Desiccation tolerance and fatty acid composition of polar green algae *Zygnema* spp. (Zygnematophyceae, Streptophyta)

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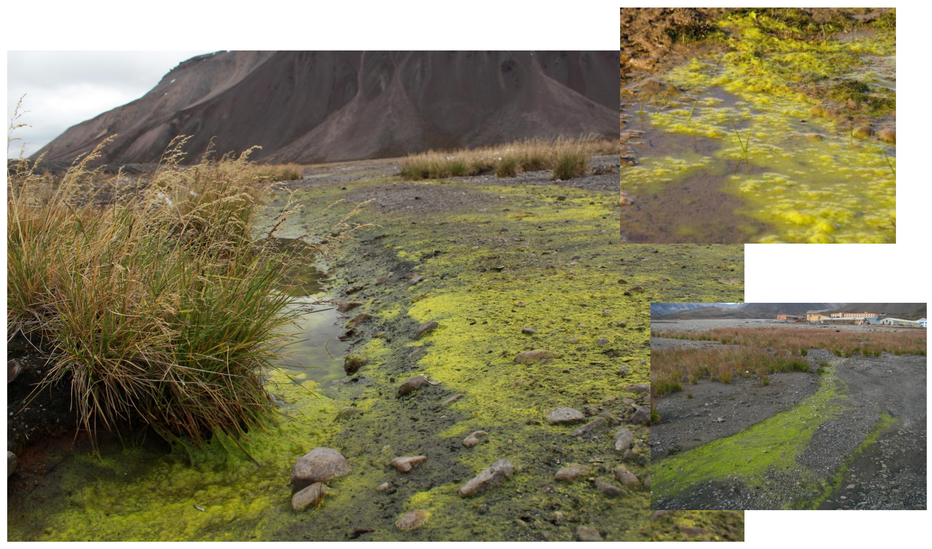
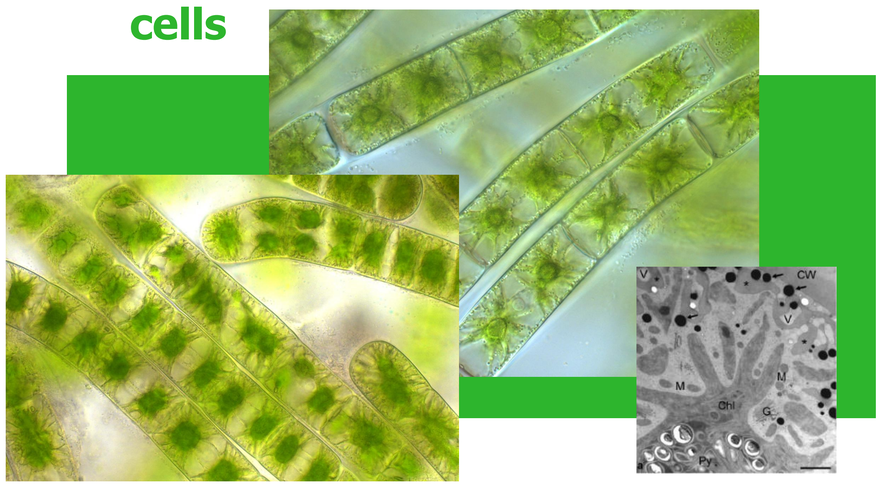
Background

