

Institute: Institute of Botany

Topic: Adaptations of lichens to excessive nitrogen compounds in the environment

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Background information:

Nitrogen pollution is one of the main environmental concerns related to anthropogenic activities in recent decades. The two main anthropogenic sources of nitrogen are the production of fertilisers and the combustion of fossil fuels. Lichens, being basically composed of heterotrophic fungus and autotrophic alga/cyanobacterium, do not possess any kind of protective mechanisms and layers, therefore, they are extremely sensitive to any excessive compounds in the environment. Nevertheless, many lichen species are known for their high tolerance to various chemical compounds, such as, for example ammonia or heavy metals. Although the response of many lichen species to nitrogen pollution is well-studied, there is still little known about the physiological, biochemical and molecular basis of their response and tolerance to this stress factor.

The main question to be addressed in the project:

The project includes the study of the impact of various nitrogen compounds at different levels: lichen communities, single species (both nitro- and acido-phytic) as well as isolated symbiotic partners, i.e., mycobiont and photobiont. Main questions:

- (1) Which physiological, biochemical, and symbiotic characteristics make lichens selectively tolerate excess nitrogen in the environment?
- (2) What are the physiological and biochemical effects of exposure to various nitrogen compounds on lichens in a functional unit and in isolated partners?
- (3) What are the potential causes of differences in tolerance to excess nitrogen in the environment in different species of lichens with a photosynthetic partner belonging to algae and cyanobacteria?

Information on the methods/description of work:

The candidate will perform the following research tasks:

- Conducting field research;
- Collection of lichen samples;
- Taxonomic verification;
- Planning and conducting laboratory experiments;
- Performing measurements of physiological and biochemical parameters;
- Comprehensive statistical analysis;
- Writing scientific papers;
- Promotion of obtained results at conferences;
- Collaboration with an international team.

The following research methods will be used:

- Determination of photosynthetic pigment concentrations;
- Assessment of photosynthetic activity based on chlorophyll fluorescence;
- Determination of cell membrane integrity level;
- Viability assessment by determination of dehydrogenase activity;
- Determination of the oxidative stress level;
- Determination of antioxidant activity;
- Isolation of both symbiotic partners and in vitro culture.

Additional information:

The PhD student should have knowledge in the field of lichenology, lichen ecophysiology and ecotoxicology. The candidate should have practical experience in performing basic laboratory analyses

and team laboratory skills. Experience in planning research experiments and the ability to use basic software for statistical analyses are welcome. Working time flexibility and regularity as well as very good knowledge of English are required.

Place/name of potential foreign collaborator:

Silvana Munzi, University of Lisbon (Portugal); Luca Paoli, University of Pisa (Italy)

References:

[1] Hauck, M., 2010. Ammonium and nitrate tolerance in lichens. *Environmental Pollution* 158(5), 1127–1133.

[2] Gaio-Oliveira, G., Dahlman, L., Palmqvist, K., Martins-Loução, M.A., Máguas, C., 2005. Nitrogen uptake in relation to excess supply and its effects on the lichen *Evernia prunastri* (L.) Ach. and *Xanthoria parietina* (L.) Th. Fr. *Planta* 220, 794–803.