

# A systems biology approach to unravel the effects of cadmium exposure on *Arabidopsis thaliana*

Citation for published version (APA):

Bohler, S., Bohler, A., Deckers, J., Vangronsveld, J., Noben, J. P., Evelo, C., Renaut, J., & Cuypers, A. (2014). A systems biology approach to unravel the effects of cadmium exposure on *Arabidopsis thaliana*. In *Systems Biology for Food, Feed and Health*  
[http://www.researchgate.net/publication/263473659\\_A\\_systems\\_biology\\_approach\\_to\\_unravel\\_the\\_effects\\_of\\_cadmium\\_exposure\\_on\\_Arabidopsis\\_thaliana](http://www.researchgate.net/publication/263473659_A_systems_biology_approach_to_unravel_the_effects_of_cadmium_exposure_on_Arabidopsis_thaliana)

## Document status and date:

Published: 01/01/2014

## Document Version:

Publisher's PDF, also known as Version of record

## Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

## General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.umlib.nl/taverne-license](http://www.umlib.nl/taverne-license)

## Take down policy

If you believe that this document breaches copyright please contact us at:

[repository@maastrichtuniversity.nl](mailto:repository@maastrichtuniversity.nl)

providing details and we will investigate your claim.

Download date: 19 Apr. 2024



# A systems biology approach to unravel the effects of cadmium exposure on *Arabidopsis thaliana*.

S. Bohler<sup>1</sup>, A. Bohler<sup>2,3</sup>, J. Deckers<sup>1</sup>, J. Vangronsveld<sup>1</sup>, J.-P. Noben<sup>4</sup>, C. Evelo<sup>2,3</sup>, J. Renaut<sup>5</sup>, A. Cuypers<sup>1</sup>

<sup>1</sup>Centre for Environmental Sciences, Hasselt University, Belgium.

<sup>4</sup>Biomedical Institute, Hasselt University, Belgium.

<sup>2</sup>Department of Bioinformatics-BIGCAT, Maastricht University, The Netherlands.

<sup>5</sup>Centre de Recherche Public - Gabriel Lippmann, Department of Environment and Agrobiotechnologies, Luxembourg.

<sup>3</sup>Netherlands Consortium of Systems Biology, The Netherlands.

sacha.bohler@uhasselt.be

## INTRODUCTION

**Cadmium (Cd)** is a biologically non-essential, toxic, metallic trace element. It is a **pollutant** which mostly accumulates in soils due to mining, metal industry, waste incineration, and the application of phosphate fertilizers. In plants, Cd leads to **decreased yield** and, eventually, death. Furthermore, Cd enters the food chain through plants to reach food and feed, in which it has detrimental effects for animal and human health. Cleansing of contaminated soils by phytoremediation has been proposed, but due to the negative effects of Cd in plants, such as the induction of **oxidative stress**, it is necessary to have a thorough understanding of the **underlying molecular responses of plants to Cd exposure**.



Fig. 1: Cadmium (Source: Wikipedia)

## MATERIALS AND METHODS

- Arabidopsis thaliana** (Columbia) plants were grown in a **hydroponics** system (Hoogland). After 19 days of growth **5 µM CdSO<sub>4</sub>** was added to the nutrient solution of treated plants. Control and treated **Arabidopsis rosettes** were harvested after **0, 24 h and 72 h** of treatment (Fig. 2).
- Proteins** were extracted using TCA/acetone and separated by **different gel electrophoresis (DiGE)**. **Genes of interest** were selected according to the proteomics results and transcript abundance was measured by **qPCR** (Fig. 3).
- Proteomics and transcriptomics data was integratively visualized** on the **Arabidopsis Primary Plant Metabolism pathway** drawn using PathVisio and shared on WikiPathways (**WP2499**) (Fig. 4).

## VISIBLE SYMPTOMS



Fig. 2: After only 72 hours of treatment clear signs of stress were visible in the form of **necroses on leaves**.

