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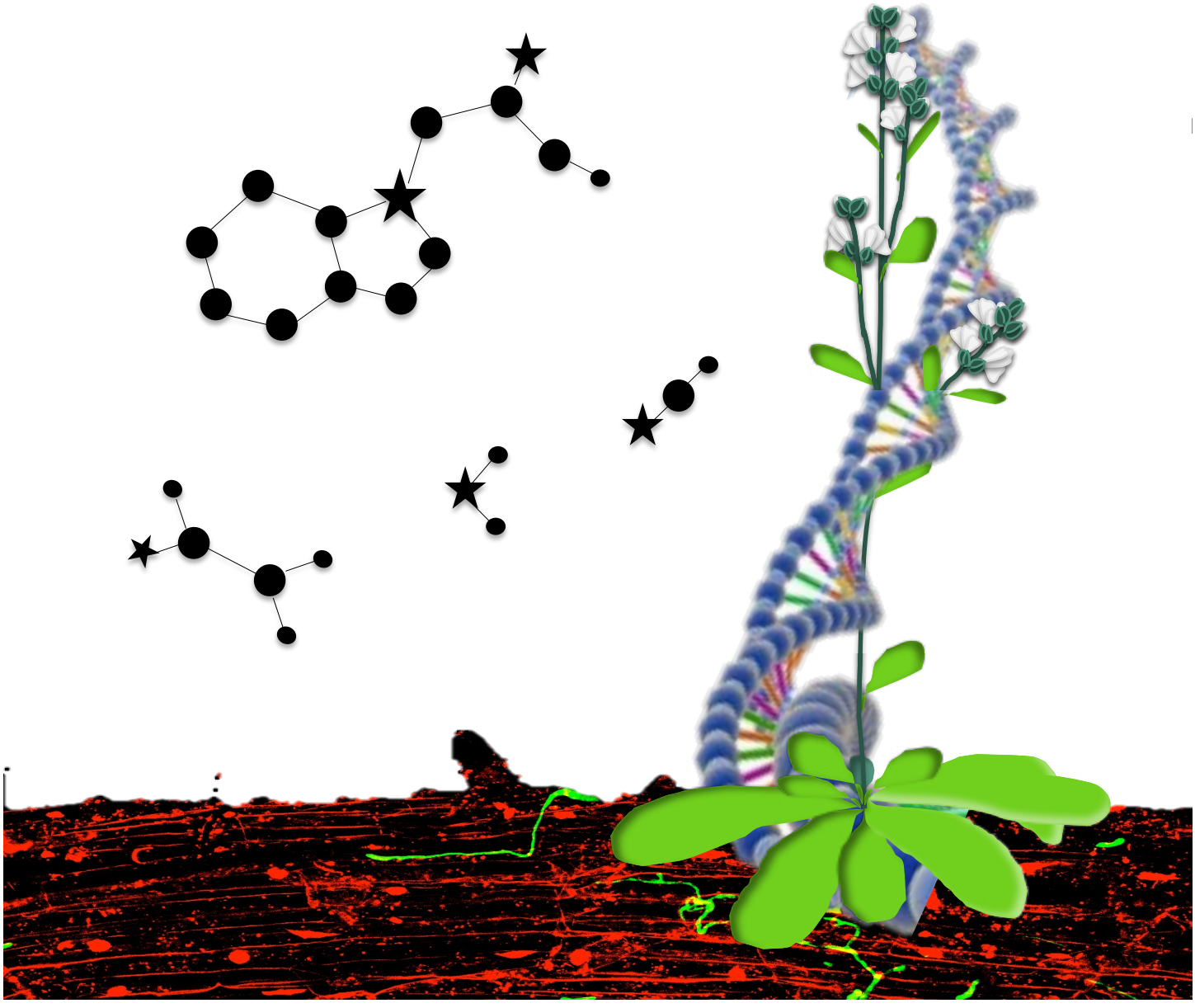
ABSTRACT BOOK



PGI1-MEDIATED VASCULAR PENTOSE PHOSPHATE PATHWAY ACTIVITY DETERMINES GROWTH, PHOTOSYNTHESIS AND METABOLISM THROUGH 2-C-METHYL-D-ERYTHRITOL 4-P PATHWAY ACTION IN ARABIDOPSIS

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Phosphoglucose isomerase is involved in the early steps of glycolysis and regeneration of glucose-6-phosphate pools in the pentose phosphate pathway (PPP). In Arabidopsis, plastidial phosphoglucose isomerase (PGI1) is an important determinant of growth, metabolism and photosynthesis, probably due to its involvement in the synthesis of 2-C-methyl-D-erythritol 4-P (MEP)-derived hormones in root tips and vascular tissues (Bahaji *et a*l., 2015; Bahaji *et a*l., 2018). To test this hypothesis, we conducted proteomic and metabolic characterization of *PGI1*-null *pgi1-2* plants. We also characterized *pgi1-2* plants ectopically expressing *PGI1* under the control of a root tip- and vascular tissue-specific promoter. Furthermore, we characterized *pfk4*/*pfk5* knockout plants impaired in the early steps of plastidial glycolysis, and *pgl3-1* plants with reduced activity of the plastidial PPP enzyme 6-phosphogluconolactonase 3. The overall data obtained in this work provide strong evidence that root tip and vascular PGI1-mediated plastidial PPP determines growth, development and photosynthesis through MEP pathway action.

