GET IN TUNE:
Chloroplast and Nucleus Harmony

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Akademisk avhandling

Som med vederbörligt tillstånd av Rektorsämbetet vid Umeå universitet för avläggande av filosofie doktorexsamen i ämnet Växters cell- och molekylärobio, framläggs till offentligt förvar i KB3B1, KBC-huset, Onsdagen den 3 december 2014, klockan 13.00

Avhandlingen kommer förvaras på engelska.

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Abstract:

Photosynthetic eukaryotes emerged as a result of several billion years of evolution between proeukaryotic cell and ancestral cyanobacteria that formed modern chloroplasts. The symbiotic relationship led to significant rearrangements in the genomes of the plastid and the nucleus: as many as 90% of all the plastid genes were transferred to the nucleus. The gene transfer has been accompanied by the development of sophisticated regulatory signaling networks originating in the organelle (retrograde) and in the nucleus (anterograde) that coordinate development of the plastid and ensure adequate cell responses to stress signals. In this thesis I have demonstrated that transcriptional activity of PEP in the chloroplast is essential for proper embryo and seedling development in Arabidopsis thaliana. The function of PEP is dependent on the nuclear encoded PEP-associated factor PRIN2 that is able to sense the redox status of the plastid during seedling development and different stress. In response to the plastid status PRIN2 modulates the transcription activity of the PEP enzyme complex. We further established that PRIN2, as an essential component for full PEP activity, is also required to emit the Plastid Gene Expression (PGE) retrograde signal to regulate the Photosynthesis-Associated Nuclear Genes (PhANG) in the nucleus during early seedling growth via GUN1. On the other hand, regulation of PhANG expression during the High Light (HL) conditions requires functional PRIN2 and PEP activity but is GUN1-independent. Another retrograde signal produced by the developing chloroplast is associated with the tetrapyrrole biosynthesis pathway. We have established that accumulation of the chlorophyll intermediate MgProtoIX-ME in the crd mutant triggers repression of the PhANG expression, and this negative signal is mediated by a cytoplasmic protein complex containing the PAPP5 phosphatase. The nuclear targets that receive the tetrapyrrole mediated signal are GLK1 and GLK2 transcription factors that control the PhANG expression and the expression of the enzymes involved in the biosynthesis of chlorophyll.

Keywords: Arabidopsis thaliana, chloroplast, development, gene expression