Aspirin-Like Compound Primes Plant Defense Against Pathogens

Willow trees are well-known sources of salicylic acid, and for thousands of years, humans have extracted the compound from the tree's bark to alleviate minor pain, fever, and inflammation.

Now, salicylic acid may also offer relief to crop plants by priming their defenses against a microbial menace known as "potato purple top phytoplasma." Outbreaks of the cell-wall-less bacterium in the fertile Columbia Basin region of the Pacific Northwest in 2002 and subsequent years inflicted severe yield and quality losses on potato crops. The Agricultural Research Service identified an insect accomplice—the beet leafhopper, which transmits the phytoplasma to plants while feeding.

Carefully timed insecticide applications can deter such feeding. But once infected, a plant cannot be cured. Now, a promising lead has emerged. An ARS-University of Maryland team has found evidence that pretreating tomato plants, a relative of potato, with salicylic acid can prevent phytoplasma infections or at least diminish their severity.

Treating crops with salicylic acid to help them fend off bacteria, fungi, and viruses isn't new, but there are no published studies demonstrating its potential in preventing diseases caused by phytoplasmas.

Wei Wu, a visiting scientist, investigated salicylic acid's effects, together with molecular biologist Yan Zhao and others at ARS's Molecular Plant Pathology Laboratory in Beltsville, Maryland. "This work reached new frontiers by demonstrating that plants could be beneficially treated even before they become infected and by quantifying gene activity underlying salicylic acid's preventive role," according to Robert E. Davis, the lab's research leader.

For the study, published in the July 2012 *Annals of Applied Biology,* the team applied two salicylic acid treatments to potted tomato seedlings. The first application was via a spray solution 4 weeks after the seedlings were planted. The second was via a root drench 2 days before phytoplasma-infected scions were grafted onto the plants' stems to induce disease. A control group of plants was not treated.

In addition to visually inspecting the plants for disease symptoms, the team analyzed leaf samples for the phytoplasma's unique DNA fingerprint, which turned up in 94 percent of samples from untreated plants but in only 47 percent of treated ones. Moreover, symptoms in the treated group were far milder than in untreated plants. In fact, analysis of mildly infected treated plants revealed phytoplasma levels 300 times below those of untreated plants, meaning that the salicylic acid treatment must have suppressed pathogen multiplication. Significantly, the remaining 53 percent of treated plants were symptom- and pathogen-free 40 days after exposure to the infected scions.

Researchers credit salicylic acid with triggering "systemic acquired resistance," a state of general readiness against microbial or insect attack. Using quantitative polymerase chain reaction procedures, the team also identified three regulatory defense genes whose activity was higher in treated plants than in untreated ones.

Why salicylic acid had this effect isn't known. Other questions remain as well, including how treated plants will fare under field conditions. Nonetheless, such investigations could set the stage for providing growers of potato, tomato, and other susceptible crops some insurance against phytoplasmas in outbreak-prone regions.—By **Jan Suszkiw,** ARS.

This research is part of Plant Diseases, an ARS national program (#303) described at www.nps.ars.usda.gov.

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Below: ARS molecular biologist Yan Zhao (left) observes as visiting scientist Wei Wu pretreats a tomato plant with salicylic acid to test its effectiveness against phytoplasma bacterial infections.
Right: Close-up of tomato leaves sprayed with the pretreatment.

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