A lentinan-loaded calcium alginate hydrogel with a core-shell structure induces broad-spectrum resistance to plant viruses by activating Nb CML19

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Abstract

Control of plant virus diseases largely depends on the induced plant defense achieved by the external application of synthetic chemical inducers with the ability to modify defense-signaling pathways. However, most of the molecular mechanisms underlying these chemical inducers remain unknown. Here, we developed a lentinan-loaded hydrogel with a core-shell structure and discovered how it protects plants from different virus infections. The hydrogel was synthesized by adding a chitosan shell on the surface of the polyanion sodium alginate-Ca $^{2+}$-lentinan (LNT) hydrogel (SL-gel) to form a CSL-gel. CSL-gels exhibit the capacity to prolong the stable release of lentinan and promote Ca $^{2+}$ release. Application of CSL-gels on the root of plants induces broad-spectrum resistance against TMV, TRV, PVX and TuMV). RNA-seq analysis identified that the *calmodulin-like protein 19* gene (*NbCML19*) is upregulated by the sustained release of Ca $^{2+}$ from the CSL-gel, and silencing and overexpression of *NbCML19* alter the susceptibility and resistance of tobacco to TMV. Our findings provide evidence that this novel and synthetic CSL-gel strongly inhibits the infection of plant viruses by the sustainable release of LNT and Ca $^{2+}$. This study uncovers a novel mode of action by which CSL-gels trigger *NbCML19* expression through the stable and sustained release of Ca $^{2+}$.

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