

Dr. Jiri Neustupa
Department of Botany
Charles University of Prague

Review – PhD thesis of Martina Pichrtová

“Stress resistance of polar hydro-terrestrial alga *Zygnema* sp. (Zygnematophyceae, Streptophyta)”

Terrestrial green algae are typical and abundant components in the polar regions. These communities form water-stable aggregates that have important ecological roles in primary production, nutrient cycling, water retention and stabilization of polar soils. Although available data on green algae are generally very limited for the Arctic and Antarctica, their functional importance as ecosystem developers is regarded as high. Nevertheless there exists still a huge gap in knowledge on the even basic ecophysiological performance and tolerance mechanisms of polar green algae under the prevailing, fluctuating harsh environmental conditions.

Therefore, in the present PhD thesis **Martina Pichrtová** investigated members of the terrestrial green algal genus *Zygnema* (Streptophyta) under various stress conditions (osmotic stress, desiccation, UV radiation) both in laboratory and field experiments. A combination of microscopic techniques (light microscopy, epifluorescence, TEM) and physiological/biochemical methods (photosynthesis, pigment HPLC) were applied to address stress tolerance mechanisms in these green algae. In addition, molecular taxonomy had to be addressed as well, because the various species of *Zygnema* are morphologically difficult to distinguish. As a result a new species of *Zygnemopsis* was discovered among the samples.

As major results **Martina Pichrtová** was able to demonstrate that *Zygnema* forms phenolic compounds as UV sunscreens which are localized in peripheral vacuoles/vesicles. *Zygnema* forms pre-akinetes as highly resistant cells against harsh abiotic factors. These specialized cells are induced by hardening during slow dehydration and/or nitrogen starvation, which guarantees survival of the population.

The PhD thesis of **Martina Pichrtová** consists of 3 publications with first authorship in very good internationally acknowledged, peer-reviewed journals. Two of the papers are already published, the third one is currently in press. The PhD thesis contains a general introduction into the topic which equals a review on the polar regions, the prevailing environmental conditions, the occurring terrestrial algae and finally a chapter on *Zygnema* – all together 22 pages with many references. It follows the research objectives. After the 3 publications, all data are shortly summarized and

discussed (incl. conclusions) on 4 pages.

I think this is a very nice PhD thesis. It has a very good and logical structure, is easy to follow and read, exhibits informative illustrations and contains various new data on polar green algae which have not been known before. Therefore, the PhD thesis of **Martina Pichrtová** represents an important scientific contribution to the field of phycology. In addition, the 3 publications have all been positively reviewed by at least 6 expert colleagues, which document the high quality of the presented research data. Finally, I like to point out that **Martina Pichrtová** has on top of these 3 key publications contributed to another 11 papers in peer-reviewed journals, which is excellent in terms of her age and young career status.

Nevertheless, I have also to mention some minor critical points:

1. the stress concept has NOT been developed by Lichtenthaler (1996), it was first suggested by J. Levitt (1972, 1980) – he should get the credit
2. I disagree on the usage of “resistance” by the candidate. Resistance always means a genetic response (e.g. salt adaptation in Halobacteria because of salt-requiring proteins), which was NOT investigated in the PhD thesis. **Martina Pichrtová** studied instead physiological response patterns, i.e. physiological plasticity under various stress scenarios, which should be reflected in the term “tolerance” (e.g. different tolerance widths among *Zygnema*).
3. I disagree also on the usage of “microalgae” to describe *Zygnema*. From my view, microalgae are mainly unicellular, while *Zygnema* is a multicellular, i.e. filamentous green macroalgae, of course of small size.
4. the process of osmotic acclimation is not comprehensively described.

Questions to the candidate:

- 1.) Can you explain the whole process of osmotic acclimation in an alga?
 - a.) What are the advantages and disadvantages when using inorganic ions and/or organic osmolytes?
- 2.) How dangerous is UV radiation for marine and terrestrial polar algae?
 - a.) Which protective mechanisms exist and how do you judge the cost-benefit ratios?

In summary, in spite of my minor critical points, I think the present PhD thesis of **Martina Pichrtová** represents a nice piece of research, absolutely comparable to the standards of my university, and hence should be accepted without any problems by the Faculty of Science, Charles University in Prague.

My recommendation: **pass**



(Prof. Dr. Ulf Karsten)