TRANSCRIPTIONAL AND POST-TRANSCRIPTIONAL CONTROL OF PLASTID GENE EXPRESSION IN POTATO TUBERS AND LEAVES


*) CNR-IGV, Institute of Plant Genetics, Via Università 133, 80055 Portici, Italy
**) Max-Planck-Institut für Molekulare Pflanzenphysiologie, Am Muhlenberg 1, 14476 Potsdam-Golm, Germany
***) Department of Plant Sciences, University of Cambridge, Downing Street, Cambridge CB2 3EA, United Kingdom

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Plastid genes expression is a complex process regulated at the transcriptional and post-transcriptional level (Valkov et al., 2009, Plant Physiol., in press, doi: 10.1104/pp.109.140483). In contrast to chloroplasts, data on gene expression and regulation in non-green plastids are scarce. Here, we present transcriptomics and translatomics analysis of all potato (Solanum tuberosum L.) plastid genes in leaf chloroplasts and tuber amyloplasts. Transcript accumulation was initially determined by hybridisation to plastome oligo-arrays and further confirmed by northern blot analyses. Except for a few genes, transcript accumulation was much lower in tubers compared to leaves. Transcripts of photosynthesis-related genes showed a greater reduction in tubers than transcripts of genes for the genetic system. Real-time quantitative PCR and Southern blot analyses showed only small variation in plastid genome copy number and thus the latter cannot account for the observed lower transcript accumulation in amyloplasts. Primer extension analysis of rbcL, clpP and rnl16 genes revealed that both the plastid-encoded (PEP) and the nuclear-encoded (NEP) RNA polymerases are active in tubers, although some differences in promoter utilization in chloroplasts and amyloplasts were evident. Different splicing and editing patterns between the two organelles were also observed. Splicing of atpF and ndhB genes was less efficient in tubers than in leaves. In addition, tissue-specific differences in editing of ndh transcripts were detected. Translational regulation of plastid genes was explored by hybridization of the plastome arrays with RNA extracted from polysomes. In tubers, ribosome association of most plastid transcripts was low. Only few mRNAs, such as that of the fatty acid biosynthesis gene accD and several ycf's with unknown function, displayed relatively high ribosome association. Finally, we investigated the expression of some nuclear genes involved in plastid biogenesis and gene expression (genes encoding different sigma factors, component of machineries for transcription-translation, and transcript splicing and stability). In comparison with leaves, all genes analysed were expressed at low levels in tubers. Hence, compared to leaf chloroplasts, gene expression in tuber amyloplasts is generally much lower, with control occurring at the transcriptional, post-transcriptional and translational levels. In this study, we also identified regulatory sequences potentially useful to improve plastid (trans)gene expression in amyloplasts.