Major breakthroughs in understanding and managing bacterial diseases in Georgia, including sour skin

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Vidalia Onions, *Allium cepa*, are a high-value crop grown in Georgia that annually are subject to significant losses to sour skin (SS), caused by the bacterium *Burkholderia cepacia*. The current lack of effective management strategies signifies the need for new management strategies. Effects of micronutrients on disease development and the use of prescription fertilizers as a disease management option were studied using Vidalia onions and *B. cepacia*, as the host-pathogen system. In 2012 and 2014, field-grown onions and soils were evaluated for mineral composition. In 2012, a tissue model (P=0.0002; adj. R^2=0.51) included Cu:Fe, Zn:Fe, Mn, and three other independent variables. Due to excessive bolting in 2013, onions purchased from grocery stores were substituted for field-grown and were inoculated with a suspension of ~1 x 10^8 CFU of *B. cepacia*/ml and incubated at 28 °C until symptom expression. The grocery store model (P=0.00001; adj. R^2=0.43) contained Cu:Fe, Al, K, and two other independent variables. In 2014, a tissue model (P=0.00002; adj. R^2=0.34) contained Cu:Fe, Na:Fe, Mn:Zn, and two other independent variables. The Cu:Fe ratio consistently appeared in the models with a negative coefficient and was even negatively related to SS in a single independent variable model in 2012 (P=0.004; R^2=0.25). Furthermore, the elements Cu, Fe, Zn and Mn, or ratios containing them, consistently occurred in the nine models developed. These cations act as co-factors for three different types of superoxide dismutase enzymes (SODs) (Cu-ZnSOD, FeSOD and MnSOD) found in plants. The Cu:Fe ratio up-regulates or down-regulates Cu-ZnSOD

depending on the concentrations of Cu and Fe, respectively. Furthermore, SODs act as antioxidants and detoxify reactive oxygen species (ROS) forming salicylic acid (SA) as an intermediate product. SA has been identified as the plant messenger to activate systemic acquired resistance (SAR) pathways to fight plant pathogenic infections. In 2014, seven fertilization treatments and standard N-P-K (6-12-18) were evaluated for their effect on SS, mineral content of bulbs and SOD activity. Addition of Cu increased both copper and iron content in bulbs. Most treatments down-regulated the Cu-ZnSOD gene and none up-regulated it. Fe treatments increased Mn levels in bulbs, but not significantly. However, Mn significantly increased as disease severity decreased and MnSOD was up-regulated with most Fe treatments. It may be possible one day to enhance SAR by applying site-specific formulations of micronutrients using precision agricultural techniques.

Frankliniella fusca (Hinds), the tobacco thrips, has been shown to acquire and transmit *Pantoea ananatis*, one of the causal agents of the center rot of onion. However, the interactions between thrips and the bacterium and the transmission mechanisms are largely uncharacterized. In this study, acquisition of *P. ananatis* by thrips and transstadial persistence of pathogen were investigated. Furthermore, the effects of bacterial acquisition on thrips' fitness were investigated. When thrips larvae and adults were subjected to different acquisition access periods (AAP) on peanut (*Arachis hypogaea* L.) leaflets contaminated with the bacterium, an exponential positive relationship was observed between AAP and *P. ananatis* acquisition ($R^2 \geq 0.77$; $P = 0.01$). Following a 48-h AAP, the bacterium persisted for 144-h in 4.8% of the adults. *P. ananatis* also persisted in thrips through the larval, pupal, and adult life stages. Despite the bacterial persistence, no significant effects on thrips' fitness i.e., fecundity or development, were observed. Immunofluorescence microscopy with a *P. ananatis*-specific labelled antibody revealed that the

bacterium was localized only in the gut of adults after 48-h AAP on contaminated food. These results suggested that pathogen is not circulative and possibly be transmitted through feces. Mechanical inoculation of onion seedlings with fecal suspensions produced center rot symptoms whereas inoculation with salivary secretions did not. These results confirmed that *P. ananatis* could be transmitted by thrips through fecal contamination. Overall, these results may provide good insight on the biology of *B. cepacia* and *P. ananatis* infection and in time may translate to sustainable management options.