Extreme light acclimation reveals inherent photosystem II photoprotection in a natively low-light *Chlorella*

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The desert-native, extreme light (2,000 μEin)-adapted green alga *Chlorella ohadii* expresses exceptional photosystem II photoprotection, due in part to high levels of PSII-cyclic electron flow. This facilitates *C. ohadii* possessing the fastest recorded doubling time of any known phototroph, 1.4 hours, in high light and 2% CO_2. When *Chlorella* NIES 642, a temperate, low light (20 μEin)-adapted alga is subjected to the same growth conditions as *C. ohadii*, we have observed various changes to the PETC indicative of high PSII-CEF and recorded a minimum doubling time of 1.6 hours. In extreme light grown NIES 642, PSII reaction centers do not fully saturate under conditions that can induce single-turnovers in organisms as recalcitrant as *C. ohadii*. 77K fluorometry and chlorophyll extraction suggest this may result from extensive minimization of chlorophyll pigments; in extreme light conditions the *C. ohadii* to *C.* NIES 642 chlorophyll *a* ratio is 1.82 ± 0.18. Acclimated NIES 642 also shows various characteristics of high PSII-CEF on the acceptor side of PSII, including near-constant utilization of the plastoquinone pool (4.2 ± 2.5% performing no electron transfer) and a majority of centers with complexed oxidized Q_B (59.7 ± 2.9%), opposed to semiquinone (35.1 ± 2.6%). P700 utilization monitored via $\Delta 810_{nm}$ absorbance illustrates that extreme light conditions greatly diminish charge separation at PSI, and *C. ohadii* expresses more PSI, comparatively. Electrochromic shift measurements of the thylakoid membrane show a diminished trans-thylakoid proton gradient in the high PSII-CEF systems, strongly suggesting a large role of PSII-CEF in optimizing ATP production.