Australian National University

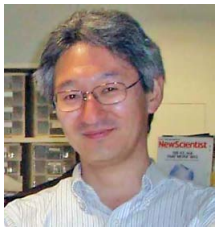
PUBLIC LECTURE

Regulation of photosynthesis by PSI cyclic electron transport

Wednesday 26 June 2013 1.00 – 2pm

Toshiharu Shikanai Professor, Kyoto University

Slatyer seminar room R.N. Robertson Building (Bldg. 46), Linnaeus Way, ANU



In the light reactions, light energy is utilized for driving photosynthetic electron transport in the thylakoid membrane. Electron transport from water to NADP+ is coupled with proton translocation across the thylakoid membrane and the resulting ΔpH is utilized in ATP synthesis. In addition to this linear electron transport, PSI cyclic electron transport recycles electrons from ferredoxin to plastoquinone, generating ΔpH without accumulation of NADPH. ΔpH plays a crucial role in regulation of photosynthesis via activating ATP synthesis and also controling the efficiency of light energy utilization in PSII (NPQ) and activity of the Cyt b6f complex. In flowering plants, PSI cyclic electron transport consists of the antimycin A-sensitive pathway depending on PGR5 and PGRL1 proteins, and also of the NDH-dependent pathway. The PGR5 pathway significantly contributes to ATP synthesis in photosynthesis, as well as linear electron transport and plays a central role in the redox homeostasis in chloroplasts via the regulation of lumen pH. In the pgr5 mutant, the size of ECSt that represents total proton motive force in the light was decreased, consistent with the lack of PSI cyclic electron transport. The gH+ is a parameter of ECS and is considered to represent the proton conductivity of ATPase. In pgr5, gH+ is upregulated at high light intensity, suggesting that ATPase is activated possibly to compensate the defect in PSI cyclic electron transport. Compared to the PGR5-dependent pathway, contribution of the NDH-dependent pathway is small but is essential for alleviating the oxidative stress in chloroplasts. Despite the structural similarity of chloroplast NDH to mitochondrial and bacterial NADH dehydrogenase, chloroplast NDH accepts electrons from ferredoxin. During the evolution of land plants chloroplast NDH changed its structure and formed the supercomplex with PSI. This structural modification is related to the functional change of chloroplast NDH in flowering plants.

Presented by
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