studies

Selenium (Se) is an element with a fascinating, albeit turbulent, history. Initially, it was considered a harmful element, but in more recently its essentiality has undoubtedly become evident in the metabolism of humans and other life forms. Se has critical roles in preventing heart diseases and certain forms of cancer, sustaining male reproduction, enhancing the immune and antioxidant systems, and reducing viral infection. In addition, it plays essential roles in mammalian development and thyroid metabolism. Thus, people are expected to ingest adequate amounts of Se to maintain their proper body functions. Se toxicity in humans is a rare condition, while the occurrence of suboptimal levels of Se in the diet of populations is more frequent globally. So far, many attempts have been made to generate Se biofortified crops to enrich the diet of vulnerable populations with Se. Different Se biofortification strategies have been developed, either agronomic or genetic, the success of which depends on a variety of factors. The effectiveness of supplementing people with Se biofortified food has been confirmed by various clinical trials, and currently the molecular biology of Se is attaining increasing interest due to the roles of Se in combating viral infections, such as that caused by COVID-19.

Prof Em. **Elizabeth Pilon-Smits**

Biology Department, Colorado State University, USA

Selenium metabolism in hemp – Potential for phytoremediation and biofortification

Selenium (Se) deficiency and toxicity affect over a billion people worldwide. Plants can mitigate both problems, via Se biofortification and phytoremediation. We explored the potential of hemp (Cannabis sativa L.) for these phytotechnologies. Field surveys in naturally seleniferous agricultural areas in Colorado, U.S.A. found 15-25 µg Se/g in seed and 5-10 µg Se/g dry weight in flowers and leaves. Thus, 4 g of this hemp seed provides the U. S. recommended daily allowance of 55-75 µg Se. In controlled greenhouse experiments, hemp seedlings supplied with 40-320 µM selenate showed complete tolerance up to 160 µM and accumulated up to 1,300 mg Se/kg shoot dry weight. Mature hemp was completely tolerant up to 40 µM selenate and accumulated up to 200 mg Se/kg DW in leaves, flowers and seeds. Synchrotron X-ray Fluorescence and X-ray Absorption Spectroscopies of selenate-supplied hemp showed Se to accumulate mainly in the leaf vasculature and in the seed embryos, with predominant Se speciation in C-Se-C forms (57-75% in leaf and >86% in seeds). Aqueous seed extracts were found by Liquid Chromatography Mass Spectrometry to contain selenomethionine and methyl-selenocysteine (1:1-3 ratio), both excellent dietary Se sources. Floral concentrations of medicinal cannabidiol (CBD) and terpenoids were not affected by Se. We conclude that hemp has good potential for Se phytoremediation while producing Se-biofortified dietary products.

Dr **Antony van der Ent**

Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, The University of Queensland, Australia

X-ray Fluorescence Microscopy for unravelling the secrets of selenium hyperaccumulator plants

Insights in the distribution and chemical form of target elements, such as selenium, in plants is critical in the study of plant molecular biology, agronomy, plant nutrition, plant physiology, and ionomics. X-ray Fluorescence Microscopy (XFM) is powerful technique that can be applied to selenium hyperaccumulator plants and is unique in providing *in situ* information true to biological conditions of the living plant. It can play a key role in answering questions at every level of the selenium metabolism in plants, from the rhizosphere interface to uptake pathways in the roots and shoots. This method offers the ability to measure plant specimens in their hydrated (live) state without any sample preparation and has high sensitivity (<1 µg Se g^{-1} level) and high spatial resolution (<1 µm). XFM can be used at length-scales ranging from whole plants down to organs, tissues, individual cells, and even cellular organelles. It can also determine the chemical speciation of selected elements in vivo as well as over time and spatially resolved. Novel XFM computed tomography (XFM-CT) methods enable to obtain 3D models of selenium distribution in physically intact specimens. In this presentation I will show how XFM can be used to unravel the secrets of selenium hyperaccumulation.

