The various roles of CsRDR1 family genes in cucumber defense against different viruses

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RNA-dependent RNA polymerases (RDR) play an important role in virus protection and plant gene control. Their activity is based on the synthesis of double stranded RNA that is a template for the gene silencing system. Four *RDR1 (RDR1a, b, c1, c2)* genes were identified in cucumber having different expression levels before and after infection by various viruses. The *CsRDR1a, b, c* genes have a homology of 60-58% at the amino acid level, while *CsRDR1c1* and *c2* are almost identical (97% homology), but have different promoter sequences. A high expression level of *CsRDR1b* was characterized in cucumber strains with partial resistance to a number of viruses, while *CsRDR1c1* and *c2* not expressed in healthy plants. Cucumber plants infected by several different viruses showed a moderate expression level of *CsRDR1b* and a dramatic level of *CsRDR1c1, c2*. The expression level of *CsRDR1a, CsRDR2* and *CsRDR6* did not increase following virus infection. The differential expression of *CsRDR1b* and CsRDR1c1, c2 indicates dissimilar control of these genes. The relationship between the high levels of expression of *CsRDR1b* in resistant cucumber cultivars reinforces the assumption that this gene is unique for virus resistance. Using the *CRISPR/Cas9* system, we created a variety of mutants in the rdr1b and rdr1c1 and *c2* genes. Knockdown of these genes increased virus accumulation. Plants with a homozygous mutation in the rdr1b genes (deletion of 34 nucleotides) and *rdr1c* (2 and 1 nucleotides in the *rdr1c1* and *rdr1c2* genes respectively) showed increased susceptibility to *Cucumber mosaic virus* 4 dpi, especially rdr1c mutants plants which collapse 6 days after infection. The viral symptoms increased also after Cucurbit vein yellowing virus infection, whereas the susceptibility to Zucchini yellow mosaic virus infection was less. Notably, *CsRDR1b* expression in healthy rdr1b mutants was less than in non-mutant plants. The control of *CsRDR1b* and CsRDR1c1, c2 is under study in our laboratory to help understand the silencing mechanism of plants defense.

Recent Publications

1. Leibman D, Kravchik M, Wolf D, Haviv S, Weissberg M, Ophir R, Paris H S, Palukaitis P, Ding S W, Gaba V and Gal-On A (2017) Differential expression of cucumber RNA-dependent RNA polymerase 1 genes during antiviral defense and resistance. Molecular Plant Pathology 19(2):300-312.
2. Chandrasekaran J, Brumin M, Wolf D, Leibman D, Klap C, Pearlsman M, Sherman A, Arazi T and Gal-On A (2016) Development of broad virus resistance in non-transgenic cucumber using CRISPR/Cas9 technology. Molecular Plant Pathology 17(7):1140-53.
3. Leibman D, Wolf D, Saharan V, Zelcer A, Arazi T, Shiboleth M Y, Gaba V, and Gal-On A (2011) A high level of transgenic viral small RNA is associated with broad *potyvirus* resistance in cucurbits. Molecular Plant-Microbe Interactions 24(10):1220–1238.

Biography

Diana Leibman completed her PhD in 2012 from the Hebrew University in Jerusalem. She works as a Research Engineer in the Agricultural Research Organization, The Volcani Center. The research topics in which she is involved are: The role of RNA-dependent RNA polymerase 1 in plant defense against viruses; CRISPR/Cas9 genome editing technology for crop improvement; development of resistance to RNA and DNA viruses in cucurbits and tomato by transgenic approaches; identification of plant genes associated with disease symptom development to plant virus infection and; genetic engineering of attenuated ZYMV-AG as a plant virus vector, for gene expression and epitope presentation.

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