

Institute: Institute of Botany

Topic: *In vitro*-derived polyploids of the metallophyte *Arabidopsis halleri* to enhance its heavy metal hyperaccumulation ability – domestication of wild plant for phytoextraction procedure

Name of supervisor: dr hab. Aneta Słomka
aneta.slomka@uj.edu.pl

Background information:

The most socially acceptable and the cheapest technology for the heavy metal contamination removal from the soil is utilizing native species of peculiar physiological properties. The current project aim to obtain polyploid plants of *A. halleri*, European metallophyte of hyperaccumulating Zn and Cd abilities, using *in vitro* culture (suspended cells and/or protoplasts). This diploid ($2n = 2x = 16$), perennial plant is rather tiny [1], thus polyploidization provides a chance to increase its biomass and hyperaccumulation ability for the practical purpose (recultivation of heavy metal contaminated sites). *A. halleri* with a short life cycle and a high regenerative potential in *in vitro* culture, closely related to *A. thaliana* - a model system with many identified genes with known functions, is a good model to study heavy metal tolerance in plants [2]. Naturally originated polyploids in the genus *Arabidopsis* have adaptive characters and could be advantageous in some circumstances, including heavy metals [3].

The main question to be addressed in the project:

1. What are the thresholds of Zn and Cd that are bearable for suspended cells of *A. halleri*?
2. Are: a) suspended cells treated with agents destroying karyological spindle, and b) fused somatic cells *via* protoplasts, both after treatment with established amount of heavy metals, able to regenerate into polyploid plants?
3. Are regenerated plants polyploids?
4. Does the use of *in vitro* culture increase the effectiveness of polyploid formation in comparison with seed/seedling treatments with agents destroying karyological spindle?
5. Do regenerated polyploid plants manifest enhanced potential for the heavy metal tolerance and accumulation in comparison with the initial plants?
6. Is enhanced hyperaccumulation in polyploids correlated with increased expression of selected tolerance genes in comparison with the initial plants?
7. Do polyploid plants set seeds? – testing the possibility to obtain the next generations of polyploids. If they do not set seed or very little due to the polyploid status, their germplasm will be preserved in the form of encapsulated propagules (synthetic seeds).
8. Are plants obtained from preserved germplasm maintaining enhanced tolerance and hyperaccumulation ability in a common garden and in the field conditions?

Information on the methods/description of work:

In vitro culture; physical/chemical fusion of protoplasts; flow cytometry; physiological parameters measurements (e.g. plant biomass, fecundity, growth speed rate, tolerance index, translocation and bioaccumulation factors); Atomic Absorption Spectroscopy; common garden experiments; germplasm encapsulation; Real-Time PCR.

Additional information (e.g. special requirements from the student):

mobility acceptance, working time flexibility and regularity, English fluency.

Place/name of potential foreign collaborator:

Ruhr University Bochum, Molecular Genetics and Physiology of Plants, Germany.

References:

- [1] Preite V. et al. 2019. *Physiological Transaction of the Royal Society B* 374: 20180243.
- [2] Courbot M. et al. 2007. *Plant Physiology* 144: 1052-1067.
- [3] Novikova P.Y. et al. 2018. *Current Opinion in Plant Biology* 42: 8-15.