Investigating Photosystem II Cyclic Electron Flow in *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. Once 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 to 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.