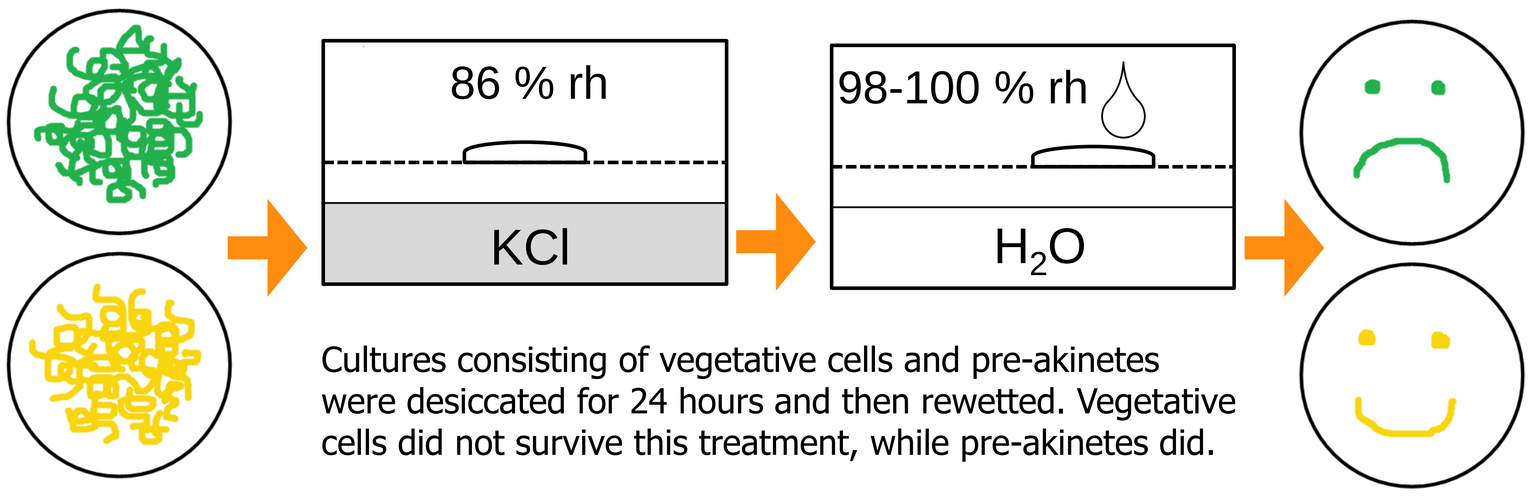
Conjugating green algae (Zygnematophyceae, Streptophyta) produce high amounts of biomass in polar hydro-terrestrial environment. Such habitats are usually shallow with only limited supply of liquid water from melting snow and active permafrost layer. Thus, the algae are subject to desiccation during the vegetation season. Production of stationary phase like cells, so called pre-akinetes has been recently reported from alpine and polar *Zygnema* spp. (Herburger et al. 2015, Pichrtová et al. 2014). The aim of this experimental study was to compare vegetative cells and pre-akinetes of *Zygnema* focusing on their ultrastructure, desiccation tolerance and fatty acid composition.



Zygnema spp. in the Arctic hydro-terrestrial environment are exposed to natural desiccation

