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Interactive effects of ultraviolet radiation and nutrient addition on growth and photosynthesis performance of four species of marine phytoplankton

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Abstract

Experiments (6–8 days) were carried out during the austral summer of 2005 in Chubut, Argentina (43° S, 65° W) to determine the interactive effects of solar UVR (280–400 nm) and nutrient addition on growth and chlorophyll fluorescence of four species of marine phytoplankton – the diatoms *Thalassiosira fluviatilis* Hustedt and *Chaetoceros gracilis* Schütt, and the dinoflagellates *Heterocapsa triquetra* (Ehrenberg) Stein and *Prorocentrum micans* (Ehrenberg). Samples were incubated under three radiation treatments (two sets of each radiation treatment): (a) samples exposed to full solar radiation (PAR + UVR, PAB treatment, 280–700 nm); (b) samples exposed to PAR and UV-A (PA treatment, 320–700 nm) and (c) samples exposed only to PAR (P treatment, 400–700 nm). At the beginning of the experiments, nutrients (i.e., $NaPO_4H_2$ and $NaNO_3$) were added to one set of samples from each radiation treatment ("N" cultures) whereas in the other, the nutrients concentration was that of the culture medium. At all times, the lowest growth rates (μ) were determined in the PAB treatments, where enriched cultures had significantly higher μ ($P < 0.05$) than non-enriched cultures. Daily cycles of photochemical quantum yield (Y) displayed a pattern of relatively high values early in the morning with a sharp decrease at noon; recovery was observed late in the afternoon. In general, higher Y values were determined in enriched cultures than in non-enriched cultures. As the experiments progressed, acclimation (estimated as the difference between Y at noon and that at time zero) was observed in all species although in variable degree. All species displayed some degree of UVR-induced decrease in the photochemical quantum yield, although it was variable among treatments and species. However, this effect decreased with time, and this pattern was more evident in the dinoflagellates, as the concentration of UV-absorbing compounds increased. Thus, under conditions of nutrient enrichment as may occur by river input or by re-suspension by mixing, dinoflagellates outcompete with diatoms because they may have a higher fitness under UVR stress.

Keywords: *Chaetoceros gracilis*; *Heterocapsa triquetra*; Nutrients; Photosynthesis; *Prorocentrum micans*; Phytoplankton; *Thalassiosira fluviatilis*; Ultraviolet radiation; UV-absorbing compounds

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