The role of salicylic acid in controlling citrus canker

By Naveen Kumar and Bob Ebel

Citrus canker is one of the most devastating bacterial citrus diseases that causes enormous production losses. Florida accounts for about two-thirds of total U.S. citrus production. Canker is endemic in Florida, which is especially vulnerable to outbreaks of citrus canker due to its climate. Grapefruit is one of the most important fresh citrus varieties in Florida and one of the most susceptible to canker. From 1994 to 2009, canker outbreaks contributed to a 61 percent decline in grapefruit acreage.

Salicylic acid (SA) is an essential plant hormone and plays a crucial role in plant defense against pathogens. It has anti-microbial properties, but also serves as an intermediate signal that interacts with and can promote production of hydrogen peroxide (H_2O_2) in plant tissues infected with pathogens. H_2O_2 serves as a signaling molecule to promote disease resistance and may also be directly involved in killing pathogens. Previous research has shown that SA alone does not significantly reduce canker in citrus. One objective of our research is to determine if SA promotes part of the defense mechanism to canker. If SA does promote some parts of citrus defense, we hope that it, coupled with other compounds, may provide a viable approach to reducing canker in commercial groves.

We first determined the direct anti-microbial effects of SA at concentrations that are typical of commercially available products that contain SA. The phases of bacterial growth after inoculation include a lag phase — characterized by slow growth — a logarithmic phase where growth is rapid, and finally a stationary phase where the bacteria has reached a limit and can't continue reproducing. SA demonstrated anti-microbial activity that increased with its concentration. The higher concentration of SA does not occur naturally in citrus plants, but may occur temporarily in plant tissues after spraying with SA. We don't know yet how long SA persists in citrus trees after spraying, but data indicate that it may provide some direct microbial effects.

SA has been shown to stimulate production of H_2O_2 in many plant species with the level of H_2O_2 affected by various biochemical pathways that produce and degrade it. We found that canker had variable effects on H_2O_2 levels in grapefruit leaves, but caused changes in those pathways that suppressed its total levels. Although canker promotes production of H_2O_2 through an increase in activity of the enzyme superoxide dismutase, it inhibited its levels through elevated activities of the enzymes catalase and peroxidase that degrade it. When we applied

SA to infected leaves, the activities of these enzymes were somewhat reversed, indicating that spray application of SA does partially restore citrus defense against canker. Unfortunately, the changes in plant defense by SA alone were not sufficient to reduce the bacterial load in the leaves, confirming results of earlier studies that show that SA alone does not inhibit canker.

We tested the direct effect of hydrogen peroxide on canker at different phases of growth. Hydrogen peroxide inhibited canker growth at higher concentrations and was most effective during the earlier growth phases.

It is interesting that SA did help partially restore hydrogen peroxide levels during the stationary phase of bacterial growth in infected grapefruit leaves. The partial restoration of citrus defense against canker by SA is encouraging. We are currently testing other commercially available products to determine if they combine with SA to restore citrus defense sufficiently to suppress canker. Specifically, we are evaluating compounds that promote hydrogen peroxide levels earlier within the leaves to levels we hope will reduce canker symptoms.

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WHAT'S SHAKIN'

Seventy people attending the International Symposium on Mechanical Harvesting & Handling Systems of Fruits and Nuts in April participated in a field tour on the last day of the symposium. The tour started at the Mosaic Company's New Wales Plant, the world's largest producer of phosphate fertilizers. Participants were then taken around Mosaic's Four Corners mining and processing facility where they were able to ride on a phosphate dragline and see the mine's water-holding system. The tour continued at Lykes Bros.'s Fort Basinger citrus grove. There, participants watched demonstrations of citrus mechanical harvesters, a trash removal system, an air-shaker fruit harvester, advanced sprayer technology for precision spraying, and a low-cost remote sensing system for citrus disease detection.

Powerpoint presentations and posters from the symposium are available through the IFAS Citrus REC (http://www.crec.ifas.ufl.edu/Harvesting) and a link on the Mechanical Harvesting and Abscission Program website (http://citrusmh.ifas.ufl.edu).

Trip to Brazil Expands Communication Channels

By Douglas Ackerman

Today's global market provides the opportunity for the Florida Department of Citrus (FDOC) to interact with citrus industries around the world. Recently, we met with key leaders in Brazil to share marketing plans and take a firsthand look at industry practices.

Florida Citrus Commission Chairman Marty McKenna, Bob Norberg, Leigh Killeen and I gave a presentation to CitrusBR, the Brazilian Association of Citrus Exporters. This organization is responsible for marketing activities, and our dialogue fostered a spirit of collaboration and created a willingness to explore future marketing synergies.

Florida Citrus Commission Chairman Marty McKenna, right, discusses growing practices in Brazilian groves.

Chairman McKenna and I also spent several days with extremely knowledgeable and experienced Brazilian counterparts, touring citrus groves and nurseries in order to get a better understanding of the state of the Brazilian citrus industry.

Our trip included visits to several research facilities to learn more about citrus diseases. At the Centro de Citricultura research facility in Araras, we met with scientists to discuss new research in the fight against greening. In Araraquara, researchers provided us with in-depth information about black spot and other diseases at Fundecitrus, the Fund for Citrus Plant Protection.

Doug Ackerman, left, and Florida Citrus Commission Chairman Marty McKenna visited several research facilities in Brazil to learn more about current citrus disease research, including greening and black spot.

We returned from Brazil with an appreciation for the fact that the Brazilian citrus industry faces many of the same challenges that we do, including diseases and increased cost of production. We also share a common goal: to ensure the sustainability of the citrus industry. By maintaining open communication with Brazil in the future, we can continue to learn from each other and keep citrus relevant in today's highly competitive, global marketplace.

The mission of the Florida Department of Citrus is to grow the market for the Florida citrus industry to enhance the economic well-being of the Florida citrus grower, citrus industry and the state of Florida. Douglas Ackerman, executive director, can be reached at (863) 537-3999. For more information, visit www.FDOCGrower.com

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