## REPRESENTATION OF OMICS DATA

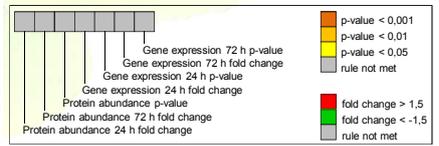
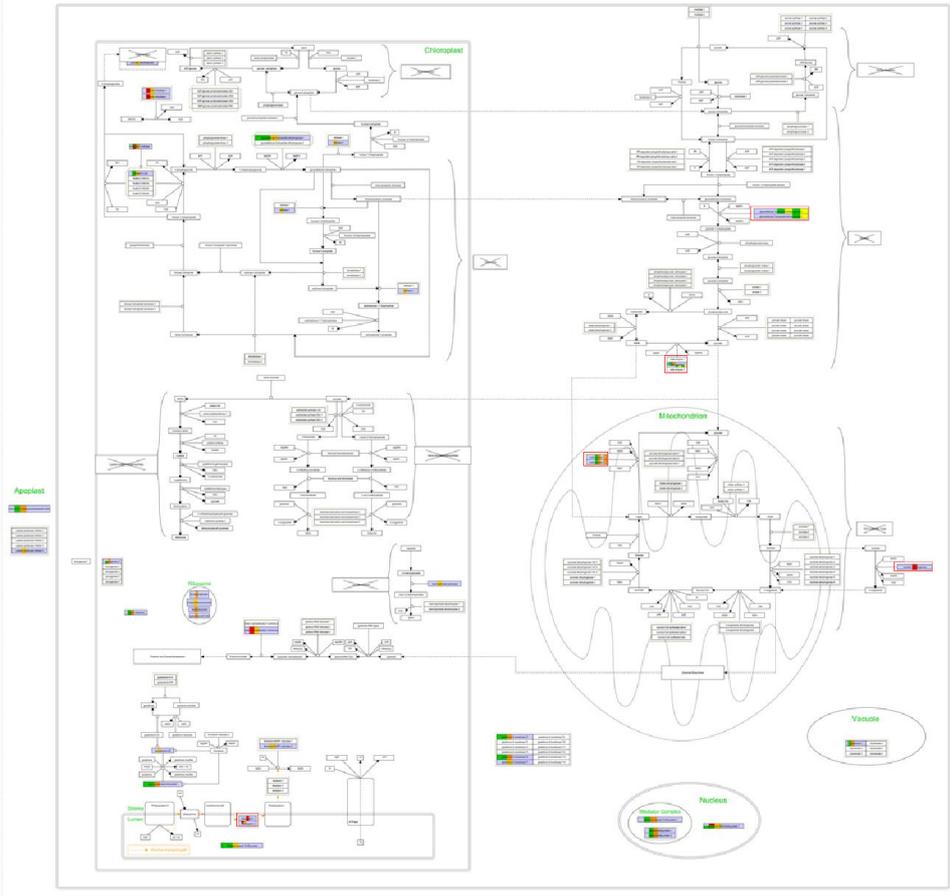
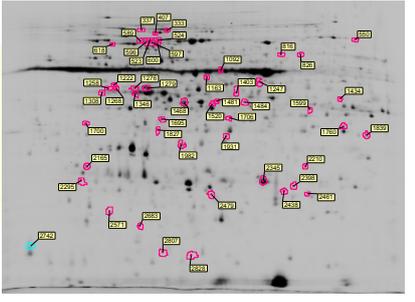


Fig. 2: 2DE gel image of the internal standard showing identified differentially abundant proteins.



## DISCUSSION

- Differentially abundant proteins** were mostly involved in **primary carbon metabolism, photosynthesis, and glutathione based detoxification**.
- Transcriptomics data was mostly confirmatory of the Proteomics results.
- Many of the proteins of interest use **NAD/NADH** or **NADP/NADPH** as a cofactor. NADH and NADPH are the most important carriers of **reducing power** and of utter importance during oxidative stress. Furthermore this is an indication of the importance of redox regulation.

Fig. 4: Proteomics and transcriptomics data visualized on the Arabidopsis Primary Plant Metabolism pathway (WP2499).