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Genes & Genomes: Biotechnology, Molecular Breeding

Concurrent Symposium 11: Biotechnology and Molecular Breeding

CS-11-1 - Modulation of Salicylic Acid Receptor Activity Confers Resistance to Potato Zebra Chip Disease

Tuesday, July 28, 2020 1:30 PM – 1:45 PM EDT

Live Q&A: Yes

Concurrent Speaker(s)

Manikandan Ramasamy
Postdoctoral Research Fellow
Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA

Potato (*Solanum tuberosum*) zebra chip is an emerging disease caused by a fastidious, phloem-limited bacterium (*Candidatus* Liberibacter solanacearum) that is transmitted by an insect vector (*Bactericera cockerelli*). Systemic acquired resistance (SAR) protects plants against a broad spectrum of pathogens. SAR is primarily regulated by the NON-EXPRESSOR OF PATHOGENESIS RELATED (NPR) proteins that are transcriptional co-factors, and receptors of the plant defense hormone, salicylic acid. In Arabidopsis, NPR1 is an activator of SAR, whereas NPR3 and NPR4 function as negative regulators. In this study, we show that overexpressing *NPR1* and down regulating *NPR3* in potato can impart resistance to the zebra chip disease. A heterologous *NPR1* gene from tomato (*Solanum lycopersicum* L.) was identified by phylogenetic analysis and overexpressed in potato hairy roots. Similarly, a potato ortholog of *AtNPR3* was identified (*StNPR3*) and edited via. CRISPR-CAS9 technology. Gene expression analysis and DNA amplicon sequencing of the transgenic hairy roots confirmed *SlNPR1* overexpression and frame-shift mutations within *StNPR3* gene, respectively. Expression analysis of pathogenesis-related (*PR*) genes further indicated enhanced SAR responses in the transgenic hairy roots. Importantly, both *SlNPR1*-overexpressing and *StNPR3*-edited hairy roots showed significantly lowered titers (>90%) of *Candidatus* Liberibacter spp. when compared to the vector-alone controls. Greenhouse experiments using stably transformed potatoes also showed similar results

with attenuated disease symptoms and a significant reduction (up to 95%) in bacterial titers in the transgenic lines, when compared to non-transgenic plants. No apparent growth-related abnormalities were found in non-challenged transgenic plants. In conclusion, we demonstrate that modulation of salicylic acid receptor activity by overexpressing SlNPR1 and/or gene editing StNPR3 in potato is a viable strategy for developing zebra chip disease resistance without negative impacts on growth.

Coauthors: Sonia Irigoyen – Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA;Shankar Pant – Agricultural Research Service, U.S. Department of Agriculture, Stillwater, OK;Renesh Bedre – Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA;Prakash Niraula – Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA;Carlos A. Avila – Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA;Kranthi K. Mandadi – Texas A&M AgriLife Research and Extension Center, Weslaco, TX, USA