# Utilization of plants for human subsistence:
# Mechanism by which plant photosystems adjust to variable sunlight

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The problems which the present society faces, such as lifestyle-related illnesses and the depletion of foods and fuels worldwide, are expected to be solved by the utilization and improvement of plants. Plants supply foods for the survival of humans, and may provide biofuels for maintaining industrial activity of this society, as well as functional components to release from the lifestyle-related illnesses. All of these productions are done by plant cells with sunlight energy accepted by photosystems (PS-I and PS-II) in chloroplasts. Alterations in light quality may perturb the balance of electron transport between PS-I and PS-II, which leads to photosynthetic inefficiency. Plastoquinone (PQ), a mobile redox-active electron shuttle between PS-I and PS-II, is believed to sense these photosynthetic imbalances and initiate a transcriptional program response that resets the stoichiometry of the two photosystems in chloroplast membranes.

We have provided evidence in *Arabidopsis thaliana* that the redox state of PQ results in changes in the phosphorylation state of plastid sigma factors (SIGs), which directly regulates transcriptional levels of photosystem genes. We have found that phosphorylation of Thr-170 of SIG1 — the most abundant sigma factor in Arabidopsis leaves — selectively reduces the transcription of *psaA*, a gene coding a component of PS-I, but barely affect transcription of PS-II genes such as *psbA*. Using small molecule reagents to perturb the redox state of PQ, we have concluded that in the oxidized state, SIG1 is phosphorylated in the RNA polymerase holoenzyme complex and reduces *psaA* transcription to adjust the balance. Though further work will be needed to identify the kinase that mediates SIG1 phosphorylation and to show how it is regulated by PQ redox state, this study provides a working model for how transcriptional changes are linked to electron transport state sensing in plants.