The Research Group

Structural Biology Brussels

has the honor to invite you to the public defense of the PhD thesis of

Aleksandra Lewandowska

to obtain the degree of Doctor of Bioengineering Sciences

Joint PhD with Universiteit Gent

Title of the PhD thesis:

Forward and reverse: looking for components of oxidative stress signalling pathways

Promotors:

Prof. dr. Joris Messens
Prof. dr. Frank Van Breusegem

The defense will take place on
Wednesday, December 1, 2021 at 16h00

The defense can be followed through a live stream. Contact Aleksandra.Lewandowska@vub.be for more information

Members of the jury

Prof. dr. Lieven de Veylder (UGent, chair)
Dr. Hilde Nelissen (UGent, secretary)
Dr. Jesalyn Bolduc (VUB)
Prof. dr. Joske Ruytinx (VUB)
Prof. dr. Ive de Smet (UGent)
Dr. Steffen Vanneste (UGent)
Prof. dr. Saijaliisa Kangasjärvi (University of Helsinki, Finland)
Dr. Cezary Waszczak (University of Helsinki, Finland)

Curriculum vitae

Aleksandra obtained her Master's degree in Biotechnology from the Jagiellonian University in Kraków, Poland. In 2014 she was offered a scholarship from the VIB International PhD Program in Life Sciences and joined the research groups of prof. dr. Joris Messens and prof. dr. Frank Van Breusegem to study oxidative stress response in plants. Her work was published in two research articles and she also contributed to a research paper. She is currently a Scientific Officer at the European Food Safety Authority.

Abstract of the PhD research

Instead of escaping the source of stress, plants reallocate all their resources from growth and reproduction to stress resistance. Irrespective of the stress type, these responses induce the production of reactive oxygen species (ROS), which at high levels cause irreversible cellular damage but at lower, tightly regulated levels act as signalling molecules. To better understand how the oxidative stress signal is initiated and transferred, I used two strategies to discover new genes involved in this process.

The first strategy entailed catalase-deficient plants which were mutagenized to revert the photorespiratory phenotype. I describe 12 mutant lines originating from this screen by focusing on common themes among the causative mutations. One common theme is how the disruption of auxin signalling affects oxidative stress resistance. As an example, I showed indirect evidence supporting the hypothesis that stabilization of IAA14, a transcriptional repressor from the Aux/IAA family, causes resistance to stress while it also causes a significant growth penalty and loss of lateral roots. Another common theme is photorespiration; here I showed that disruption of *GLYCOLATE OXIDASE 1*, but not its homolog *GLYCOLATE OXIDASE 2*, causes reversion of the photorespiratory phenotype of *cat2-2*. I characterized the transcriptomic and metabolomic changes that cause loss of either homolog to explain why their contribution to the stress response is very different.

The second strategy for finding new components of plant oxidative stress signalling is a validation study of one of the proteins found to be sulfenylated in vivo, chloroplastic DJ-1B. I showed that this protein has glyoxalase and holdase activity and that only its glyoxalase activity is sensitive to H_2O_2. I also showed that neither DJ-1B nor its homolog, cytosolic DJ-1A, are essential for plant viability and their loss does not cause any discernible phenotype under the tested conditions. However, while DJ-1B is not likely to play a major role in glyoxal detoxification, its chaperone activity might be linked to other cellular roles that are worth exploring. Overall, the role of the DJ-1 family in plants is still not fully understood and merits further investigation.