Prof **Mark Aarts**

The laboratory of Genetics, Wageningen University, the Netherlands

Exploring the genetics underlying Arabidopsis zinc deficiency response

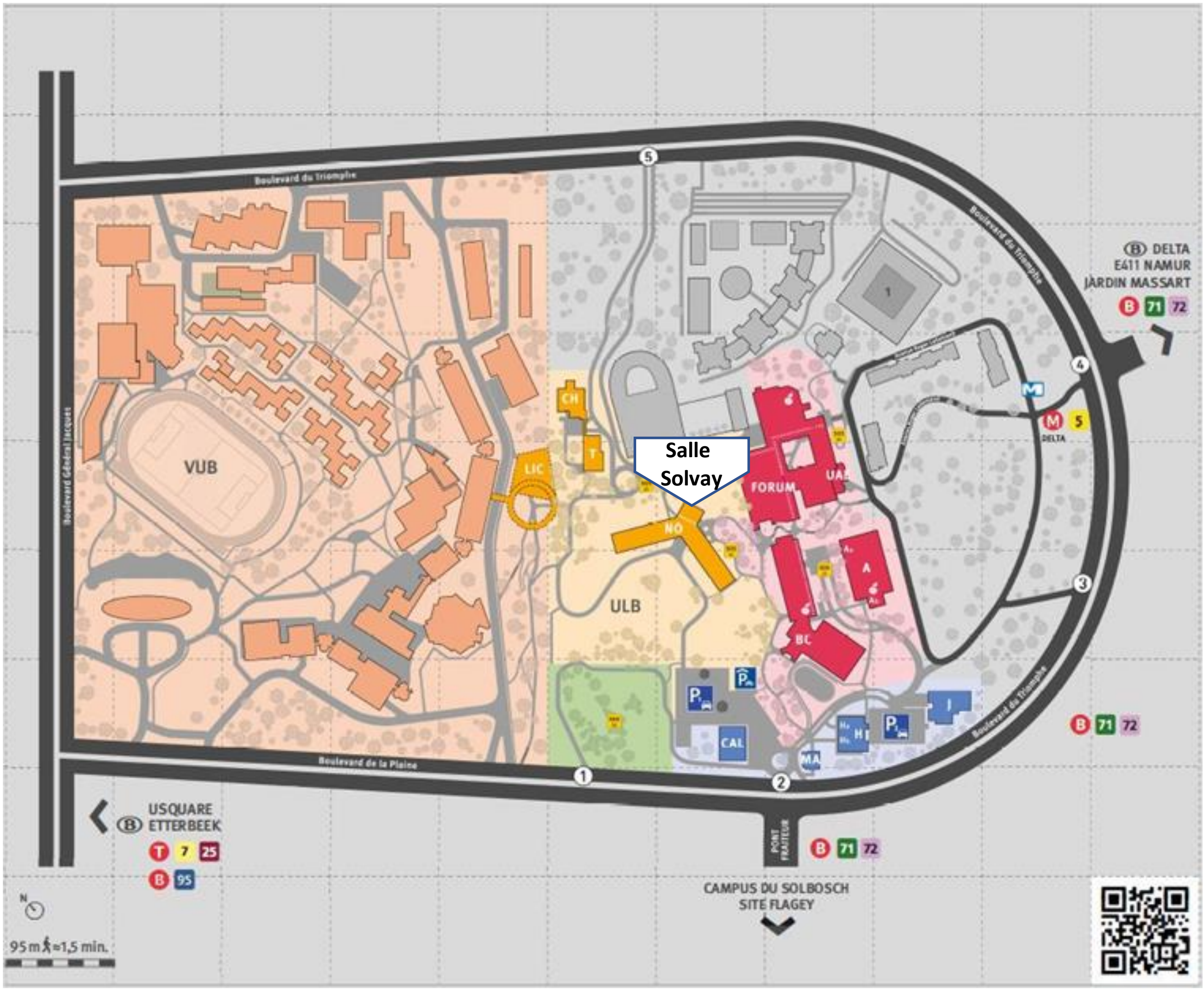
Zinc (Zn) is an essential element and the most abundant transition metal in plants. To cope with Zn deficiency, plants adjust their Zn homeostasis by inducing expression of several genes. Most important is the regulatory role of bZIP19/23 transcription factors, that also act as sensors of Zn status. In order to learn more about the role and function of transporters in relieving Zn deficiency, we have analysed some of them in more detail. We visualized the distribution of Zn depletion in Zn deficient roots, determined the expression of Zn transporter genes in response to Zn deficiency in time, mapped their cellular specificity of expression in roots, and examined the effects of their loss of function using single and double mutants. In addition, we studied the role of *N-ALPHA-TERMINAL ACETYLTRANSFERASE 25* (*NAA25*) in Zn response and performed a Genome Wide Association analysis of the Zn deficiency ionome, which revealed the involvement of a cluster of *HIPP* genes in Zn deficiency response. Our findings generally confirm the complexity of the Zn deficiency response, and the high redundancy with respect to different Zn transporters, but also shows that there are several other genes that play a role, which will help in further unravelling the different components of the plant Zn deficiency response.

Dr **Vanessa Minden**[1], Koen Verhoeven[2], Harry Olde Venterink[1]

[1]Department of Biology, Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050 Brussel, Belgium
[2]Terrestrial Ecology Department, Netherlands Institute of Ecology (NIOO-KNAW), Droevendaalsesteeg 10, 6708 PB Wageningen, The Netherlands.

Within-generational and transgenerational plasticity to nutrient stress in endangered, non-endangered and invasive plants

Phenotypic plasticity is the ability of individual genotypes to produce different phenotypes in different environments, either within a single generation (within-generation plasticity, WGP) or across generations (transgenerational plasticity, TGP). TGP theory assumes elevated offspring-tolerance towards abiotic stressors, e.g. through epigenetic DNA methylation. High TGP plants may be ecological generalists, low TGP plants may be restricted to narrower ecological ranges. Whereas TGP is accepted as an important plant mechanism, knowledge on aspects such as the environmental conditions promoting it, and its relationship with WGP is limited.
In our current project, we aim to explore the adaptive value of WGP and TGP between endangered, non-endangered and invasive plant species; tested in the framework of nutrient availability (nitrogen and phosphorus limitation, and balanced nutrient conditions). We hypothesise WGP and TGP potentials to be lowest in traits of endangered and highest in traits of in invasive species. In my presentation, I will introduce the project ideas and its design and will present the results of our first experiment on within-generation plasticity (WGP).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