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Engineering Resistance Against Citrus Disease Using Candidate Genes

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Citrus canker is a devastating disease caused by *Xanthomonas axonopodis* pv. *citri* (*Xac*). The *NPR1* gene plays a pivotal role in systemic acquired resistance (SAR) in Arabidopsis. We report the isolation and characterization of an *NPR1* homolog from citrus, namely *Citrus NPR1 homolog 1* (*CtNH1*). When over-expressed in citrus, *CtNH1* confers resistance to *Xac* and leads to constitutive expression of the pathogenesis-related (*PR*) gene *chitinase 1* (*Chi1*), suggesting that *CtNH1* is orthologous to *NPR1*. In addition, we recently identified two closely-related citrus genes, named *Xbct31* and *Xbct32*. Database searching and sequence analyses reveals that other plant species, including rice, Arabidopsis, tomato, and *Nicotiana benthamiana*, contain homologs of these two citrus genes and they share high levels of sequence identity at the amino acid level. When overexpressed in *Nicotiana benthamiana* via Agrobacterium infiltration-mediated transient expression, the citrus genes as well as their closely-related homologs from rice and Arabidopsis all trigger (HR)-like cell death hypersensitive response. Since HR is often associated with resistance (*R*) gene-mediated immunity, our data suggests *Xbct3s* represent a family of evolutionarily conserved defense regulators and could be used to heighten defense against citrus diseases including greening and canker.