SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Plant Genetics

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

Bram Vancompernolle

to obtain the degree of Doctor of Bioengineering Sciences

Title of the PhD thesis:

The effect of lysine overproduction on the phenotype of *Arabidopsis thaliana*

Promotor:
Prof. Dr. ir. Geert Angenon

The defense will take place on

Monday, October 26, 2020 at 17h00

at the Campus Etterbeek of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, D.2.01
The defense can be followed through a live stream. Contact bram.vancompernolle@vub.be for more information

Members of the jury

Prof. Dr. ir. Eveline Peeters (VUB, chair)
Prof. Dr. Joris Messens (VUB, secretary)
Prof. Dr. Jean-Pierre Hernalsteens (VUB)
Prof. Dr. ir. Bram Van de Poel (KU Leuven)
Prof. Dr. ir. Nathalie Verbruggen (ULB)

Curriculum vitae

Bram Vancompernolle graduated as a biochemist in 2006 at the Universiteit Gent. He started his PhD on amino acid metabolism in *Arabidopsis thaliana* as an assistant in 2008. The research was funded by the Vrije Universiteit Brussel. Bram Vancompernolle published 1 paper as the first author pertaining to his PhD in a peer-reviewed journal. He supervised practicals for 9 different courses at the Bachelor and Master level from 2008 till 2015 and organized workshops in plant genetics from 2009 till 2016 and supervised 5 Master students during their Master thesis. He was an active member in the department council and the education council. Currently, Bram is working for the Federal Public Service of Public Health, Food Chain Safety and Environment at the department of Plant Protection Products and Fertilizers.

Abstract of the PhD research

Amino acids are mostly known as the building blocks of proteins in all living organisms, but they have many other important functions in plants as precursors of several molecules with a multitude of functions in plant metabolism, development and defence. From a nutritional point of view, accumulation in plants of the amino acids that cannot be produced by the human body, is of major interest; these so-called indispensable amino acids need to be acquired from the diet. In plants the “aspartate super pathway” is a highly regulated metabolic pathway through which four indispensable amino acids are produced: lysine, threonine, methionine and isoleucine. This pathway is a desired target for biofortification research, which aims to decrease the incidence of amino acid deficiency in populations with a mostly plant-based diet by increasing the levels of one or more of the indispensable amino acids in a target crop such as rice or maize. However, a strong increase of an amino acid in a plant often has negative side effects such as altered development or a decrease in fertility and yield.

This study aimed to describe in detail these negative effects of increased levels of lysine on the phenotype of young developing plants and to find a molecular link between these processes. The focus of this work was on the analysis of transgenic *Arabidopsis thaliana* lines expressing *dhdps-r1*, which either continuously or inducibly produce lysine in the whole plant, without any means to regulate this production. Through phenotypic analysis in different growth conditions at both macroscopic and microscopic level, amino acid analysis of leaves and transcriptome analysis using RNAseq technology, it became clear that the earliest stages of development are the most crucial, since delaying the onset of the high lysine levels significantly benefits the plant phenotype. Since leaf development is a highly regulated process, disruption of the balance in the amino acid metabolism influences leaf development on multiple levels (with involvement of many different molecular factors) and not a single factor can be designated as the main perpetrator of the response. It is however likely that due to the high levels of lysine, the plant prioritizes defense over growth, since lysine is metabolized into N-hydroxypipecolic acid, which functions as a defense elicitor.

In light of biofortification, both timing and organ-specific increase of lysine levels will be crucial to prevent negative effects on plant yield.