Institute: Institute of Botany

Topic: The impact of microplastic and heavy metals on plant cell

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Background information:
Despite the known impact of microplastics (MPs) on aquatic organisms, knowledge about their influence on terrestrial organisms, especially plants, is very scarce. Some reports in recent years show that particles as large as tens of micrometers could be collected (absorbed or transported) by plants as their presence is confirmed within root cells [1, 2]. Therefore, there is a risk of the MPs being transferred to the aerial organs of plants and then their consumption by animals or humans. We know nothing yet about how plastic affects plants, positively or negatively. The problem of uptake and impact of heavy metals (HMs) in plants is much more elaborated. Overall, an excess of heavy metals negatively affects plant growth and metabolism, with the exception of species that tolerate increased concentrations of heavy metals in the soil (metallophytes). As an inert carbon stream in an aquatic environment, MPs have been reported as carriers for HMs and both exhibit various interactive effects [3]. However, these interactions are still poorly understood, especially the mechanisms driving these interactions and how they pose risks on organisms such as terrestrial plants.

The main question to be addressed in the project:
The main aim of the project is to determine the influence and predict the effects of MPs and MPs in combination with HMs on the functioning of the plant cell.

Information on the methods/description of work:
1/ identification of the types of microplastics found in a post-industrial dump containing HMs, on which a landfill operates, and chemical synthesis/purchase of appropriate ready-made commercially available MPs;
2/ treatment of cells with MPs and confirmation of the presence of MPs within cell structures;
3/ measurement of viability and physiological parameters of cells under the influence of MPs alone, HMs alone, MPs + HMs, manipulating various culture parameters, i.e. temperature, pH;
4/ modelling of interaction between HMs and MPs.
Various microscopic and spectrophotometric techniques on *in vitro* culture of suspended cells will be applied.

Additional information (e.g. special requirements from the student):
basic knowledge on plant cell structure and plant physiology, working time flexibility and regularity, English fluency, readiness to work in interdisciplinary team, basic statistical knowledge.

Place/name of potential foreign collaborator:
The collaboration between Polish and Chinese and/or German and/or North American scientific groups will be established. Three of them belong to the small group of scientists studying the effects of MPs on plants [1-3].

References (3**):**
[1] Austen K., MacLean J., Balanzategui D., Hölker F. 2022. Microplastic inclusion in birch tree roots. *Science of the Total Environment*, 808, 152085.
[2] Li L., Luo Y., Li R. *et al.* 2020. Effective uptake of submicrometre plastics by crop plants via a crack-entry mode. *Nature Sustainability*, 3, 929–937.
[3] Liu S., Shi J., Wang J., *et al.* 2021. Interactions between microplastics and heavy metals in aquatic environments: A Review. *Frontiers in Microbiology*, 12, 652520.