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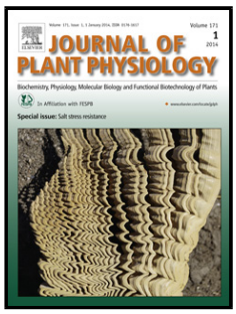

Title: Chloroplastic ATP synthase plays an important role in the regulation of proton motive force in fluctuating light

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PII: S0176-1617(18)30094-4
DOI: https://doi.org/10.1016/j.jplph.2018.03.020
Reference: JPLPH 52758

To appear in:

Received date: 4-12-2017
Revised date: 25-3-2018
Accepted date: 26-3-2018

Please cite this article as: Huang Wei, Cai Yan-Fei, Wang Ji-Hua, Zhang Shi-Bao.Chloroplastic ATP synthase plays an important role in the regulation of proton motive force in fluctuating light.*Journal of Plant Physiology* https://doi.org/10.1016/j.jplph.2018.03.020

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Chloroplastic ATP synthase plays an important role in the regulation of proton motive force in fluctuating light

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Abstract

The proton motive force (*pmf*) across the thylakoid membranes plays a key role for photosynthesis in fluctuating light. However, the mechanisms underlying the regulation of *pmf* in fluctuating light are not well known. In this study, we aimed to identify the roles of chloroplastic ATP synthase and cyclic electron flow (CEF) around photosystem I (PSI) in the regulation of the *pmf* in fluctuating light. To do this, we measured chlorophyll fluorescence, P700 parameters, and the electrochromic shift signal in the fluctuating light alternating between 918 (high light) and 89 (low light) μmol photons m^{-2} s^{-1} every 5 min. We found that the activity of chloroplastic ATP synthase (g_H^+), *pmf*, CEF activity, non-photochemical quenching (NPQ), and the P700 redox state changed rapidly in fluctuating light. During transition from low to high light, the decreased g_H^+ and the stimulation of CEF both contributed to the rapid formation of *pmf*, activating NPQ and optimizing the redox state of P700 in PSI. During the low-light phases, g_H^+ rapidly increased and the *pmf* declined sharply, leading to the relaxation of NPQ and down-regulation of photosynthetic control. These findings indicate that in fluctuating light the g_H^+ and CEF are finely regulated to modulate the *pmf* formation, avoiding the over-accumulation of reactive intermediates and maximizing energy efficiency.

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