The role of phytoplasma effector interaction with phosphoglucomutase in the pathogenicity of '*Candidatus* Phytoplasma solani' in grapevine

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Abstract

Bois noir is the most widespread phytoplasma grapevine disease in Europe. It is associated with '*Candidatus* Phytoplasma solani'. In symptomatic grapevines cv. 'Zweigelt' infected with '*Ca*. P. solani' compared with uninfected grapevines, metabolic pathways associated with phosphorylated sugar production were induced both at the transcriptional level and at the level of activity of the corresponding enzymes (Dermastia et al., 2021, *Int. J. Mol. Sci.* 22: 3531). In particular, the expression of gene coding for phosphoglucoisomerase was upregulated, resulting in increased phosphoglucoisomerase enzyme activity. Phosphoglucoisomerase converse glucose-1-phosphate to glucose-6-phosphate, which can be used as a substrate for starch biosynthesis. Besides, phosphoglucomutase activity was induced also in *Nicotiana benthamiana* leaves transiently transformed with the construct of putative effector PoStoSP28, previously annotated as an antigenic membrane protein StAMP related to interaction of phytoplasma with its insect vector. Using a pull-down assay and in planta co-IP assay, we confirmed that PoStoSP28 interacts with both grapevine phosphoglucomutases. In transiently transformed *N. benthamiana* leaves, PoStoSP28 was localized in the nucleus and cytosol and accompanied by a distinct border at the periphery or just outside the nucleus and in the thread-like structures spanning the cells. Upon closer inspection, some autophagosome-like structures were found in *N. benthamiana* cells expressing the PoStoSP28 effector. Moreover, PoStoSP28 was not only localized in the autophagosome but also increased the occurrence of autophagosomes (Dermastia et al., 2023, *Front. Plant Sci.* 14: 1232367). Therefore, the results suggest that PoStoSP28 plays a role in the pathogenicity of phytoplasma in grapevine by interacting with grapevine phosphoglucomutase enzymes.

Keywords: grapevine, *Candidatus* Phytoplasma solani, effector, StAMP, phosphoglucomutase