

breakage of disulfide bonds in proteins, facilitating its correct folding. AtCYO1 coexists with photosynthetic apparatus in the thylakoid membrane where light energy is converted into chemical energy for subsequent CO₂ uptake. We hypothesize that AtCYO1 functions in the assembly of photosynthetic apparatus during the rapid chloroplast transformation. Homology search of amino acid sequence shows that the genes encoding CYO1-like proteins are widely conserved among seed plants including rice, the species in a large family of monocots (Fig. 1b). This is surprising because, in rice, cotyledon does not develop chloroplast. In this work, we examined the role of CYO1 in rice (OsCYO1).



Fig. 2. The OsCYO1 suppression mutant has albino leaves in rice. Control (1), moderately suppressed mutant (2), and severely suppressed mutant (3).

We first confirmed that OsCYO1 had the similar enzymatic characteristics and functions as AtCYO1 does. Genetic transformation with *OsCYO1* enabled *Arabidopsis* mutant lacking *AtCYO1* to recover green cotyledons. While the *AtCYO1* gene was scarcely expressed in leaves in *Arabidopsis* the *OsCYO1* was expressed in leaves rather than the cotyledon in rice. Then, we genetically modified rice to suppress *OsCYO1* gene expression, and found it to be albino seedling (Fig. 2). Evidently, the *OsCYO1* takes a critical role in chloroplast biogenesis in leaves and/or whole plant. Relatively moderate *OsCYO1* suppression allowed the leaves to be green (Fig. 2), but these green leaves showed lower photosynthetic activities and higher susceptibility to light stress as compared to controls.

This work gives a new insight into the different regulation of chloroplast biogenesis between dicots

and monocots. Interestingly, the leaf express less *OsCYO1* as it ages. In rice, growing point remained at the shoot base covered by a culm and leaf sheath. While a new leaf is emerging, it may receive a little light as in underground cotyledons in *Arabidopsis*. *CYO1* may be indispensable in assembly/maintenance of chloroplasts in the growing tissue, in the dark or the transition from prolonged darkness to light period.

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Publication

[Rice *CYO1*, an ortholog of *Arabidopsis thaliana* cotyledon chloroplast biogenesis factor *AtCYO1*, is expressed in leaves and involved in photosynthetic performance.](#)

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J Plant Physiol. 2016 Dec 1