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The role of chloroplast precursor phosphorylating SYT kinases in protein import and acclimation in Arabidopsis thaliana

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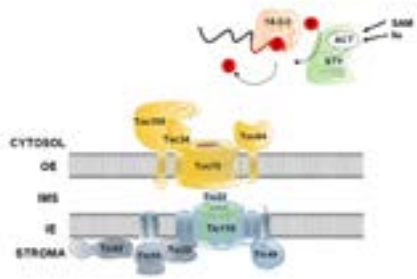
Plants are continuously exposed to various environmental trigger factors. Due to their immobile nature, plants need to employ mechanisms to acclimate to varying light intensities or temperatures. A plethora of nuclear-encoded chloroplast proteins are post-translationally modified in the cytosol before being imported to the chloroplast. So far, it has been shown that specific serine/threonine/tyrosine (STY) kinases, STY8, STY17, and STY46 are involved in the phosphorylation preproteins prior their targeting to the chloroplast. In addition, the import process itself is highly regulated at different levels where distinct signaling cascades lead to dynamic acclimation of import activity. Therefore, tight regulation of these processes in plays a critical role in plants survival. Our aim is to investigate the regulation of the STY kinases and to elucidate the effects of high light and temperature on phosphorylation and import of established preproteins into the chloroplast in Arabidopsis thaliana. So far, our data shows that the STY kinase activity is negatively regulated by an uncharacterized metabolite-binding ACT domain and its deletion leads to protein misfolding and increase in kinase auotphorylationa nd precursor phosphorylation yield. Using microscale thermophoresis we show secondary metabolite S-adenosylmethionine (SAM) and Isoleucine to negatively regulate kinase activity via the ACT domain. Furthermore, we observed preprotein phosphorylation and kinase expression is enhanced in high light adapted Arabidopsis thaliana. Knockdown mutant plants showed reduced precursor phosphorylation under normal and high light conditions. Finally, we show significant decrease in import capacity of high light acclimated plants in Arabidopsis thaliana.



Recent Publications

Sjuts I, Soll J, Bölter B. (2017). Import of Soluble Proteins into Chloroplasts and Potential Regulatory Mechanisms. *Front Plant Sci. 8:168.*

1. Lamberti G, Gügel IL, Meurer J, Soll J, Schwenkert S. (2011). The cytosolic kinases STY8, STY17, and STY46 are involved in chloroplast differentiation in Arabidopsis. *Plant Physiol. 70-85.*
2. Lamberti G, Drurey C, Soll J, Schwenkert S. (2011). The phosphorylation state of chloroplast transit peptides regulates preprotein import. *Plant Signal Behav. 1918-20.*

3. Martin T, Sharma R, Sippel C, Waegemann K, Soll J, Vothknecht UC. (2006). A protein kinase family in Arabidopsis phosphorylates chloroplast precursor proteins. J Biol Chem. 40216-23.
4. Waegemann K., Soll J. (1996). Phosphorylation of the transit sequence of chloroplast precursor proteins. *J. Biol. Chem.* 271 6545–6554.

Biography

Ahmed Eisa obtained his bachelor degree in Biomedical Science from the University of Glasgow (UK). Subsequently, he pursued master degree in Molecular Biology at the University of Vienna (Austria). He did his master thesis under the supervision of Jürgen Kleine-Vehn. Using biochemical and microscopical techniques, he looked at the effect of auxin in vacuolar morphology (Scheuring et al., 2016). He is currently pursuing his PhD in Plant Biology under the supervision of Serena Schwenkert at the laboratory of Jürgen Soll at the University of Munich (Germany). His research focuses on the regulation of a chloroplast precursor phosphorylating STY kinase and their role in the protein import process in acclimation. Using biochemical and biophysical techniques, he is investigating the mode of function of STY kinases in Arabidopsis thaliana, as well as the regulatory function of preprotein phosphorylation for chloroplast biogenesis.

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