Unraveling the eco-physiological roles of phytoplankton-derived reactive oxygen species

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Reactive oxygen species (ROS) are powerful oxidants and reductants that have profound biogeochemical impacts on the cycling of carbon and metals, and can pose both detrimental and beneficial impacts on life. The ability to produce extracellular ROS such as superoxide ($O_2^{\cdot -}$) and hydrogen peroxide (H_2O_2) is widespread among marine phytoplankton, but the potential eco-physiological roles and wider environmental consequences of this ROS production remain enigmatic. In some organisms, such as bacteria, yeast, and the harmful alga *Chattonella* spp., $O_2^{\cdot -}$ functions as a signaling molecule that promotes cellular growth, however the presence of analogous functions in other phytoplankton are largely unknown. Here, we investigated the potential growth regulating function of ROS in model phytoplankton by examining how extracellular ROS production rates vary as a function of cell density and at different stages of growth. Furthermore, we examined phytoplankton growth after removing extracellular ROS with the addition of exogenous antioxidants such as superoxide dismutase (SOD). This study directly addresses cellular-level mechanisms that may underlie phytoplankton growth in the oceans, including the rise and decline of phytoplankton blooms. Therefore, this work may aid in advancing the current understanding of factors that regulate the structure and productivity of marine microbial communities, the coupled biogeochemical cycles of carbon, nutrients, and metals, and thereby provide implications for marine ecosystem health and climate.