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Photophysiological investigations of the temperature stress responses of Zygnema spp (Zygnematophyceae) from subpolar and polar habitats (Iceland, Svalbard)

Charlotte Permann[1], Mattia Pierangelini[1], Daniel Remias[2], Louise A. Lewis[3] and Andreas Holzinger[1]
[1]Department of Botany, Functional Plant Biology, University of Innsbruck, Innsbruck, Austria
[2]School of Engineering and Environmental Sciences, University of Applied Sciences Upper Austria, Wels, Austria
[3]Department of Ecology and Environmental Biology, University of Connecticut, Connecticut, USA

Abstract:

Zygnematophyceae are main primary producers in polar hydro-terrestrial habitats, characterized by extreme abiotic conditions. They are expected to be strongly impacted by climate change, leading to threats to subpolar and polar ecosystems. Two isolates of *Zygnema* from a subpolar (Iceland, *Zygnema* sp. I) and a polar Island (Svalbard, *Zygnema* sp. B) were compared by their photophysiological performance and phenolic content. A phylogenetic analysis was performed in a newly isolated *Zygnema* I where also morphology and ultrastructure were characterized. The *rbc*L sequence of the Icelandic *Zygnema* I was identical to that of *Zygnema* V, previously isolated from Svalbard, and phylogenetic analysis placed this strain into *Zygnema* clade 2. Average width of vegetative filaments (28 ± 0.7 µm) and ultrastructure was similar to closely related *Zygnema* strains. *Zygnema* I and *Zygnema* B were exposed to three different treatment temperatures (15, 20 and 25°C) for two weeks, then photophysiological parameters and cellular phenol contents were acquired. The maximum electron transport rate increased significantly with elevated temperatures, but non-photochemical quenching did not change. Net photosynthetic oxygen production was higher in *Zygnema* B, but decreased in both strains from 10 to 15°C measuring temperature. *Zygnema* I showed a significant decrease between 15/25°C-treated cultures above 20°C measuring temperature. The phenolic content did not change significantly with experimental treatments, the spectral absorption at 350 nm was significantly lower in *Zygnema* B when compared with *Zygnema* I. Taken together our results indicate that *Zygnema* B and *Zygnema* I cannot adapt to elevated temperatures.

Keywords: Climate change, green algae, photosynthesis, rbcL phylogeny, streptophyta, transmission electron microscopy