Elevated CO2 increases sensitivity to ultraviolet radiation in lacustrine phytoplankton assemblages

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ABSTRACT: This study tests the effects of elevated CO2 and ultraviolet radiation (UVR) on phytoplankton photosynthesis through in situ incubations in Lake Giles, Pennsylvania. In a first experiment, CO2 was supplied from a tank to simulate atmospheric CO_2 concentrations predicted in scenarios of future global change. In a second experiment, elevated CO_2 conditions were obtained by the mineralization of added colored dissolved organic matter (CDOM) of terrestrial origin (400 μmol L^{-1} final concentration). The results demonstrated that for natural assemblages from Lake Giles, atmospheric CO_2 concentrations similar to those predicted for the end of the century can increase primary productivity up to 23% in the absence of photoinhibition. However, elevated CO_2 concentrations also increased sensitivity of phytoplankton to UVR, making cells more susceptible and increasing photoinhibition. Increased sensitivity was observed in samples incubated with the artificial CO_2 supply as well as with the CDOM addition, the latter resulting in CO2 partial pressures close to three times present atmospheric levels. Photosynthetic rate modeled for elevated CO_2 and midday solar exposure just below the lake surface was 17% of potential production compared with 21% under usual CO_2 levels in the lake, resulting in similar rates between phytoplankton assemblages grown under high and low CO_2 levels. Understanding the effect on primary productivity of the interaction between factors that may be affected by global change is essential to predict future changes in ecosystems and climate.

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