W04 – Photosynthesis and primary production

Time: Wednesday February 9th 2022 10:00-15:00

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

Organizer: Christian Hermans
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Schedule:

10:00-10:10 Welcome

10:10-10:50 Giles Johnson, Manchester University, United Kingdom
Optimising photosynthesis across different environments

10:50-11:30 Mark Aarts, Wageningen University, the Netherlands
Exploring the unexplored: revealing genetic variation in organellar genomes to improve photosynthetic performance in Arabidopsis thaliana

11:30-12:10 Marinus Pilon, Colorado State University, USA
The incorporation of iron and copper ions into proteins that function in photosynthesis in plant chloroplasts

12:10-13:30 Break

13:30-14:10 Christopher I. Vincent, University of Florida, USA
Widening the energetic highway: do plants acclimate to whole-plant energy fluxes, and can the transient rise in chlorophyll fluorescence assess photosynthetic flux acclimation?

14:10-14:30 Jonathan Pzybyla-Toscano, Université de Liège Belgium
Role of the iron-sulfur transfer protein NFU1 of the microalga Chlamydomonas reinhardtii *in chloroplast metabolism in oxic and anoxic conditions*

14:30-14:50 Loïc Haelterman, Université libre de Bruxelles, Belgium
Natural variation of Arabidopsis in the photosynthetic capacity during nitrogen deficiency

14:50-15:00 Closing remarks

The number of onsite participants is limited. Please confirm participation by e-mail 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.
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The event is organized in junction with the Ecole doctorale thématique (EDT) Plant Science, F.R.S.-FNRS.

Prof **Giles Johnson**
School of Biological Sciences, University of Manchester, United Kingdom

Optimising photosynthesis across different environments

Plants are exposed to environments that fluctuate on timescales ranging from seconds to seasons and require regulatory and acclimatory mechanisms to protect them from the resulting stress. In this presentation, I will present some of the recent work we have carried out, seeking to understand these processes. Our work focuses on how plants optimise photosynthesis and related metabolism to avoid oxidative stress, resulting from imbalances in light absorption and assimilation.

Prof Em **Marinus Pilon**
Emeritus Professor, Biology Department, Colorado State University, Fort Collins, CO.

The incorporation of iron and copper ions into proteins that function in photosynthesis in plant chloroplasts

Metal ions are essential to living organisms; for instance respiratory and photosynthetic electron transfer chains depend on metal cofactors, especially Iron (Fe) and Copper (Cu). Because they can be toxic when in excess, all organisms need to regulate the uptake and distribution of these elements. Plants must do with the ions present in the soil; different distributions of metal ions are needed during the vegetative growth phase and seed development. Furthermore, the presence of chloroplasts gives plants a more complex sub-cellular organization compared to other eukaryotes. To study the machinery required for Fe and Cu cofactor homeostasis in the model plant *Arabidopsis thaliana*, we used genetics (point mutants and knock-out mutants, over-expression, and antisensing), together with biochemical approaches (experiments with isolated proteins and chloroplasts as well as immuno-localization experiments). The systems and protein factors required for chloroplast Fe and Cu homeostasis in plants are related to and derived from prokaryotic systems, however with specific adaptations and regulation. A better understanding of metal ion cofactor use in chloroplasts not only gives insight into the evolution of photosynthesis and metal homeostasis in eukaryotes but may also benefit crop productivity, human nutrition and renewable biofuel production.

Prof. **Mark Aarts**
Laboratory of Genetics, Wageningen University, the Netherlands

Exploring the unexplored: revealing genetic variation in organellar genomes to improve photosynthetic performance in Arabidopsis thaliana

Natural genetic variation for photosynthetic traits is rapidly gaining more attention as a potential resource to improve plant performance. In these efforts the impact of variation in chloroplast and mitochondrial genomes are largely ignored due to the difficulty in separating their effect from nuclear-derived variation. We developed an efficient system to generate new organelle-nuclear combinations, with the resulting genotypes referred to as cybrids. A large cybrid panel representing species wide organelle variation in Arabidopsis thaliana, reveals variation for a large range of fluorescence based photosynthetic traits. Organellar genomes can result in phenotypic differences, regardless of the nuclear genome, but often also in interaction with the nuclear genome. In doing so we identified a potential link between natural variation for the NDH complex and increased photosynthetic performance. Cybrids also can be used to assess nuclear adaptation to naturally occurring organelle mutants. To reveal these nuclear adaptations a large mapping population, phenotyped during highly dynamic environments, revealed a dozen QTLs that represent different photosynthetic mechanisms. Our results show that there is ample room for improvement of photosynthetic traits, not only in the nuclear genome, but also hidden in the organellar genomes.

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