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CHLOROPLAST RETROGRADE SIGNALLING: FROM BIOGENESIS TO PLANT STRESS ADAPTATION

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Chloroplasts are semi-autonomous organelles, thus requiring an attuned gene expression in plastid and nuclear genomes, that play a key role in plant homeostasis and metabolism. In order to achieve this coordination, complex and not fully understood mechanisms have evolved. Chloroplast-to-nucleus communication, generally known as retrograde signalling (RS), regulates the expression of nuclear genes encoding organellar proteins with the developmental (biogenic signals, BS) and metabolic (operational signals, OS) state of the plastid through signals emitted by the organelle. Here, we investigated biogenic and operational controls using as models two tobacco transplastomic plants, characterized by a severe impairment of chloroplast biogenesis (Scotti et al 2015, Transgenic Research 24:319-331; Castiglia et al 2016, Biotechnology for Biofuels 9:154), and tomato plants subjected to drought stress, respectively. The expression of selected genes known to be involved in biogenic or operational pathways were evaluated by qRT-PCR. Preliminary results, generally revealed the same alteration profile of gene expression for the two transplastomic tobacco plants, named NS40 (expressing the Pr55gag antigen of the HIV-1) and DC2 (expressing the endoglucanase of the *Sulfolobus solfataricus*), because of genetically arrested plastid development at proplastid stage. However, the accumulation of *lhcb1* gene, a favoured marker of RS, displayed a contrasting trend being down-regulated only in DC2 plants. As concerns operational control, qRT-PCR analysis confirmed our previous data revealing the induction of plastid-to-nucleus communication (Tamburino et al 2017, BMC Plant Biology 17:40) in drought-stressed tomato plants. Further, the up-regulation of *abi4*, a nuclear transcription factor proposed to be a final link in ABA-triggered signal chains (Yamburenko et al 2015, Plant J 82:1030-1041), suggested a possible interconnection between the retrograde and the hormonal pathways. To evaluate this crosslink, we investigated the expression level of the same genes in excised tomato leaves treated with 75 µM ABA solution for 3 h. Observed variations in expression levels were not statistically significant excepted for the down-regulation of r*poC1* gene encoding a subunit of the plastid-encoded RNA polymerase (PEP), and of *rsh2* and *rsh3* genes which protein products are known to synthesize guanosine-3’-5’-bisdiphosphate (ppGpp), an inhibitor of the plastid gene encoded chloroplast RNA polymerase (Yamburenko et al . 2015, Plant J 82:1030-1041).

Although these preliminary results indicate the activation of retrograde pathways in both models used, further analyses are required to unravel other molecular partners of the complex biogenic and operational signalling networks responsible for plant development and stress adaptation, and the interconnection between hormonal and retrograde signalling pathways following water withholding.