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Potassium Phosphite responsive miRNAs in Potato

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Micro RNAs (miRNAs) are small single strand non-coding RNAs that regulate gene expression at the post-transcriptional level, either by translational inhibition or mRNA degradation based on the extent of complementarity between the miRNA and its target mRNAs. Potato (*Solanum tuberosum L.*) is the most important horticultural crop in Argentina. Achieving an integrated control of diseases is crucial for this crop, where frequent agrochemical applications, particularly fungicides, are carried out. A promising strategy is based on promoting induced resistance through the application of environmentally friendly compounds such as phosphites, inorganic salts of phosphorous acid. The use of phosphites in disease control management has proven to be effective. Although the mechanisms underlying their effect remain unclear, we postulated that miRNAs could be involved. Therefore we performed next generation sequencing (NGS) in potato leaves treated and non- treated with potassium phosphite (KPhi). We identified 25 miRNAs that were expressed differentially, 14 already annotated in miRBase and 11 mapped to the potato genome as potential new miRNAs. A prediction of miRNA targets showed genes related to pathogen resistance, transcription factors, and oxidative stress. We have also analyzed in-silico stress and phytohormone responsive cis-acting elements on differentially expressed pre miRNAs.

Despite the fact that some of the differentially expressed miRNAs have been already identified elsewhere, this is to our knowledge the first report identifying miRNAs responsive to a biocompatible stress resistance inducer such as potassium phosphite, in plants. Further characterization of these miRNAs and their target genes, might help to elucidate the molecular mechanisms underlying KPhi-induced resistance. This might, in turn, aid in the design of genetically engineered potatoes to achieve a product with enhanced resistance to environmental stress.

Recent Publications

1. Importance of potato late blight in Argentina, and the effect of fungicide treatments on yield increments over twenty years. Cien InvAgr.2009;36:115-122.doi:10.4067/S0718-16202009000100011
2. Arora RK, Sharma S, Singh BP. Late blight disease of potato and its management. Potato J. 2014; 4: 16-40.
3. Trejo-Téllez LI, Gómez-Merino FC. Phosphite as an inductor of adaptive responses to stress and stimulator of better plant performance. In: Vats S, editor. Biotic and Abiotic Stress Tolerance in Plants. Springer, Singapore. 2018. doi: 10.1007/978-981-10-9029-5_8.
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5. Olivieri FP, Feldman ML, Machinandiarena MF, Lobato MC, Caldiz DO, Daleo GR, et al. Phosphite applications induce molecular modifications in potato tuber periderm and cortex that enhance resistance to pathogens. Crop Prot. 2012;32: 1–6. doi:10.1016/j.cropro.2011.08.025.
6. Machinandiarena MF, Lobato MC, Feldman ML, Daleo GR, Andreu AB. Potassium phosphite primes defense responses in potato against Phytophthora infestans. J Plant Physiol.; 2012;169: 1417–1424.
7. Song X, Li Y, Cao X, Qi Y. microRNAs and their regulatory roles in plant-environment interactions. Annu Rev Plant Biol. 2019; 70: 1–37. Doi: 10.1146/annurev-arplant-050718.

8. Zhang R, Marshall D, Bryan GJ, Hornyik C. Identification and characterization of miRNA transcriptome in potato by high-throughput sequencing. PLoS One. 2013;8. doi:10.1371/journal.pone.0057233.
9. Rey-Burusco MF, Daleo GR, Feldman ML (2019) Identification of potassium phosphite responsive miRNAs and their targets in potato. PLOSONE14 (9):e0222346. doi:10.1371/journal.pone.0222346

Biography

Mariana Feldman is an established researcher from CONICET. She is engaged in the study of Plant Biochemistry and Molecular Biology, for 25 years, at the Plant Biochemistry Group (Biological Research Institute -National University of Mar del Plata, Argentina). Since 2007 our group is interested in the use of biocompatible chemical compounds that enhance plant disease resistance as an innovative strategy to improve the yield and quality of crops, particularly in potato.

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