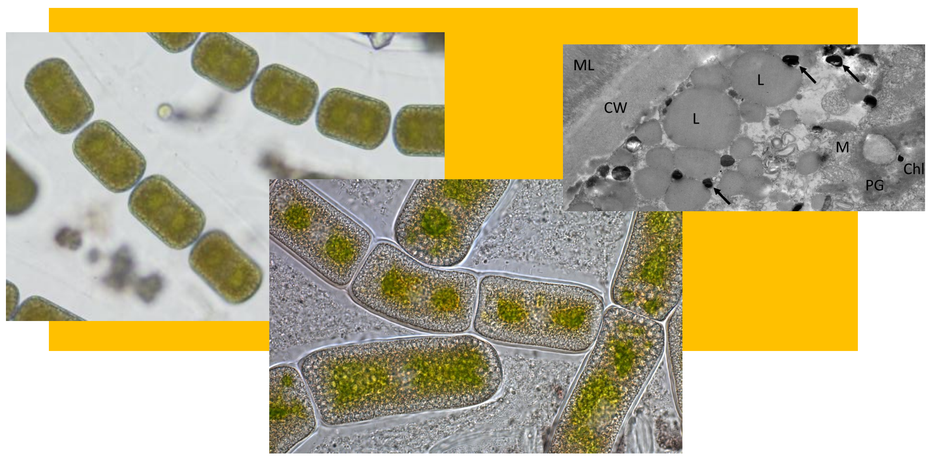
Vegetative cells



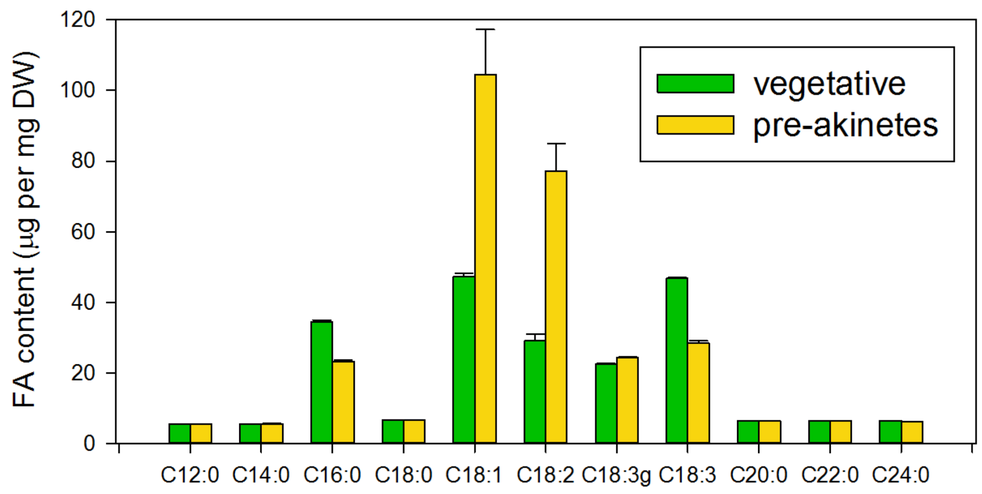


Cultures consisting of vegetative cells and pre-akinetes were desiccated for 24 hours and then rewetted. Vegetative cells did not survive this treatment, while pre-akinetes did.

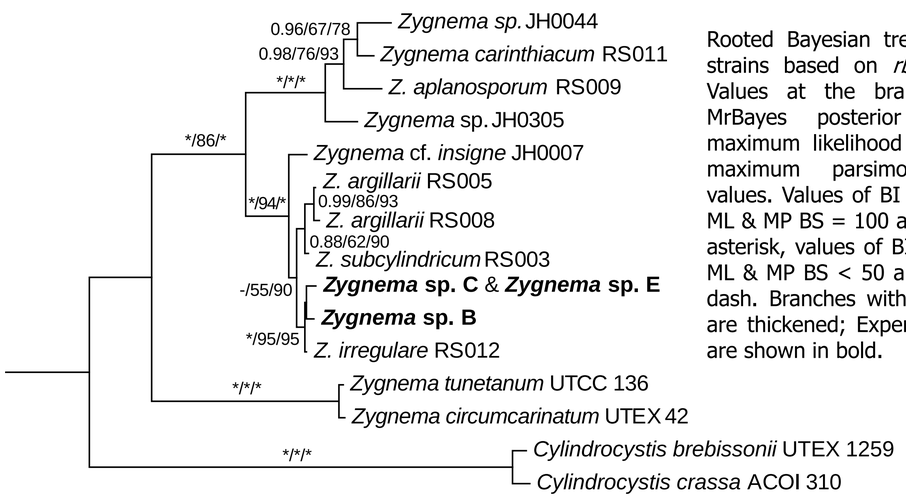
Pre-akinetes



Morphological and ultrastructural differences between vegetative cells and pre-akinetes



Difference in the composition of fatty acids between vegetative cells and pre-akinetes studied by FAME analysis.



Rooted Bayesian tree of *Zygnema* strains based on *rbc*L sequences. Values at the branches indicate MrBayes posterior probabilities, maximum likelihood bootstrap and maximum parsimony bootstrap values. Values of BI PP = 1.00 and ML & MP BS = 100 are marked with asterisk, values of BI PP < 0.8 and ML & MP BS < 50 are marked with dash. Branches with BI PP = 1.00 are thickened; Experimental strains are shown in bold.

Zygnema spp. strains used for the experiment

Summary

Pre-akinetes of *Zygnema* are not really specialized cells, they can be viewed as mature, starved or stationary-phase-like cells. When compared to the fresh vegetative cells, the pre-akinetes are yellow-brown in colour, their chloroplasts have reduced lobes and they also possess large accumulations of lipids. Moreover, significant differences in the fatty acid composition between young and pre-akinete cultures were detected, the most abundant fatty acids in pre-akinetes were oleic (C 18:1) and linoleic (C 18:2) acid. Only cultures consisting of pre-akinetes were able to survive experimental desiccation which was lethal to the vegetative cells. All three strains used for the experiment showed very similar performance. The results indicate that pre-akinetes play an important role in desiccation tolerance and survival of polar *Zygnema* spp. while the production of specialized cells is largely suppressed.

References:

Herburger, K., Lewis, L. A., Holzinger, A. (2015): "Photosynthetic efficiency, desiccation tolerance and ultrastructure in two phylogenetically distinct strains of alpine *Zygnema* sp. (Zygnematophyceae, Streptophyta): Role of pre-akinete formation. " Protoplasma 252(2): 571-589

Pichrtová, M., Hájek, T., Elster, J. (2014): "Osmotic stress and recovery in field populations of *Zygnema* sp. (Zygnematophyceae, Streptophyta) on Svalbard (High Arctic) subjected to natural desiccation." FEMS Microbiology Ecology 89(2): 270-280

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