Bahaji A, et al (2015) Plastidic phosphoglucose isomerase is an important determinant of starch accumulation in mesophyll cells, growth, photosynthetic capacity, and biosynthesis of plastidic cytokinins in Arabidopsis. PLoS One 10: e0119641.
Bahaji A, et al (2018) Plastidial phosphoglucose isomerase is an important determinant of seed yield through its involvement in gibberellin-mediated reproductive development and storage reserve biosynthesis in Arabidopsis. Plant Cell 30: 2082–2098.

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THE MICROBIAL VOLATILE-RESPONSIVE REDOX-SENSITIVE CYS^{154} RESIDUE OF THE CALVIN-BENSON ENZYME FRUCTOSE-1,6-BISPHOSPHATASE 1 IS AN IMPORTANT DETERMINANT OF PHOTOSYNTHETIC ACTIVITY IN ARABIDOPSIS

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Microorganisms emit volatile compounds (VCs) that promote plant growth and photosynthesis as well as strong developmental and metabolic changes through multiple and complex regulatory mechanisms including global reduction of the thiol redox proteome (Gámez-Arcas *et al.* 2022). Recently, we found that microbial VC treatment promotes the reduction of the Cys_{154} residue of the redox-regulated Calvin-Benson cycle enzyme fructose-1,6-bisphosphatase 1 (cFBP1) (Ameztoy et al. 2019). Although highly conserved throughout land plants and algae, this residue is not located in the proposed regulatory Trx redox or catalytic domains of cFBP1. To investigate the role played by Cys^{154} in the activity of cFBP1 and the response of plants to microbial VCs, we produced and characterized recombinantly produced wild type (WT) cFBP1 (cFBP1wt) and a mutated form of cFBP1 in which the Cys_{154} residue has been replaced by serine (cFBP1mut). We also produced and characterized cfbp1 plants ectopically expressing cFBP1wt and cFBP1mut under the control of the cFBP1 promoter. In native gels, the electrophoretic mobilities of recombinantly produced cFBP1 and cFBP1mut were different. In addition, recombinant cFBP1mut had ca. 85% less activity than cFBP1wt. The ectopic expression of cFBP1wt, and to a lesser extent that of cFBP1mut, countered the reduced photosynthetic activity of cFBP1-lacking cfbp1 plants, reverting it to the WT. Results presented in this work provide strong evidence that the Cys_{154} residue of cFBP1 is an important determinant of photosynthetic activity in Arabidopsis.

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Ameztoy K, Baslam M, Sánchez-López ÁM, Muñoz FJ, Bahaji A, Almagro G, García-Gómez P, Baroja-Fernández E, De Diego N, Humplík JF, Ugena L, Spíchal L, Dolezal K, Kaneko K, Mitsui T, Cejudo FJ, Pozueta-Romero J (2019) Plant responses to fungal volatiles involve global post-translational thiol redox proteome changes that affect photosynthesis. Plant Cell Environ 42: 2627–2644.

Gámez-Arcas S, Baroja-Fernández E, García-Gómez P, Muñoz FJ, Almagro G, Bahaji A, Sánchez-López ÁM, Pozueta-Romero J (2022) Action mechanisms of small microbial volatile compounds in plants. J Exp Bot. 73: 498–510.

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VASCULAR AND ROOT TIP GPT2 EXPRESSION MEDIATES THE *PGI1*-INDEPENDENT RESPONSE OF ARABIDOPSIS TO SMALL MICROBIAL VOLATILES

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Microorganisms emit a plethora of volatile compounds (VCs) that promote plant growth and photosynthesis as well as strong developmental and metabolic changes. In Arabidopsis, the plastidial isoform of phosphoglucose isomerase PGI1 mediates photosynthesis, metabolism and development, probably due to its involvement in the synthesis of isoprenoid-derived signals in vascular tissues (Bahaji *et al.*, 2015; Bahaji *et al.*, 2018). Like in wild-type (WT) plants, microbial VCs promote growth and photosynthesis as well as starch and CK accumulation in PGI1-lacking pgi1-2 plants (Sánchez-López et al. 2016). A striking alteration in the transcriptome of leaves of small fungal VC-treated plants involves strong up-regulation of levels of transcripts of GPT2 (At1g61800), a gene that codes for a plastidial G6P/Pi transporter. We hypothesized that the PGI1-independent response to microbial volatile emissions involves GPT2 action. To test this hypothesis, we characterized responses of *WT, GPT2-null gpt2-1, PGI1-null pgi1-2* and *pgi1-2gpt2-1* plants to small fungal VCs. In addition, we characterized responses of *pgi1-2gpt2-1* plants expressing GPT2 under the control of a vascular tissue- and root tip-specific promoter to small fungal VCs. Results presented in this work provide evidence that, under conditions in which PGI1 activity is reduced, long-distance action of GPT2 plays an important role in the response of plants to small VCs through mechanisms involving resetting of the photosynthesis-related proteome in leaves and complex GPT2 regulation.

Bahaji A, et al (2015) Plastidic phosphoglucose isomerase is an important determinant of starch accumulation in mesophyll cells, growth, photosynthetic capacity, and biosynthesis of plastidic cytokinins in Arabidopsis. PLoS One 10: e0119641.

Bahaji A, et al (2018) Plastidial phosphoglucose isomerase is an important determinant of seed yield through its involvement in gibberellin-mediated reproductive development and storage reserve biosynthesis in Arabidopsis. Plant Cell 30: 2082–2098.

Sánchez-López ÁM, et al (2016) Arabidopsis responds to Alternaria alternata volatiles by triggering plastid phosphoglucose isomerase-independent mechanisms. Plant Physiol 172: 1989–2001.

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